PRESIDENCY UNIVERSITY
Presidency University Act, 2013 of the Karnataka Act No. 41 of 2013 | Established under Section 2(f) of UGC Act, 1956
Approved by AICTE, New Delhi

## PRESIDENCY SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

# Program Regulations and Curriculum

# 2023-2027

## BACHELOR OF TECHNOLOGY (B.Tech.) in Computer Science and Engineering(Data Science)

### based on Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

**Regulation Number: PU/AC-21.5/SoCSE2/CSD/2023-2027**

**Resolution No. 5 of the 21st Meeting of the Academic Council held on 06th Sept 2023, and ratified by the Board of Management in its 22nd Meeting held on 02nd Nov 2023.**

***(As amended up to the 26th Meeting of the Academic Council held on 25th July 2025, and ratified by the Board of Management in its 27th Meeting held on 28th July 2025)***

**September 2023**

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## 1. Vision & Mission of the University and the School / Department

### *1.1 Vision of the University*

To be a Value-driven Global University, excelling beyond peers and creating professionals of integrity and character, having concern and care for society.

### *1.2 Mission of the University*

- Commit to be an innovative and inclusive institution by seeking excellence in teaching, research and knowledge-transfer.
- Pursue Research and Development and its dissemination to the community, at large.
- Create, sustain and apply learning in an interdisciplinary environment with consideration for ethical, ecological and economic aspects of nation building.
- Provide knowledge-based technological support and services to the industry in its growth and development.
- To impart globally-applicable skill-sets to students through flexible course offerings and support industry's requirement and inculcate a spirit of new-**venture creation.**

### 1.3 Vision of Presidency School of Computer Science and Engineering

To be a value based, practice-driven School of Computer Science and Engineering, committed to developing globally-competent Engineers, dedicated to developing cutting-edge technology, towards enhancing Quality of Life.

### 1.4 Mission of Presidency School of Computer Science and Engineering

▪ Cultivate a practice-driven environment, with computing-based pedagogy, integrating theory and practice.

· Attract and nurture world-class faculty to excel in Teaching and Research, in the realm of Computing Sciences.

· Establish state-of-the-art computing facilities, for effective Teaching and Learning experiences.

· Promote Interdisciplinary Studies to nurture talent for global impact.

· Instill Entrepreneurial and Leadership Skills to address Social, Environmental and Community-needs.

## 2. Preamble to the Program Regulations and Curriculum

This is the subset of Academic Regulations and it is to be followed as a requirement for the award of B. Tech degree.

The Curriculum is designed to take into the factors listed in the Choice Based Credit System (CBCS) with focus on Industrial Based Project Learning, Industrial Training, and Internship to enable the students to become eligible and fully equipped for employment in industries, choose higher studies or entrepreneurship.

In exercise of the powers conferred by and in discharge of duties assigned under the relevant provision(s) of the Act, Statutes and Academic Regulations of the University, the Academic Council hereby makes the following Regulations.

## 3. Short Title and Applicability

a. These Regulations shall be called the Bachelor of Technology Degree Program Regulations and Curriculum 2023-2027.
b. These Regulations are subject to, and pursuant to the Academic Regulations .
c. These Regulations shall be applicable to the ongoing Bachelor of Technology Degree Programs of the 2023-2027 batch, and to all other Bachelor of Technology Degree Programs which may be introduced in future.
d. These Regulations shall supersede all the earlier Bachelor of Technology Degree Program Regulations and Curriculum, along with all the amendments thereto.
e. These Regulations shall come into force from the Academic Year 2023-2024.

## 4. Definitions

*In these Regulations, unless the context otherwise requires:*

a. *"Academic Calendar" means the schedule of academic and miscellaneous events as approved by the Vice Chancellor;*
b. *"Academic Council" means the Academic Council of the University;*
c. *"Academic Regulations" means the Academic Regulations, of the University;*
d. *"Academic Term" means a Semester or Summer Term;*
e. *"Act" means the Presidency University Act, 2013;*
f. *"AICTE" means All India Council for Technical Education;*
g. *"Basket" means a group of courses bundled together based on the nature/type of the course;*
h. *"BOE" means the Board of Examinations of the University;*
i. *"BOG" means the Board of Governors of the University;*
j. *"BOM" means the Board of Management of the University;*
k. *"BOS" means the Board of Studies of a particular Department/Program of Study of the University;*
l. *"CGPA" means Cumulative Grade Point Average as defined in the Academic Regulations;*
m. *"Clause" means the duly numbered Clause, with Sub-Clauses included, if any, of these Regulations;*
n. *"COE" means the Controller of Examinations of the University;*
o. *"Course In Charge" means the teacher/faculty member responsible for developing and organising the delivery of the Course;*
p. *"Course Instructor" means the teacher/faculty member responsible for teaching and evaluation of a Course;*
q. *"Course" means a specific subject usually identified by its Course-code and Course-title, with specified credits and syllabus/course-description, a set of references, taught by some teacher(s)/course-instructor(s) to a specific class (group of students) during a specific Academic Term;*

r. *"Curriculum Structure" means the Curriculum governing a specific Degree Program offered by the University, and, includes the set of Baskets of Courses along with minimum credit requirements to be earned under each basket for a degree/degree with specialization/minor/honours in addition to the relevant details of the Courses and Course catalogues (which describes the Course content and other important information about the Course). Any specific requirements for a particular program may be brought into the Curriculum structure of the specific program and relevant approvals should be taken from the BOS and Academic Council at that time.*

s. *"DAC" means the Departmental Academic Committee of a concerned Department/Program of Study of the University;*

t. *"Dean" means the Dean / Director of the concerned School;*

u. *"Degree Program" includes all Degree Programs;*

v. *"Department" means the Department offering the degree Program(s) / Course(s) / School offering the concerned Degree Programs / other Administrative Offices;*

w. *"Discipline" means specialization or branch of B.Tech. Degree Program;*

x. *"HOD" means the Head of the concerned Department;*

y. *"L-T-P-C" means Lecture-Tutorial-Practical-Credit – refers to the teaching – learning periods and the credit associated;*

z. *"MOOC" means Massive Open Online Courses;*

aa. *"MOU" means the Memorandum of Understanding;*

bb. *"NPTEL" means National Program on Technology Enhanced Learning;*

cc. *"Parent Department" means the department that offers the Degree Program that a student undergoes;*

dd. *"Program Head" means the administrative head of a particular Degree Program/s;*

ee. *"Program Regulations" means the Bachelor of Technology Degree Program Regulations and Curriculum, 2023-2027;*

ff. *"Program" means the Bachelor of Technology (B.Tech.) Degree Program;*

gg. *"PSCS" means the Presidency School of Computer Science and Engineering;*

hh. *"Registrar" means the Registrar of the University;*

ii. *"School" means a constituent institution of the University established for monitoring, supervising and guiding, teaching, training and research activities in broadly related fields of studies;*

jj. *"Section" means the duly numbered Section, with Clauses included in that Section, of these Regulations;*

kk. *"SGPA" means the Semester Grade Point Average as defined in the Academic Regulations.*

ll. *"Statutes" means the Statutes of Presidency University;*

mm. *"Sub-Clause" means the duly numbered Sub-Clause of these Program Regulations;*

nn. *"Summer Term" means an additional Academic Term conducted during the summer break (typically in June-July) for a duration of about eight (08) calendar weeks, with a minimum of thirty (30) University teaching days;*

oo. *"SWAYAM" means Study Webs of Active Learning for Young Aspiring Minds.*

pp. *"UGC" means University Grant Commission;*

*qq. "University" means Presidency University, Bengaluru; and*
*rr. "Vice Chancellor" means the Vice Chancellor of the University.*

## 5. Program Description

The Bachelor of Technology Degree Program Regulations and Curriculum 2023-2027 are subject to, and, pursuant to the Academic Regulations, 2021. These Program Regulations shall be applicable to the following ongoing Bachelor of Technology (B.Tech.) Degree Programs of 2023-2027 offered by the Presidency School of Computer Science and Engineering (PSCS):

1. Bachelor of Technology in Computer Science and Engineering, abbreviated as B.Tech. Computer Science and Engineering;
2. Bachelor of Technology in Computer Science and Technology (Big Data), abbreviated as B.Tech. Computer Science and Technology (Big Data);
3. Bachelor of Technology in Computer Science and Engineering (Block Chain), abbreviated as B.Tech. Computer Science and Engineering (Block Chain);
4. Bachelor of Technology in Computer Science and Technology (Dev Ops), abbreviated as B.Tech. Computer Science and Technology (Dev Ops);
5. Bachelor of Technology in Computer Science and Engineering (Cyber Security), abbreviated as B.Tech. Computer Science and Engineering (Cyber Security);
6. Bachelor of Technology in Computer Science and Engineering (Internet of Things), abbreviated as B.Tech. Computer Science and Engineering (Internet of Things);
7. Bachelor of Technology in Computer Science and Engineering (Data Science), abbreviated as B.Tech. Computer Science and Engineering (Data Science);
8. Bachelor of Technology in Computer Science and Technology (Artificial Intelligence and Machine Learning), abbreviated as B.Tech. Computer Science and Technology (Artificial Intelligence and Machine Learning);
9. Bachelor of Technology in Information Science and Technology, abbreviated as B.Tech. Information Science and Technology;
10. Bachelor of Technology in Computer Science and Information Technology, abbreviated as B.Tech. Computer Science and Information Technology;
11. Bachelor of Technology in Computer Science and Engineering (Networks), abbreviated as B.Tech. Computer Science and Engineering (Networks);

12. Bachelor of Technology in Computer Engineering (Artificial Intelligence and Machine Learning), abbreviated as B.Tech. Computer Engineering (Artificial Intelligence and Machine Learning);
13. Bachelor of Technology in Information Science and Engineering (Artificial Intelligence and Robotics), abbreviated as B.Tech. Information Science and Engineering (Artificial Intelligence and Robotics); and
14. Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence and Machine Learning) abbreviated as B.Tech. Computer Science and Engineering (Artificial Intelligence and Machine Learning);

5.1 These Program Regulations shall be applicable to other similar programs, which may be introduced in future.

5.2 These Regulations may evolve and get amended or modified or changed through appropriate approvals from the Academic Council, from time to time, and shall be binding on all concerned.

5.3 The effect of periodic amendments or changes in the Program Regulations, on the students admitted in earlier years, shall be dealt with appropriately and carefully, so as to ensure that those students are not subjected to any unfair situation whatsoever, although they are required to conform to these revised Program Regulations, without any undue favour or considerations

## 6. Minimum and Maximum Duration

6.1 Bachelor of Technology Degree Program is a Four-Year, Full-Time Semester based program. The minimum duration of the B.Tech. Program is four (04) years and each year comprises of two academic Semesters (Odd and Even Semesters) and hence the duration of the B.Tech. program is eight (08) Semesters.

6.2 A student who for whatever reason is not able to complete the Program within the normal period or the minimum duration (number of years) prescribed for the Program, may be allowed a period of two years beyond the normal period to complete the mandatory minimum credits requirement as prescribed by the concerned Program Regulations and Curriculum. In general, the permissible maximum duration (number of years) for completion of Program is 'N' + 2 years, where 'N' stands for the normal or minimum duration (number of years) for completion of the concerned Program as prescribed by the concerned Program Regulations and Curriculum.

6.3 The time taken by the student to improve Grades/CGPA, and in case of temporary withdrawal/re-joining (Refer to Clause 16.1 of Academic Regulations), shall be counted in the permissible maximum duration for completion of a Program.

6.4 In exceptional circumstances, such as temporary withdrawal for medical exigencies where there is a prolonged hospitalization and/or treatment, as

certified through hospital/medical records, women students requiring extended maternity break (certified by registered medical practitioner), and, outstanding sportspersons representing the University/State/India requiring extended time to participate in National/International sports events, a further extension of one (01) year may be granted on the approval of the Academic Council.

6.5 The enrolment of the student who fails to complete the mandatory requirements for the award of the concerned Degree (refer Section 19.0**Error! Reference s ource not found.** of Academic Regulations) in the prescribed maximum duration (Clauses 18.1 and 18.2 of Academic Regulations), shall stand terminated and no Degree shall be awarded.

## 7 Programme Educational Objectives (PEO)

After four years of successful completion of the program, the graduates shall be able to:

**PEO 01: Demonstrate as a Computer Engineering Professional with innovative skills and moral and ethical values**

**PEO 02: Engage in lifelong learning through research and professional development**

**PEO 03: Serve as a leader in the profession through consultancy, extension activities and/ or entrepreneurship**

## 8 Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

### 8.1 Programme Outcomes (PO)

On successful completion of the Program, the students shall be able to:

**PO 1: Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO 2: Problem Analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO 3: Design/development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO 4: Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO 5: Modern Tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

**PO 6: The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO 7: Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**PO 8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO 9: Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO 10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**PO 11: Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**PO 12: Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### 8.2 Program Specific Outcomes (PSOs):

On successful completion of the Program, the students shall be able to:

**PSO1: Employability:** acquire technical and managerial skill that make them an employable graduate.

**PSO2: Research:** acquire theoretical background of each course that they are capable of applying it for solving real-time (Physical) problems.

**PSO3: Entrepreneurship:** acquire time management, strategic thinking, team work, and network though out their course study and project work enable them to be an entrepreneurship.

**PSO4: Philanthropist:** get experienced through SIC (Social Immersion Course), social outreach, blood donation and other social activity during their 4 year stay and enable them to be a philanthropist.

## 9 Admission Criteria (as per the concerned Statutory Body)

The University admissions shall be open to all persons irrespective of caste, class, creed, gender or nation. All admissions shall be made on the basis of merit in the qualifying examinations; provided that forty percent of the admissions in all Programs of the University shall be reserved for the students of Karnataka State and admissions shall be made through a Common Entrance Examination conducted by the State Government

or its agency and seats shall be allotted as per the merit and reservation policy of the State Government from time to time**.** The admission criteria to the B.Tech. Program is listed in the following Sub-Clauses:

9.1 An applicant who has successfully completed Pre-University course or Senior Secondary School course (+2) or equivalent such as (11+1), 'A' level in Senior School Leaving Certificate Course from a recognized university of India or outside or from Senior Secondary Board or equivalent, constituted or recognized by the Union or by the State Government of that Country for the purpose of issue of qualifying certificate on successful completion of the course, may apply for and be admitted into the Program.

9.2 Provided further, the applicant must have taken Physics and Mathematics as compulsory subjects in the Pre-University / Higher Secondary / (10+2) / (11+1) examination, along with either Chemistry / Biology / Electronics / Computer Science / Biotechnology subject, and, the applicant must have obtained a minimum of 45% of the total marks (40% in case of candidates belonging to the Reserved Category as classified by the Government of Karnataka) in these subjects taken together.

9.3 The applicant must have appeared for Joint Entrance Examinations (JEE) Main / JEE (Advanced) / Karnataka CET / COMED-K, or any other State-level Engineering Entrance Examinations.

9.4 Reservation for the SC / ST and other backward classes shall be made in accordance with the directives issued by the Government of Karnataka from time to time.

9.5 Admissions are offered to Foreign Nationals and Indians living abroad in accordance with the rules applicable for such admission, issued from time to time, by the Government of India.

9.6 Candidates must fulfil the medical standards required for admission as prescribed by the University.

9.7 If, at any time after admission, it is found that a candidate had not in fact fulfilled all the requirements stipulated in the offer of admission, in any form whatsoever, including possible misinformation and any other falsification, the Registrar shall report the matter to the Board of Management (BOM), recommending revoking the admission of the candidate.

9.8 The decision of the BOM regarding the admissions is final and binding.

## 10 Lateral Entry / Transfer Students requirements

### 10.1 Lateral Entry

The University admits students directly to the second year (3rd Semester) of the B.Tech. Degree program as per the provisions and/or regulations of the Government of Karnataka pertaining to the "Lateral Entry" scheme announced by the Government from time to time. Further, the general conditions and rules governing the provision of Lateral Entry to the B.Tech. Program of the University are listed in the following Sub-Clauses:

10.1.1 Admission to 2nd year (3rd Semester) of the B.Tech. Degree program shall be open to the candidates who are holders of a 3-year Diploma in Engineering (or equivalent qualification as recognized by the University), who have secured not less than forty-five percentage (45%) marks in the final year examination (5th and 6th Semesters of the Diploma Program) in the appropriate branch of Engineering. Provided that, in case of SC / ST and OBC candidates from Karnataka the minimum marks for eligibility shall be forty percent (40%).

10.1.2 Provided further that, candidates seeking Lateral Entry may be required to complete specified bridge Courses as prescribed by the University. Such bridge Courses, if any, shall not be included in the CGPA computations.

10.1.3 All the existing Regulations and Policies of the University shall be binding on all the students admitted to the Program through the provision of Lateral Entry.

10.1.4 The Course requirements prescribed for the 1st Year of the B.Tech. Program shall be waived for the student(s) admitted through Lateral Entry and the duration of the B.Tech. Program for such students is three (03) years, commencing from the 3rd Semester (commencement of the 2nd Year) of the B.Tech. Program and culminating with the 8th Semester (end of the 4th Year) of the B.Tech. Program.

10.1.5 Provided that, if a Lateral Entry student misses any mandatory program specific courses that are typically offered in the 1st year (1st or 2nd semesters), then those courses must be cleared by the students as soon as possible, preferably during the Summer Term.

10.1.6 The existing Program Regulations of the concerned Program to which the student is admitted through the provision of Lateral Entry shall be binding on the student with effect from the 3rd Semester of the Program. i.e., the Program Structure and Curriculum from the 3rd to 8th Semesters of the Program concerned shall be binding on the student admitted through Lateral Entry. Further, any revisions / amendments made to the Program Regulations thereafter, shall be binding on all the students of the concerned Program.

10.1.7 All the Courses (and the corresponding number of Credits) prescribed for the 1st Year of the concerned B.Tech. Program shall be waived for the

student(s) admitted to the concerned B.Tech Program through Lateral Entry. Further, the *Minimum Credit Requirements* for the award of the B.Tech. Degree in the concerned Program shall be prescribed / calculated as follows:

The ***Minimum Credit Requirements*** for the award of the Bachelor of Technology (B.Tech.) Degree prescribed by the concerned Bachelor of Technology Degree Program Regulations and Curriculum, 2024-2028, minus the number of Credits prescribed / accepted by the Equivalence Committee for the 1st Year (1st and 2nd Semesters) of the B.Tech. Program.

For instance, if the *Minimum Credit Requirements* for the award of the Bachelor of Technology (B.Tech.) Degree as prescribed by the Regulations for B.Tech. Computer Science and Engineering (Data Science) is "N" Credits, and, if the total credits prescribed in the 1st Year (total credits of the 1st and 2nd Semesters) of the Program concerned is "M" Credits, then the *Minimum Credit Requirements* for the award of the B.Tech. Computer Science and Engineering in Data Science for a student who joins the Program through the provision of the Lateral Entry, shall be "N – M" Credits.

10.1.8 Further, no other waiver except the Courses prescribed for the 1st year of the B.Tech. Program of the University shall be permissible for students joining the B.Tech. Program through the provision of Lateral Entry.

**10.2 Transfer of student(s) from another recognized University to the 2nd year (3rd Semester) of the B.Tech. Program of the University**

A student who has completed the 1st Year (i.e., passed in all the Courses / Subjects prescribed for the 1st Year) of the B.Tech. , Four-Year Degree Program from another recognized University, may be permitted to transfer to the 2nd Year (3rd Semester) of the B.Tech. Program of the University as per the rules and guidelines prescribed in the following Sub-Clauses:

**10.2.1** The concerned student fulfils the criteria specified in Sub-Clauses 10.1.1, 10.1.2 and 10.1.3.

**10.2.2** The student shall submit the Application for Transfer along with a non-refundable Application Fee (as prescribed by the University from time to time) to the University no later than July 10 of the concerned year for admission to the 2nd Year (3rd Semester) B.Tech. Program commencing on August 1 on the year concerned.

**10.2.3** The student shall submit copies of the respective Marks Cards / Grade Sheets / Certificates along with the Application for Transfer.

**10.2.4** The transfer may be provided on the condition that the Courses and Credits completed by the concerned student in the 1st Year of the B.Tech. , Four Degree Program from the concerned University, are declared equivalent and acceptable by the Equivalence Committee constituted by the Vice Chancellor for this purpose. Further, the Equivalence Committee may also prescribe the Courses and Credits the concerned students shall have to mandatorily complete, if admitted to the 2nd Year of the B.Tech. Program of the University.

**10.2.5** The Branch / Discipline allotted to the student concerned shall be the decision of the University and binding on the student.

## 11 Change of Branch / Discipline / Specialization

A student admitted to a particular Branch of the B.Tech. Program will normally continue studying in that Branch till the completion of the program. However, the University reserves the right to provide the option for a change of Branch, or not to provide the option for a change of Branch, at the end of 1st Year of the B.Tech. Program to eligible students in accordance with the following rules and guidelines: framed by the University from time to time.

11.1 Normally, only those students, who have passed all the Courses prescribed for the 1st Year of the B.Tech. Program and obtained a CGPA of not less than 6.50 at the end of the 2nd Semester, shall be eligible for consideration for a change of Branch.

11.2 Change of Branch, if provided, shall be made effective from the commencement of the 3rd Semester of the B.Tech. Program. There shall be no provision for change of Branch thereafter under any circumstances whatsoever.

11.3 The student provided with the change of Branch shall fully adhere to and comply with the Program Regulations of the concerned Branch of the B.Tech. Program, the Fee Policy pertaining to that Branch of the B.Tech. Program, and, all other rules pertaining to the changed Branch existing at the time.

11.4 Change of Branch once made shall be final and binding on the student. No student shall be permitted, under any circumstances, to refuse the change of Branch offered.

11.5 The eligible student may be allowed a change in Branch, strictly in order of *inter se* merit, subject to the conditions given below:

11.5.1 The actual number of students in the 3rd Semester in any particular Branch to which the transfer is to be made, should not exceed the intake fixed by the University for the concerned Branch;

11.5.2 The actual number of students in any Branch from which transfer is being sought does not fall below 75% of the total intake fixed by the University for the concerned Branch.

The process of change of Branch shall be completed within the first five days of Registration for the 3rd Semester of the B.Tech. Program.

## 12 Specific Regulations regarding Assessment and Evaluation (including the Assessment Details of NTCC Courses, Weightages of Continuous Assessment and End Term Examination for various Course Categories)

**12.1** The academic performance evaluation of a student in a Course shall be according to the University Letter Grading System based on the class performance distribution in the Course.

**12.2** Academic performance evaluation of every registered student in every Course registered by the student is carried out through various components of Assessments spread across the Semester. The nature of components of Continuous Assessments and the weightage given to each component of Continuous Assessments (refer Clause 12.5 of Academic Regulations) shall be clearly defined in the Course Plan for every Course, and approved by the DAC.

**12.3** Format of the End-Term examination shall be specified in the Course Plan.

**12.4** Grading is the process of rewarding the students for their overall performance in each Course. The University follows the system of Relative Grading with statistical approach to classify the students based on the relative performance of the students registered in the concerned Course except in the following cases:

- Non-Teaching Credit Courses (NTCC)
- Courses with a class strength less than 30

Absolute grading method may be adopted, where necessary with prior approval of concerned DAC.

Grading shall be done at the end of the Academic Term by considering the aggregate performance of the student in all components of Assessments prescribed for the Course. Letter Grades (Clause 8.10 of Academic Regulations )shall be awarded to a student based on her/his overall performance relative to the class performance distribution in the concerned Course. These Letter Grades not only indicate a qualitative assessment of the student's performance but also carry a quantitative (numeric) equivalent called the Grade Point.

### 12.5 Assessment Components and Weightage

| Table 1: Assessment Components and Weightage for different category of Courses | | |
|---|---|---|
| **Nature of Course and Structure** | **Evaluation Component** | **Weightage** |
| **Lecture-based Course**<br>L component in the L-T-P Structure is predominant (more than 1)<br>(Examples: 3-0-0; 3-0-2; 2-1-0; 2-0-2, 2-0-4 etc.) | Continuous Assessments | 50% |
| | End Term Examination | 50% |
| **Lab/Practice-based Course**<br>P component in the L-T-P Structure is predominant<br>(Examples: 0-0-4; 1-0-4; 1-0-2; etc.) | Continuous Assessments | 75% |
| | End Term Examination | 25% |
| **Skill based Courses** like Industry Internship, Capstone project, Research Dissertation, Integrative Studio, Interdisciplinary Project, Summer / Short Internship, Social Engagement / Field Projects, Portfolio, and such similar Non-Teaching Credit Courses, where the pedagogy does not lend itself to a typical L-T-P structure | Guidelines for the assessment components for the various types of Courses, with recommended weightages, shall be specified in the concerned Program Regulations and Curriculum / Course Plans, as applicable. | |

The exact weightages of Evaluation Components shall be clearly specified in the concerned PRC and respective Course Plan.

Normally, for Practice/Skill based Courses, without a defined credit structure (L–T–P) [NTCC], but with assigned Credits (as defined in Clause 5.2 of the Academic Regulations), the method of evaluation shall be based only on Continuous Assessments. The various components of Continuous Assessments, the distribution of weightage among such components, and the method of evaluation/assessment, shall be as decided and indicated in the Course Plan/PRC. The same shall be approved by the respective DAC.

### 12.6 Minimum Performance Criteria:

#### 12.6.1 Theory only Course and Lab/Practice Embedded Theory Course

A student shall satisfy the following minimum performance criteria to be eligible to earn the credits towards the concerned Course:

a. A student must obtain a minimum of 30% of the total marks/weightage assigned to the End Term Examinations in the concerned Course.

b. The student must obtain a minimum of 40% of the AGGREGATE of the marks/weightage of the components of Continuous Assessments, Mid Term Examinations and End Term Examinations in the concerned Course.

**12.6.2 Lab/Practice only Course and Project Based Courses**

The student must obtain a minimum of 40% of the AGGREGATE of the marks/weightage of all assessment components in the concerned Course.

**12.6.3** A student who fails to meet the minimum performance criteria listed above in a Course shall be declared as "Fail" and given "F" Grade in the concerned Course. For theory Courses, the student shall have to re-appear in the "Make-Up Examinations" as scheduled by the University in any subsequent semester, or, re-appear in the End Term Examinations of the same Course when it is scheduled at the end of the following Semester or Summer Term, if offered. The marks obtained in the Continuous Assessments (other than the End Term Examination) shall be carried forward and be included in computing the final grade, if the student secures the minimum requirements (as per Sub-Clauses 8.9.1 and 8.9.2 of Academic Regulations ) in the "Make-Up Examinations" of the concerned Course. Further, the student has an option to re-register for the Course and clear the same in the summer term/ subsequent semester if he/she wishes to do so, provided the Course is offered.

## 13 Additional clarifications - Rules and Guidelines for Transfer of Credits from MOOC, etc. – Note: These are covered in Academic Regulations

The University allows students to acquire credits from other Indian or foreign institutions and/or Massive Open Online Course (MOOC) platforms, subject to prior approval. These credits may be transferred and counted toward fulfilling the minimum credit requirements for the award of a degree. The process of transfer of credits is governed by the following rules and guidelines:

**13.1** The transfer of credits shall be examined and recommended by the Equivalence Committee (Refer Annexure B of Academic Regulations ) and approved by the Dean - Academics.

**13.2** Students may earn credits from other Indian or foreign Universities/Institutions with which the University has an MOU, and that MOU

shall have specific provisions, rules and guidelines for transfer of credits. These transferred credits shall be counted towards the minimum credit requirements for the award of the degree.

**13.3** Students may earn credits by registering for Online Courses offered by *Study Web of Active Learning by Young and Aspiring Minds* (SWAYAM) and *National Program on Technology Enhanced Learning* (NPTEL), or other such recognized Bodies/ Universities/Institutions as approved by the concerned BOS and Academic Council from time to time. The concerned School/Parent Department shall publish/include the approved list of Courses and the rules and guidelines governing such transfer of credits of the concerned Program from time to time. The Rules and Guidelines for the transfer of credits specifically from the Online Courses conducted by SWAYAM/ NPTEL/ other approved MOOCs are as stated in the following Sub-Clauses:

**13.3.1** A student may complete SWAYAM/NPTEL/other approved MOOCs as mentioned in Clause 17.3 (as per the Academic Regulations) and transfer equivalent credits to partially or fully complete the mandatory credit requirements of Discipline Elective Courses and/or the mandatory credit requirements of Open Elective Courses as prescribed in the concerned Curriculum Structure. However, it is the sole responsibility of the student to complete the mandatory credit requirements of the Discipline Elective Courses and the Open Elective Courses as prescribed by the Curriculum Structure of the concerned Program.

**13.3.2** SWAYAM/NPTEL/ other approved MOOCs as mentioned in Clause 17.3 (as per the Academic Regulations) shall be approved by the concerned Board of Studies and placed (as Annexures) in the concerned PRC.

**13.3.3** Parent Departments may release a list of SWAYAM/NPTEL/other approved MOOCs for Pre-Registration as per schedule in the Academic Calendar or through University Notification to this effect.

**13.3.4** Students may Pre-Register for the SWAYAM/NPTEL/other approved MOOCs in the respective Departments and register for the same Courses as per the schedule announced by respective Online Course Offering body/institute/ university.

**13.3.5** A student shall request for transfer of credits only from such approved Courses as mentioned in Sub-Clause 13.3.2 above.

**13.3.6** SWAYAM/NPTEL/other approved MOOCs Courses are considered for transfer of credits only if the concerned student has successfully completed the SWAYAM/NPTEL/other approved MOOCs and obtained a certificate of successful/satisfactory completion.

**13.3.7** A student who has successfully completed the approved SWAYAM/NPTEL/ other approved MOOCs and wants to avail the provision of transfer of equivalent credits, must submit the original Certificate of Completion, or such similar authorized documents to the HOD concerned, with a written request for the transfer of the equivalent credits. On verification of the Certificates/Documents and approval by the HOD concerned, the Course(s) and equivalent Credits shall forwarded to the COE for processing of results of the concerned Academic Term.

**13.3.8** The credit equivalence of the SWAYAM/NPTEL/other approved MOOCs are based on Course durations and/or as recommended by the Course offering body/institute/university. The Credit Equivalence mapped to SWAYAM/ NPTEL approved Courses based on Course durations for transfer of credits is summarised in Table shown below. The Grade will be calculated from the marks received by the Absolute Grading Table 8.11 in the Academic Regulations.

**Table 2: Durations and Credit Equivalence for Transfer of Credits from SWAYAM-NPTEL/ other approved MOOC Courses**

| Sl. No. | Course Duration | Credit Equivalence |
|---|---|---|
| 1 | 4 Weeks | 1 Credit |
| 2 | 8 Weeks | 2 Credits |
| 3 | 12 Weeks | 3 Credits |

**13.3.9** The maximum permissible number of credits that a student may request for credit transfer from MOOCs shall not exceed 20% of the mandatory minimum credit requirements specified by the concerned Program Regulations and Curriculum for the award of the concerned Degree.

**13.3.10** The University shall not reimburse any fees/expense; a student may incur for the SWAYAM/NPTEL/other approved MOOCs.

**13.4** The maximum number of credits that can be transferred by a student shall be limited to forty percent (40%) of the mandatory minimum credit requirements specified by the concerned Program Regulations and Curriculum for the award of the concerned Degree. However, the grades obtained in the Courses transferred from other Institutions/MOOCs, as mentioned in this Section ( 13.0 ), shall not be included in the calculation of the CGPA.

**13.5** Mandatory Non-Credit Course Completion Requirements: All mandatory non-credit courses shall be satisfactorily completed by the student as part of the degree

requirements. These courses will be evaluated and awarded letter grades based on the following criteria:
S (Satisfactorily Completed): Awarded when the student successfully completes all prescribed course requirements.
NC (Not Completed): Awarded when the student fails to meet the prescribed course requirements.
A student receiving an NC grade must reappear for and complete the course in accordance with the guidelines prescribed by the University.
In the case of non-taught and non-credited mandatory courses—where students are advised to undertake learning through MOOC platforms—there shall be a clearly defined Course Catalogue and a corresponding Course Plan. The Course Plan shall outline the assessment components, which will form the basis for evaluation.

# PART B: PROGRAM STRUCTURE

### 14. Structure / Component with Credit Requirements Course Baskets & Minimum Basket wise Credit Requirements

The B.Tech. Computer Science and Engineering(CSD) Program Structure (2023-2027) totalling 160 credits. Table 3 summarizes the type of baskets, number of courses under each basket and the associated credits that are mandatorily required for the completion of the Degree.

**Table 3.0: B.Tech. (Data Science) 2023-2027: Summary of Mandatory Courses and Minimum Credit Contribution from various Baskets**

| Sl. No. | Baskets | Credit Contribution |
|---|---|---|
| 1 | School Core | 68 |
| 2 | Program Core | 65 |
| 3 | Discipline Elective | 18 |
| 4 | Open Elective | 09 |
| | **Total Credits** | **160 (Minimum)** |

In the entire Program, the practical and skill based course component contribute to an extent of approximately 57% out of the total credits of 160 for B.Tech. (CSD) program of four years' duration.

### 15. Minimum Total Credit Requirements of Award of Degree

As per the AICTE guidelines, a minimum of 160 credits is required for the award of a B.Tech. degree.

### 16. Other Specific Requirements for Award of Degree, if any, as prescribed by the Statutory Bodies,

16.1 The award of the Degree shall be recommended by the Board of Examinations and approved by the Academic Council and Board of Management of the University**.**

16.2 A student shall be declared to be eligible for the award of the concerned Degree if she/he:

a. Fulfilled the Minimum Credit Requirements and the Minimum Credits requirements under various baskets;

b. Secure a minimum CGPA of 4.50 in the concerned Program at the end of the Semester/Academic Term in which she/he completes all the requirements for the award of the Degree as specified in Sub-Clause 19.2.1 of Academic Regulations**;**

c. No dues to the University, Departments, Hostels, Library, and any other such Centers/ Departments of the University; and

d. No disciplinary action is pending against her/him.

# PART C – CURRICULUM STRUCTURE

**17. Curriculum Structure – Basket Wise Course List (not Semester Wise)**
**List of Courses Tabled – aligned to the Program Structure**
**(Course Code, Course Name, Credit Structure (LTPC), Contact Hours, Type of Skills etc., as applicable).**

| Type of Skill |
|---|
| F - Foundation |
| S - Skill Development |
| EM – Employability |
| EN – Entrepreneurship |

| Course Caters to |
|---|
| GS - Gender Sensitization |
| ES - Environment and sustainability |
| HP - Human values and Professional Ethics |
| |

**Table 3.1 : School Core Courses**

| S.No | Course Code | Course Name | L | T | P | C | Contact Hr | Type of Skill | Pre Requisite |
|---|---|---|---|---|---|---|---|---|---|
| 1 | MAT1001 | Calculus and Linear Algebra | 3 | 0 | 2 | 4 | 5 | F | -- |
| 2 | PHY1002 | Optoelectronics and Device Physics | 2 | 0 | 2 | 3 | 4 | F | -- |
| 3 | ECE1001 | Elements of Electronics Engineering | 3 | 0 | 2 | 4 | 5 | F | -- |
| 4 | ENG1002 | Technical English | 1 | 0 | 2 | 2 | 3 | S | -- |
| 5 | PPS1001 | Introduction to soft skills | 0 | 0 | 2 | 1 | 2 | S | -- |
| 6 | CSE1004 | Problem Solving Using C | 1 | 0 | 4 | 3 | 5 | S | -- |
| 7 | CHE1018 | Environmental Science | 1 | 0 | 2 | 0 | 3 | F | -- |
| 8 | PPS1011 | Introduction to Verbal Ability | 0 | 1 | 0 | 0 | 1 | | -- |
| 9 | MAT1003 | Applied Statistics | 1 | 0 | 2 | 2 | 3 | F | -- |
| 10 | CIV1008 | Basic Engineering Sciences | 2 | 0 | 0 | 2 | 2 | F | -- |
| 11 | MEC1006 | Engineering Graphics | 2 | 0 | 0 | 2 | 2 | F | -- |
| 12 | CSE1006 | Problem Solving using JAVA | 1 | 0 | 4 | 3 | 5 | S | -- |
| 13 | ENG2001 | Advanced English | 1 | 0 | 2 | 2 | 3 | F | -- |
| 14 | PPS1012 | Enhancing Personality Through Soft Skills | 0 | 0 | 2 | 1 | 2 | S | -- |
| 15 | ECE2010 | Innovative Projects Using Arduino | - | - | - | 1 | - | S | -- |
| 16 | MAT1002 | Transform Techniques, Partial Differential | 3 | 0 | 0 | 3 | 3 | F | --- |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Equations and Their Applications | | | | | | | |
| 17 | CSE2001 | Data Structures and Algorithms | 3 | 0 | 2 | 4 | 5 | F | -- |
| 18 | MAT2004 | Discrete Mathematical Structures | 3 | 0 | 0 | 3 | 3 | F | -- |
| 19 | ECE2011 | Innovative Projects Using Rasperry Pi | - | - | - | 1 | | S | -- |
| 20 | CSE1005 | Programming in Python | 1 | 0 | 4 | 3 | 5 | S | -- |
| 21 | PPS4002 | Introduction to Aptitude | 0 | 0 | 2 | 1 | 2 | S | -- |
| 22 | MAT2003 | Numerical Methods for Engineers | 1 | 0 | 2 | 2 | 3 | F | -- |
| 23 | PPS4004 | Aptitutde Training Intermediate | 0 | 0 | 2 | 1 | 2 | S | -- |
| 24 | CSE3216 | Mastering Object-Oriented Concepts in Python | 0 | 0 | 2 | 1 | 2 | F | -- |
| 25 | CSE7000 | Internship | 0 | 0 | 0 | 2 | 0 | S | -- |
| 26 | PPSXXXX | Industry PreparednessProgram | 2 | 0 | 0 | 0 | 2 | | -- |
| 27 | CSE2074 | Competitive Programming and Problem Solving | 0 | 0 | 4 | 2 | 4 | S | -- |
| 28 | CSE7101 | Mini Project | - | - | - | 5 | | S | -- |
| 29 | CSE7300 | Capstone Project | - | - | - | 10 | | S | -- |
| | | **Total Credit** | | | | **68** | | | -- |

| | **Table 3.2 : Program Core Courses (PCC)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Sl No** | **Course Code** | **Course Name** | **L** | **T** | **P** | **C** | **Contact Hr** | **Type of Skill** | **Pre Requisite** |
| 1 | ECE2007 | Digital Design | 2 | 0 | 2 | 3 | 4 | F | -- |
| 2 | CSE3155 | Data Communications and Computer Networks | 3 | 0 | 2 | 4 | 5 | F | -- |
| 3 | CSE2009 | Computer Organization and Architecture | 3 | 0 | 0 | 3 | 3 | F | -- |
| 4 | CSE3190 | Fundamentals of Data Analytics | 2 | 0 | 2 | 3 | 4 | F | -- |
| 5 | CSE2014 | Software Engineering | 3 | 0 | 0 | 3 | 3 | F | -- |
| 6 | CSE2007 | Design and Analysis of Algorithms | 3 | 0 | 0 | 3 | 3 | F | -- |
| 7 | CSE3156 | Database Management System | 3 | 0 | 2 | 4 | 5 | F | -- |
| 8 | CSE3351 | Operating Systems | 3 | 0 | 0 | 3 | 3 | F | -- |
| 9 | CSE3078 | Cryptography and Network Security | 3 | 0 | 0 | 3 | 3 | F | -- |
| 10 | CSE1700 | Essentials of AI | 3 | 0 | 0 | 3 | 3 | F | -- |
| 11 | CSD1712 | Statistical Foundations of Data Science | 3 | 0 | 0 | 3 | 3 | F | -- |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 12 | CSD1703 | Introduction to Data Science | 3 | 0 | 0 | 3 | 3 | F | -- |
| 13 | CSE2021 | Data Mining | 3 | 0 | 0 | 3 | 3 | F | -- |
| 14 | CSE3078 | Cryptography and Network Security | 3 | 0 | 0 | 3 | 3 | F | -- |
| 15 | CSE1701 | Essentials of AI Lab | 0 | 0 | 4 | 2 | 4 | | -- |
| 16 | CSD1713 | Statistical Foundations of Data Science Lab | 0 | 0 | 2 | 1 | 2 | S | -- |
| 17 | AID1701 | Machine Learning for Intelligent data Science | 2 | 0 | 0 | 2 | 2 | F | -- |
| 18 | CSD1714 | Predictive Analytics | 2 | 0 | 0 | 2 | 2 | F | -- |
| 19 | AID1705 | Explainable AI (XAI) | 3 | 0 | 0 | 3 | 3 | F | -- |
| 20 | CSD1701 | Social Media Analytics | 3 | 0 | 0 | 3 | 3 | F | -- |
| 21 | CSD1705 | Cloud Computing for Data Science | 2 | 0 | 0 | 2 | 2 | F | -- |
| 22 | CSD1709 | Edge AI and IoT Analytics | 3 | 0 | 0 | 3 | 3 | F | -- |
| 23 | CSD1715 | Predictive Analytics Lab | 0 | 0 | 2 | 1 | 2 | S | -- |
| 24 | CSD1702 | Social Media Analytics Lab | 0 | 0 | 2 | 1 | 2 | S | -- |
| 25 | CSE1706 | Cloud Computing for Data Science Lab | 0 | 0 | 2 | 1 | 2 | S | -- |
| 26 | AID1707 | Generative AI and Prompt Engineering | 3 | 0 | 0 | 3 | 3 | F | -- |
| 27 | CSD1714 | Predictive Analytics | 2 | 0 | 0 | 2 | 2 | F | -- |
| | | **Total No. of Credits** | | | | **65** | | | |

## 18. Practical / Skill based Courses – Internships / Thesis / Dissertation / Capstone Project Work / Portfolio / Mini project

Practical / Skill based Courses like internship, project work, capstone project, research project / dissertation, and such similar courses, where the pedagogy does not lend itself to a typical L-T-P-C Structure as defined in Clause 5.1 of the Academic Regulations, are simply assigned the number of Credits based on the quantum of work / effort required to fulfill the learning objectives and outcomes prescribed for the concerned Courses. Such courses are referred to as Non-Teaching Credit Courses (NTCC). These Courses are designed to provide students with hands-on experience and skills essential for their professional development. These courses aim to equip students with abilities in problem identification, root cause analysis, problem-solving, innovation, and design thinking through industry exposure and project-based learning. The expected outcomes are first level proficiency in problem solving and design thinking skills to better equip B.Tech. graduates for their professional careers. The method of evaluation and grading for the Practical / Skill based Courses shall be prescribed and approved by the concerned Departmental Academic Committee (refer Annexure A of the Academic Regulations). The same shall be prescribed in the Course Handout.

### 18.1 Internship / In-plant Training / Skill-based Program / International Immersion (IM) / Recognition of Prior Learning (RPL)

A student may undergo an Internship / In-plant Training / Skill-based Program / IM / RPL for a period minimum 04 weeks in an industry / company, government bodies, academic / research institution or recognized online platforms offering certified skill-based programs during the semester break between $4^{th}$ and $5^{th}$ semesters, subject to the following conditions:

**18.1.1** The Internship / In-plant Training / Skill-based Program / IM / RPL shall be

conducted in accordance with the Internship Policy prescribed by the University from time to time.

**18.1.2** Internship: student shall undergo internship, either in industry / company, academic / research organizations, government bodies, or international institutions. The objective is to provide practical exposure, industry insights, and real-world experience relevant to the student's field of study.

**18.1.3** In-plant Training: student shall undergo training / industrial exposure program aimed at providing with practical insights into real-world working environments. The training may be conducted by industries / companies on-campus or through student visits to industries / companies, government bodies / institutions, or technical organizations.

**18.1.4** Skill-based Program: student shall undergo a certified skill-based program of 30 hours / 04 weeks. Skill-based program should cater to Skill-Enhancement, Practical Focus, and Career orientation, Complementary to Curriculum or Industry relevant.

**18.1.5** International Immersion (IM): student shall undergo IM aimed at providing global exposure through collaborations with foreign universities, industries, or research institutions. The International Immersion may include industry visits, expert interactions, and cultural exchange activities, enhancing students' international outlook, communication skills, and professional readiness.

**18.1.6** Recognition of Prior Learning (RPL): student who shall undergo any formally recognize relevant prior work experience, internships, or project-based learning that meet the internship learning outcomes, thereby allowing students to earn internship credit without repeating equivalent practical training.

**18.1.7** The number of Internships available for the concerned Academic Term. Further, the available number of Internships / In-plant training / Skill-based Program / IM / RPL shall be awarded to the students by the University on the basis of merit using the CGPA secured by the student and as per the selection criteria. Provided further, the student fulfils the criteria, as applicable, specified by the industry / company, government bodies, academic / research or through certified courses.

**18.1.8** A student may opt for Internship / In-plant Training / IM / RPL in an industry / company, government bodies / academic / research institution, international bodies of her / his choice, subject to the condition that the concerned student takes the responsibility to arrange the Internship / In-plant Training / IM / RPL on her / his own. Provided further, that the industry / company, government bodies, academic / research institution national or international offering such Internship / Training confirms to the University that the Internship shall be conducted in accordance with the Program Regulations and Internship Policy of the University / Rubrics.

**18.1.9** A student undergoing RPL must submit an application with supporting documents such as experience letters, project reports, employer feedback, certifications, a self-reflection report etc. Application must be submitted before the commencement of the internship semester.

**18.1.10** A student selected for an Internship / In-plant Training / Skill-based Program / IM / RPL in an industry / company, government bodies, academic / research institution shall adhere to all the rules and guidelines prescribed in the Internship Policy of the University.

The performance will be assessed and grades awarded as per the university's academic grading policy. It may be included as a non-GPA course (Grade-based Satisfactorily Completed / Not Completed). The student must secure a minimum of 50% of the total marks to be declared as having successfully completed the course.

### *18.2 Mini Project*

A student may opt to do a Mini Project for a period of 4-6 weeks in an Industry / Company or academic / research institution or the University Department(s) as an equivalence of Internship during the Semester Break between 4th and 5th Semesters or 6th and 7th Semesters or during the 5th / 6th / 7th Semester as applicable, subject to the following conditions:

**18.2.1** The Mini Project shall be approved by the concerned HOD and be carried out under the guidance of a faculty member.

**18.2.2**The student may do the mini project in an Industry / Company or academic / research institution of her / his choice subject to the above mentioned condition (Sub-Clause 18.2.1 ). Provided further, that the Industry / Company or academic / research institution offering such project work confirms to the University that the Mini project will be conducted in accordance with the Program Regulations and requirements of the University.

### 18.3 *Capstone Project*

A student may undergo a Capstone Project for a period of 12-14 weeks in an industry / company or academic / research institution in the 7th / 8th Semester as applicable, subject to the following conditions:

**18.3.1** The Capstone Project shall be in conducted in accordance with the Capstone Project Policy prescribed by the University from time to time.

**18.3.2 The** selection criteria (minimum CGPA, pass in all Courses as on date, and any other qualifying criteria) as applicable / stipulated by the concerned Industry / Company or academic / research institution for award of the Capstone Project to a student;

**18.3.3** The number of Capstone Project available for the concerned Academic Term. Further, the available number of Capstone Project shall be awarded to the students by the University on the basis of merit using the CGPA secured by the student. Provided further, the student fulfils the criteria, as applicable, specified by the Industry / Company or

academic / research institution providing the Capstone Project, as stated in Sub-Clause 18.3.2 above.

**18.3.4** A student may opt for Capstone Project in an Industry / Company or academic / research institution of her / his choice, subject to the condition that the concerned student takes the responsibility to arrange the I Capstone Project on her / his own. Provided further, that the Industry / Company or academic / research institution offering such Capstone Project confirms to the University that the Capstone Project shall be conducted in accordance with the Program Regulations and Capstone Project Policy of the University.

**18.3.5** A student selected for a Capstone Project in an industry / company or academic / research institution shall adhere to all the rules and guidelines prescribed in the Capstone Project Policy of the University.

18.4 ***Research Project / Dissertation***

A student may opt to do a Research Project / Dissertation for a period of 12-14 weeks in an Industry / Company or academic / research institution or the University Department(s) as an equivalence of Capstone Project, subject to the following conditions:

18.4.1 The Research Project / Dissertation shall be approved by the concerned HOD and be carried out under the guidance of a faculty member.

The student may do the Research Project / Dissertation in an Industry / Company or academic / research institution of her / his choice subject to the above mentioned condition (Sub-Clause 18.4.1 ). Provided further, that the Industry / Company or academic / research institution offering such Research Project / Dissertation confirms to the University that the Research Project / Dissertation work will be conducted in accordance with the Program Regulations and requirements of the University.

## 19.List of Elective Courses under various Specialisations / Stream Basket

Discipline Elective courses/Specialization Tracks – Minimum of 12 credits is to be earned by the student in a particular track and overall 18 credits

**Table 3.3: Discipline Electives Courses/Specialization Tracks – Minimum of 12 credits is to be earned by the student in a particular track and overall 18 credits.**

| | | L | T | P | C | Con ta | Type of Skill | Pre Requisite |
|---|---|---|---|---|---|---|---|---|
| | Data Science Basket | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | CSD3401 | Business Continuity and Risk Analysis for Data Science | 3 | 0 | 0 | 3 | 3 | S/EM | CSE2074 |
| 2 | CSD3402 | Web Data Analytics for Data Science | 2 | 0 | 2 | 3 | 4 | S/EM | CSE2067 |
| 3 | CSD3403 | Optimization techniques for Data Science | 2 | 0 | 2 | 3 | 4 | S | MAT1001 |
| 4 | CSE3088 | Business Intelligence and Analytics | 3 | 0 | 0 | 3 | 3 | S | CSE3190 |
| 5 | CSD3419 | Edge Computing for Data Science | 3 | 0 | 0 | 3 | 3 | S | - |
| 6 | CSD3426 | Cloud Services for Big Data and Analytics | 3 | 0 | 0 | 3 | 3 | S | CSE3343 |
| 7 | CSD3421 | Mobile Application for Data Science | 3 | 0 | 0 | 3 | 3 | S | - |
| 8 | CSD3422 | Intelligent Interfaces and User Experience | 3 | 0 | 0 | 3 | 3 | S | - |
| 11 | CSE3002 | Big Data Technologies | 2 | 0 | 2 | 3 | 4 | S | - |
| 12 | CSD3423 | Applied Artificial Intelligence | 2 | 0 | 2 | 3 | 4 | S | |
| 13 | CSE3006 | Neural Networks and Fuzzy Logic | 3 | 0 | 0 | 3 | 3 | S/ EM | MAT1002 |
| 15 | CSD3445 | Social Media Analytics | 2 | 0 | 2 | 3 | 3 | S/ EM | |
| 16 | CSD3424 | Data warehousing and its application | 3 | 0 | 0 | 3 | 3 | S/ EM | |
| 17 | CSD3406 | Business Oriented Data Analytics | 3 | 0 | 0 | 3 | 3 | S/ EM | |
| 18 | CSD3416 | Probabilistic Modelling for Machine Learning | 3 | 0 | 0 | 3 | 3 | F | MAT2402 |
| 19 | CSD3405 | Text Mining and Analytics | 2 | 0 | 2 | 3 | 4 | EM | CSE2064 |
| 20 | CSE3426 | Front End Full Stack Development | 2 | 0 | 2 | 3 | S/ E M | 0 | CSE2058 |
| 21 | CSE3427 | Java Full Stack Development | 2 | 0 | 2 | 3 | S/ E M | 0 | CSE2059 |
| 22 | CSE3428 | .Net Full Stack Development | 2 | 0 | 2 | 3 | S/ E M | 0 | CSE2058 |
| 23 | CSD3412 | Graph Analytics | 3 | 0 | 0 | 3 | 3 | EM | MAT2303 |
| 24 | CSD3415 | NextGen Predictive Analytics | 2 | 0 | 2 | 3 | 4 | EM | CSD2011 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 25 | CSD3411 | Cybersecurity and Data Privacy | 3 | 0 | 0 | 3 | 3 | EM | - |
| 26 | CSD3413 | Data Visualization and Dashboards | 3 | 0 | 0 | 3 | 3 | S | CSD2009 |
| 27 | CSD3402 | Web Data Analytics | 2 | 0 | 2 | 3 | 4 | EM | CSE1500 |
| 28 | CSD3404 | E-Business and Marketing Analytics | 2 | 0 | 2 | 3 | 4 | EM | CSD2002 |
| 29 | CSD3410 | IoT and Sensor Data Analysis | 3 | 0 | 0 | 3 | 3 | EM | CSE1014 |
| 30 | CSD3409 | Financial Data Analysis | 2 | 0 | 2 | 3 | 4 | EM | CSD2002 |
| 31 | CSD3407 | Statistical Inference and Modelling | 3 | 0 | 0 | 3 | 3 | S/ EM | MAT2402 |
| 33 | CSD3414 | Statistics-Driven Data Science | 2 | 0 | 2 | 3 | 4 | S/ EM | MAT2402 |
| 34 | CSD3408 | Data Mining and Warehousing | 3 | 0 | 0 | 3 | 3 | EM | CSE1510 |
| 35 | CSD2006 | Edge AI and IoT Analytics | 3 | 0 | 0 | 3 | 3 | EM | 0 |
| 36 | CSD3417 | Scientific Computing for Intelligent Systems | 3 | 0 | 0 | 3 | 3 | EM | CSE1500 |
| 37 | CSD3403 | Optimization for Data Science | 2 | 0 | 2 | 3 | 4 | F | MAT1003 |
| 38 | CSD3418 | Feature Engineering and Model Optimization | 3 | 0 | 0 | 3 | 3 | EM | CSE1500 |
| 39 | CSD3431 | Expert Systems | 3 | 0 | 0 | 3 | 3 | EM | 0 |
| 40 | CSD3433 | Computational Intelligence Research | 3 | 0 | 0 | 3 | 3 | EM | 0 |
| 41 | CSD3429 | Cognitive Robotics | 3 | 0 | 0 | 3 | 3 | EM | CSE1500 |
| 42 | CSD3430 | Autonomous Navigation and Vehicles | 3 | 0 | 0 | 3 | 3 | EM | CSE1506 |
| 43 | CSD3434 | Digital Health and Imaging | 3 | 0 | 0 | 3 | 3 | EM | CSD1716 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 44 | CSD3432 | Quantum Computing and AI | 3 | 0 | 0 | 3 | 3 | EM | CSE1500 |
| 45 | Track 12 : Special Basket | | | | | | | | |
| 1 | CAI3427 | Language Models for Text Mining | 2 | 0 | 2 | 3 | 4 | S/EM | CSE3001 |
| 2 | CAI3428 | Practical Deep Learning with TensorFlow | 2 | 0 | 2 | 3 | 4 | S/EM | CSE3001 |
| 3 | CAI3429 | Deep Learning Techniques for Computer Vision | 2 | 0 | 2 | 3 | 4 | S/EM | MAT1003 |
| | **Total No of Credits to be earned from DE = 18.12 Credits from program specialization baskets and 6 from other baskets."** | | | | | | | | |

20. **List of Open Electives to be offered by the School / Department (Separately for ODD and EVEN Semesters.**

| Type of Skill |
|---|
| F - Foundation |
| S - Skill Development |
| EM – Employability |
| EN – Entrepreneurship |

| Course Caters to |
|---|
| GS - Gender Sensitization |
| ES - Environment and sustainability |
| HP - Human values and Professional Ethics |
| |

**Table 3.4 : Open Elective Courses Baskets: Minimum Credits to be earned from this Basket is 09**

| Sl. No. | Course Code | Course Name | L | T | P | C | Type of Skill/ Focus | Course Caters to | Prerequisites/ Corequisites | Antirequisites | Future Courses that need this as a Prerequisite |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Chemistry Basket | | | | | | | | | | | |
| 1 | CHE1003 | Fundamentals of Sensors | 3 | 0 | 0 | 3 | S | ES | - | - | - |
| 2 | CHE1004 | Smart materials for IOT | 3 | 0 | 0 | 3 | S | ES | - | - | - |
| 3 | CHE1005 | Computational Chemistry | 2 | 0 | 0 | 2 | S | ES | - | - | - |
| 4 | CHE1006 | Introduction to Nano technology | 3 | 0 | 0 | 3 | S | ES | - | - | - |
| 5 | CHE1007 | Biodegradable electronics | 2 | 0 | 0 | 2 | S | ES | - | - | - |
| 6 | CHE1008 | Energy and Sustainability | 2 | 0 | 0 | 2 | S | ES | - | - | - |
| 7 | CHE1009 | 3D printing with Polymers | 2 | 0 | 0 | 2 | S | ES | - | - | - |
| 8 | CHE1010 | Bioinformatics and | 2 | 0 | 0 | 2 | S | ES | - | - | - |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Healthcare IT | | | | | | | | | |
| 9 | CHE1011 | Chemical and Petrochemical catalysts | 3 | 0 | 0 | 3 | S | ES | - | - | - |
| 10 | CHE1012 | Introduction to Composite materials | 2 | 0 | 0 | 2 | S | ES | - | - | - |
| 11 | CHE1013 | Chemistry for Engineers | 3 | 0 | 0 | 3 | S | ES | - | - | - |
| 12 | CHE1014 | Surface and Coatings technology | 3 | 0 | 0 | 3 | S | ES | - | - | - |
| 13 | CHE1015 | Waste to Fuels | 2 | 0 | 0 | 2 | S | ES | - | - | - |
| 14 | CHE1016 | Forensic Science | 3 | 0 | 0 | 3 | S | ES | - | - | - |
| Civil Engineering Basket | | | | | | | | | | | |
| 1 | CIV1001 | Disaster mitigation and management | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 2 | CIV1002 | Environment Science and Disaster Management | 3 | 0 | 0 | 3 | FC | - | - | - | - |
| 3 | CIV2001 | Sustainability Concepts in Engineering | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 4 | CIV2002 | Occupational Health and Safety | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 5 | CIV2003 | Sustainable Materials and Green Buildings | 3 | 0 | 0 | 3 | EM | - | - | - | - |
| 6 | CIV2004 | Integrated Project Management | 3 | 0 | 0 | 3 | EN | - | - | - | - |
| 7 | CIV2005 | Environmental Impact Assessment | 3 | 0 | 0 | 3 | EN | - | - | - | - |
| 8 | CIV2006 | Infrastructure Systems for Smart Cities | 3 | 0 | 0 | 3 | EN | - | - | - | - |
| 9 | CIV2044 | Geospatial Applications for Engineers | 2 | 0 | 2 | 3 | EM | - | - | - | - |
| 10 | CIV2045 | Environmental Meteorology | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 11 | CIV3046 | Project Problem Based Learning | 3 | 0 | 0 | 3 | S | - | - | - | - |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | CIV3059 | Sustainability for Professional Practice | 3 | 0 | 0 | 3 | EN | - | - | - | - |
| Commerce Basket | | | | | | | | | | | |
| 1 | COM2001 | Introduction to Human Resource Management | 2 | 0 | 0 | 2 | F | HP/GS | - | - | - |
| 2 | COM2002 | Finance for Non Finance | 2 | 0 | 0 | 2 | S | - | - | - | - |
| 3 | COM2003 | Contemporary Management | 2 | 0 | 0 | 2 | F | - | - | - | - |
| 4 | COM2004 | Introduction to Banking | 2 | 0 | 0 | 2 | F | - | - | - | - |
| 5 | COM2005 | Introduction to Insurance | 2 | 0 | 0 | 2 | F | - | - | - | - |
| 6 | COM2006 | Fundamentals of Management | 2 | 0 | 0 | 2 | F | - | - | - | - |
| 7 | COM2007 | Basics of Accounting | 3 | 0 | 0 | 3 | F | - | - | - | - |
| Computer Science Basket (not to be offered for Computer Science and Engineering students) | | | | | | | | | | | |
| 1 | CSE2002 | Programming in Java | 2 | 0 | 2 | 3 | S/EM | - | - | - | - |
| 2 | CSE2003 | Social Network Analytics | 3 | 0 | 0 | 3 | S | GS | - | - | - |
| 3 | CSE2004 | Python Application Programming | 2 | 0 | 2 | 3 | S/ EM | - | - | - | - |
| 4 | CSE2005 | Web design fundamentals | 2 | 0 | 2 | 3 | S/ EM/EN | - | - | - | - |
| Design Basket | | | | | | | | | | | |
| 1 | DES1001 | Sketching and Painting | 0 | 0 | 2 | 1 | S | - | - | - | - |
| 2 | DES1002 | Innovation and Creativity | 2 | 0 | 0 | 2 | F | - | - | - | - |
| 3 | DES1121 | Introduction to UX design | 1 | 0 | 2 | 2 | S | - | - | - | - |
| 4 | DES1122 | Introduction to Jewellery Making | 1 | 0 | 2 | 2 | S | - | - | - | - |
| 5 | DES1124 | Spatial Stories | 1 | 0 | 2 | 2 | S | - | - | - | - |
| 6 | DES1125 | Polymer Clay | 1 | 0 | 2 | 2 | S | - | - | - | - |
| 7 | DES2001 | Design Thinking | 3 | 0 | 0 | 3 | S | - | - | - | - |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | DES1003 | Servicability of Fashion Products | 1 | 0 | 2 | 2 | F | ES | - | - | - |
| 9 | DES1004 | Choices in Virtual Fashion | 1 | 0 | 2 | 2 | F | ES, GS, HP | - | - | - |
| 10 | DES1005 | Fashion Lifestyle and Product Diversity | 1 | 0 | 2 | 2 | F | ES, GS, HP | - | - | - |
| 11 | DES1006 | Colour in Everyday Life | 1 | 0 | 2 | 2 | F | ES | - | - | - |
| 12 | DES2080 | Art of Design Language | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 13 | DES2081 | Brand Building in Design | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 14 | DES2085 | Web Design Techniques | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 15 | DES2089 | 3D Modeling for Professionals | 1 | 0 | 4 | 3 | S | - | - | - | - |
| 16 | DES2090 | Creative Thinking for Professionals | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 17 | DES2091 | Idea Formulation | 3 | 0 | 0 | 3 | S | - | - | - | - |
| Electrical and Electronics Basket | | | | | | | | | | | |
| 1 | EEE1002 | IoT based Smart Building Technology | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 2 | EEE1003 | Basic Circuit Analysis | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 3 | EEE1004 | Fundamentals of Industrial Automation | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 4 | EEE1005 | Electric Vehicles & Battery Technology | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 5 | EEE1006 | Smart Sensors for Engineering Applications | 3 | 0 | 0 | 3 | S | - | - | - | - |
| Electronics and Communication Basket | | | | | | | | | | | |
| 1 | ECE1003 | Fundamentals of Electronics | 3 | 0 | 0 | 3 | F | - | - | - | - |
| 2 | ECE1004 | Microprocessor based systems | 3 | 0 | 0 | 3 | F | - | - | - | - |
| 3 | ECE3089 | Artificial Neural Networks | 3 | 0 | 0 | 3 | S | - | - | - | - |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | ECE3097 | Smart Electronics in Agriculture | 3 | 0 | 0 | 3 | F/EM | - | - | - | - |
| 5 | ECE3098 | Environment Monitoring Systems | 3 | 0 | 0 | 3 | F/EM | - | - | - | - |
| 6 | ECE3102 | Consumer Electronics | 3 | 0 | 0 | 3 | F/EM | - | - | - | - |
| 7 | ECE3103 | Product Design of Electronic Equipment | 3 | 0 | 0 | 3 | S/F/ EM / EN | - | - | - | - |
| 8 | ECE3106 | Introduction to Data Analytics | 3 | 0 | 0 | 3 | F/EM | - | - | - | - |
| 9 | ECE3107 | Machine Vision for Robotics | 3 | 0 | 0 | 3 | F/EM | - | - | - | - |
| English Basket | | | | | | | | | | | |
| 1 | ENG1008 | Indian Literature | 2 | 0 | 0 | 2 | - | GS/ HP | - | - | - |
| 2 | ENG1009 | Reading Advertisement | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 3 | ENG1010 | Verbal Aptitude for Placement | 2 | 0 | 2 | 3 | S | - | - | - | - |
| 4 | ENG1011 | English for Career Development | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 5 | ENG1012 | Gender and Society in India | 2 | 0 | 0 | 2 | - | GS/ HP | - | - | - |
| 6 | ENG1013 | Indian English Drama | 3 | 0 | 0 | 3 | - | - | - | - | - |
| 7 | ENG1014 | Logic and Art of Negotiation | 2 | 0 | 2 | 3 | - | - | - | - | - |
| 8 | ENG1015 | Professional Communication Skills for Engineers | 1 | 0 | 0 | 1 | - | - | - | - | - |
| DSA Basket | | | | | | | | | | | |
| 1 | DSA2001 | Spirituality for Health | 2 | 0 | 0 | 2 | F | HP | - | - | - |
| 2 | DSA2002 | Yoga for Health | 2 | 0 | 0 | 2 | S | HP | - | - | - |
| 3 | DSA2003 | Stress Management and Well Being | 2 | 0 | 0 | 2 | F | - | - | - | - |
| Kannada Basket | | | | | | | | | | | |
| 1 | KAN1001 | Kali Kannada | 1 | 0 | 0 | 1 | S | - | - | - | - |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | KAN1003 | Kannada Kaipidi | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 3 | KAN2001 | Thili Kannada | 1 | 0 | 0 | 1 | S | - | - | - | - |
| 4 | KAN2003 | Pradharshana Kale | 1 | 0 | 2 | 2 | S | - | - | - | - |
| 5 | KAN2004 | Sahithya Vimarshe | 2 | 0 | 0 | 2 | S | - | - | - | - |
| 6 | KAN2005 | Anuvadha Kala Sahithya | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 7 | KAN2006 | Vichara Manthana | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 8 | KAN2007 | Katha Sahithya Sampada | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 9 | KAN2008 | Ranga Pradarshana Kala | 3 | 0 | 0 | 3 | S | - | - | - | - |
| Foreign Language Basket | | | | | | | | | | | |
| 1 | FRL1004 | Introduction of French Language | 2 | 0 | 0 | 2 | S | S | - | - | - |
| 2 | FRL1005 | Fundamentals of French | 2 | 0 | 0 | 2 | S | S | - | - | - |
| 3 | FRL1009 | Mandarin Chinese for Beginners | 3 | 0 | 0 | 3 | S | S | - | - | - |
| Law Basket | | | | | | | | | | | |
| 1 | LAW1001 | Introduction to Sociology | 2 | 0 | 0 | 2 | F | HP | | - | - |
| 2 | LAW2001 | Indian Heritage and Culture | 2 | 0 | 0 | 2 | F | HP/GS | | - | - |
| 3 | LAW2002 | Introduction to Law of Succession | 2 | 0 | 0 | 2 | F | HP/GS | | - | - |
| 4 | LAW2003 | Introduction to Company Law | 2 | 0 | 0 | 2 | F | HP | | - | - |
| 5 | LAW2004 | Introduction to Contracts | 2 | 0 | 0 | 2 | F | HP | - | - | - |
| 6 | LAW2005 | Introduction to Copy Rights Law | 2 | 0 | 0 | 2 | F | HP | - | - | - |
| 7 | LAW2006 | Introduction to Criminal Law | 2 | 0 | 0 | 2 | F | HP | - | - | - |
| 8 | LAW2007 | Introduction to Insurance Law | 2 | 0 | 0 | 2 | F | HP | - | - | - |
| 9 | LAW2008 | Introduction to Labour Law | 2 | 0 | 0 | 2 | F | HP | - | - | - |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | LAW2009 | Introduction to Law of Marriages | 2 | 0 | 0 | 2 | F | HP/GS | - | - | - |
| 11 | LAW2010 | Introduction to Patent Law | 2 | 0 | 0 | 2 | F | HP | - | - | - |
| 12 | LAW2011 | Introduction to Personal Income Tax | 2 | 0 | 0 | 2 | F | HP | - | - | - |
| 13 | LAW2012 | Introduction to Real Estate Law | 2 | 0 | 0 | 2 | F | HP | - | - | - |
| 14 | LAW2013 | Introduction to Trademark Law | 2 | 0 | 0 | 2 | F | HP | - | - | - |
| 15 | LAW2014 | Introduction to Competition Law | 3 | 0 | 0 | 3 | F | HP | - | - | - |
| 16 | LAW2015 | Cyber Law | 3 | 0 | 0 | 3 | F | HP | - | - | - |
| 17 | LAW2016 | Law on Sexual Harrassment | 2 | 0 | 0 | 2 | F | HP/GS | - | - | - |
| 18 | LAW2017 | Media Laws and Ethics | 2 | 0 | 0 | 2 | F | HP/GS | - | - | - |
| Mathematics Basket | | | | | | | | | | | |
| 1 | MAT2008 | Mathematical Reasoning | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 2 | MAT2014 | Advanced Business Mathematics | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 3 | MAT2041 | Functions of Complex Variables | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 4 | MAT2042 | Probability and Random Processes | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 5 | MAT2043 | Elements of Number Theory | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 6 | MAT2044 | Mathematical Modelling and Applications | 3 | 0 | 0 | 3 | S | - | - | - | - |
| Mechanical Basket | | | | | | | | | | | |
| 1 | MEC1001 | Fundamentals of Automobile Engineering | 3 | 0 | 0 | 3 | F | - | - | - | - |
| 2 | MEC1002 | Introduction to Matlab and Simulink | 3 | 0 | 0 | 3 | S/EM | - | - | - | - |
| 3 | MEC1003 | Engineering Drawing | 1 | 0 | 4 | 3 | S | - | - | - | - |
| 4 | MEC2001 | Renewable Energy Systems | 3 | 0 | 0 | 3 | F | ES | - | - | - |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | MEC2002 | Operations Research & Management | 3 | 0 | 0 | 3 | F | - | - | - | - |
| 6 | MEC2003 | Supply Chain Management | 3 | 0 | 0 | 3 | S/ EM/ EN | - | - | - | - |
| 7 | MEC2004 | Six Sigma for Professionals | 3 | 0 | 0 | 3 | S/EM | - | - | MEC2008 | - |
| 8 | MEC2005 | Fundamentals of Aerospace Engineering | 3 | 0 | 0 | 3 | F | - | - | - | - |
| 9 | MEC2006 | Safety Engineering | 3 | 0 | 0 | 3 | S/EM | ES | - | - | - |
| 10 | MEC2007 | Additive Manufacturing | 3 | 0 | 0 | 3 | F/EM | - | - | - | - |
| 11 | MEC3069 | Engineering Optimisation | 3 | 0 | 0 | 3 | S/EM | - | - | - | - |
| 12 | MEC3070 | Electronics Waste Management | 3 | 0 | 0 | 3 | F/S | ES | - | - | - |
| 13 | MEC3071 | Hybrid Electric Vehicle Design | 3 | 0 | 0 | 3 | S/EM | ES | - | - | - |
| 14 | MEC3072 | Thermal Management of Electronic Appliances | 3 | 0 | 0 | 3 | S/EM | - | - | - | - |
| 15 | MEC3200 | Sustainable Technologies and Practices | 3 | 0 | 0 | 3 | S/EM | - | - | - | - |
| 16 | MEC3201 | Industry 4.0 | 3 | 0 | 0 | 3 | S/EM | - | - | - | - |
| Petroleum Basket | | | | | | | | | | | |
| 1 | PET1011 | Energy Industry Dynamics | 3 | 0 | 0 | 3 | FC | ES | - | NIL | - |
| 2 | PET1012 | Energy Sustainability Practices | 3 | 0 | 0 | 3 | FC | ES | - | NIL | - |
| Physics Basket | | | | | | | | | | | |
| 1 | PHY1003 | Mechanics and Physics of Materials | 3 | 0 | 0 | 3 | FC / SD | | | | |
| 2 | PHY1004 | Astronomy | 3 | 0 | 0 | 3 | FC | | | | |
| 3 | PHY1005 | Game Physics | 2 | 0 | 2 | 3 | FC / SD | | | | |
| 4 | PHY1006 | Statistical Mechanics | 2 | 0 | 0 | 2 | FC | | | | |
| 5 | PHY1007 | Physics of Nanomaterials | 3 | 0 | 0 | 3 | FC | | | | |
| 6 | PHY1008 | Adventures in nanoworld | 2 | 0 | 0 | 2 | FC | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | PHY2001 | Medical Physics | 2 | 0 | 0 | 2 | FC | ES | | | |
| 8 | PHY2002 | Sensor Physics | 1 | 0 | 2 | 2 | FC / SD | | | | |
| 9 | PHY2003 | Computational Physics | 1 | 0 | 2 | 2 | FC | | | | |
| 10 | PHY2004 | Laser Physics | 3 | 0 | 0 | 3 | FC | ES | | | |
| 11 | PHY2005 | Science and Technology of Energy | 3 | 0 | 0 | 3 | FC | ES | | | |
| 12 | PHY2009 | Essentials of Physics | 2 | 0 | 0 | 2 | FC | | | | |
| Management Basket- I | | | | | | | | | | | |
| 1 | MGT2007 | Digital Entrepreneurship | 3 | 0 | 0 | 3 | S/EM/EN | - | - | - | - |
| 2 | MGT2015 | Engineering Economics | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 3 | MGT2023 | People Management | 3 | 0 | 0 | 3 | S/EM/ EN | HP | - | - | - |
| Management Basket- II | | | | | | | | | | | |
| 1 | MGT1001 | Introduction to Psychology | 3 | 0 | 0 | 3 | F | HP | - | - | - |
| 2 | MGT1002 | Business Intelligence | 3 | 0 | 0 | 3 | EN | - | - | - | - |
| 3 | MGT1003 | NGO Management | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 4 | MGT1004 | Essentials of Leadership | 3 | 0 | 0 | 3 | EM/ EN | GS/ HP | - | - | - |
| 5 | MGT1005 | Cross Cultural Communication | 3 | 0 | 0 | 3 | S/EM/ EN | HP | - | - | - |
| 6 | MGT2001 | Business Analytics | 3 | 0 | 0 | 3 | S/ EM/EN | - | - | - | - |
| 7 | MGT2002 | Organizational Behaviour | 3 | 0 | 0 | 3 | F | HP | - | - | - |
| 8 | MGT2003 | Competitive Intelligence | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 9 | MGT2004 | Development of Enterprises | 3 | 0 | 0 | 3 | S/EM/EN | - | - | - | - |
| 10 | MGT2005 | Economics and Cost Estimation | 3 | 0 | 0 | 3 | S/EM | - | - | - | - |
| 11 | MGT2006 | Decision Making Under Uncertainty | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 12 | MGT2008 | Econometrics for Managers | 3 | 0 | 0 | 3 | S | - | - | - | - |
| 13 | MGT2009 | Management Consulting | 3 | 0 | 0 | 3 | S/EM/EN | - | - | - | - |
| 14 | MGT2010 | Managing People and Performance | 3 | 0 | 0 | 3 | S/EM/EN | HP/GS | - | - | - |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | MGT2011 | Personal Finance | 3 | 0 | 0 | 3 | F | - | - | - | - |
| 16 | MGT2012 | E Business for Management | 3 | 0 | 0 | 3 | S/EM | - | - | - | - |
| 17 | MGT2013 | Project Management | 3 | 0 | 0 | 3 | EN / EM | GS/HP/ES | - | - | - |
| 18 | MGT2014 | Project Finance | 3 | 0 | 0 | 3 | EN / EM | HP | - | - | - |
| 19 | MGT2016 | Business of Entertainment | 3 | 0 | 0 | 3 | EM/ EN | - | - | - | - |
| 20 | MGT2017 | Principles of Management | 3 | 0 | 0 | 3 | S/EM/ EN | - | - | - | - |
| 21 | MGT2018 | Professional and Business Ethics | 3 | 0 | 0 | 3 | S/EM/ EN | HP | - | - | - |
| 22 | MGT2019 | Sales Techniques | 3 | 0 | 0 | 3 | S/EM/ EN | HP | - | - | - |
| 23 | MGT2020 | Marketing for Engineers | 3 | 0 | 0 | 3 | S/EM/ EN | HP | - | - | - |
| 24 | MGT2021 | Finance for Engineers | 3 | 0 | 0 | 3 | S/EM/ EN | HP | - | - | - |
| 25 | MGT2022 | Customer Relationship Management | 3 | 0 | 0 | 3 | S/EM/ EN | HP | - | - | - |
| Media Studies Basket | | | | | | | | | | | |
| 1 | BAJ3050 | Corporate Filmmaking and Film Business | 0 | 0 | 4 | 2 | EM | HP | - | - | - |
| 2 | BAJ3051 | Digital Photography | 2 | 0 | 2 | 3 | EM | HP | - | - | - |
| 3 | BAJ3055 | Introduction to News Anchoring and News Management | 0 | 0 | 2 | 1 | EM | - | - | - | - |

## 21. List of MOOC Courses for B.Tech (Computer Science and Engineering (Data Science ))

**21.1 Presidency University students are given the opportunity to study abroad in International Universities through a selection process coordinated by the Office of International Affairs (OIA). Such selected students need to complete their credits for the semester that they are abroad in the following way:**

**21.1 The student needs to study and complete School Core and Program Core Courses in offline mode only.**

**21.2** **Massive Open Online Course (MOOC) courses maybe given for Open Elective and Discipline Elective Courses. These courses need to be approved by the concerned BOS and Academic Council from time to time.**

**21.3** **SWAYAM/NPTEL/ other approved MOOCs shall be approved by the concerned Board of Studies and placed in the concerned PRC.**

**21.4** **Student shall register for these courses in the ERP of Presidency University.**

**21.5** **For these MOOC courses faculty coordinators are identified. These faculty should have undergone similar MOOC courses and therefore should be familiar with the mode of class conduction, types of assessments and evaluation procedures.**

**21.6** **Study materials shall be provided to the students as video lectures shared by the MOOCs Coordinator(s), or the students may access the approved MOOCs Portal directly. The mode of class conduction is determined by the MOOCs coordinator(s) as detailed in the Course Catalogue and Course Plan.**

**21.7** **The question paper shall be prepared by the MOOCs coordinator(s).**

**21.8** **Students write the exams in online mode. These exams are scheduled and conducted by the School.**

**21.9** **Results are evaluated by School and given to the Office of the Controller of Examinations (CoE).**

**21.10** **The details of the duration, credits and evaluation are given below:**

| Sl# | Duration | Credits | Evaluation |
|---|---|---|---|
| 1. | 12 weeks | 3 | Continuous Assessment –50 Marks<br>Mid Term –50 Marks<br>End Term-100 Marks |
| 2. | 8 weeks | 2 | Mid Term-50 Marks<br>End Term-100 Marks |
| 3 | 4 weeks | 1 | End Term-100 Marks |

## 21.2 MOOC - Discipline Elective Courses for B. Tech. Computer Science and Engineering -Data Science

**Table 3.5 : MOOC Discipline Elective Courses**

| Sl.No | Course Code | Course Name | Credits | L-T-P-C |
|---|---|---|---|---|
| 1. | CSE3111 | Artificial Intelligence: Search Methods for Problem Solving | 3 | 3-0-0-3 |
| 2. | CSE3112 | Privacy and Security in Online Social Media | 3 | 3-0-0-3 |
| 3. | CSE3113 | Computational Complexity | 3 | 3-0-0-3 |
| 4. | CSE3114 | Deep Learning for Computer Vision | 3 | 3-0-0-3 |
| 5. | CSE3115 | Learning Analytics Tools | 3 | 3-0-0-3 |
| 6. | CSE505 | The Joy of Computing Using Python | 3 | 3-0-0-3 |

| | | | | |
|---|---|---|---|---|
| 7. | CSE3119 | Coding Skills in Python | 3 | 3-0-0-3 |
| 8. | CSE3121 | Parallel Computer Architecture | 3 | 3-0-0-3 |
| 9. | CSE3124 | Games and Information | 3 | 3-0-0-3 |
| 10. | CSE3140 | Introduction to Industry 4.0 and Industrial Internet of Things | 3 | 3-0-0-3 |
| 11. | CSE3142 | Affective Computing | 3 | 3-0-0-3 |
| 12. | CSE3196 | Foundations of Cyber Physical Systems | 3 | 3-0-0-3 |
| 13. | CSE3197 | Getting Started with Competitive Programming | 3 | 3-0-0-3 |
| 14. | CSE3198 | GPU Architectures and Programming | 3 | 3-0-0-3 |
| 15. | CSE3199 | Artificial Intelligence: Knowledge Representation and Reasoning | 3 | 3-0-0-3 |
| 16. | CSE3200 | Programming in Modern C++ | 3 | 3-0-0-3 |
| 17. | CSE3201 | Circuit Complexity Theory | 3 | 3-0-0-3 |
| 18. | CSE3202 | Basics of Computational Complexity | 3 | 3-0-0-3 |
| 19. | CSE3212 | Introduction to Computer and Network Performance Analysis using Queuing | 1 | 1-0-0-1 |
| 20. | CSE3213 | C Programming and Assembly Language | 1 | 1-0-0-1 |
| 21. | CSE3214 | Python for Data Science | 1 | 1-0-0-1 |
| 22. | CSE3215 | Software Conceptual Design | 1 | 1-0-0-1 |
| 23. | CSE3117 | Industrial Digital Transformation | 3 | 3-0-0-3 |
| 24. | CSE3118 | Blockchain for Decision Makers | 3 | 3-0-0-3 |
| 25. | CSE3349 | Technology for Lawyers | 3 | 3-0-0-3 |
| 26. | CSE3430 | Deep Learning for Natural Language Processing | 3 | 3-0-0-3 |
| 27. | CSE3431 | Machine Learning for Engineering and Science Applications | 3 | 3-0-0-3 |
| 28. | CSE3432 | Algorithms in Computational Biology and Sequence Analysis | 3 | 3-0-0-3 |
| 29. | CSE3433 | Introduction to Large Language Models (LLMs) | 3 | 3-0-0-3 |
| 30. | CSE3434 | Quantum Algorithms and Cryptography | 3 | 3-0-0-3 |
| 31. | CAI3430 | Responsible & Safe AI Systems | 3 | 3-0-0-3 |
| 32. | CCS3416 | Practical Cyber Security for Cyber Security Practitioners | 3 | 3-0-0-3 |

| | | | | |
|---|---|---|---|---|
| 33. | IST3409 | Design & Implementation of Human-Computer Interfaces | 3 | 3-0-0-3 |

### 21.3 MOOC - Open Elective Courses for B. Tech. (Computer Science and Engineering (Data Science )

Table 3.6: MOOC Open Elective Courses
Courses duration is 4 weeks (01 credit)/ 8 weeks (02 credits)/ 12 weeks (03 credits)

| Sl. No. | Course Code | Course Name | Total Credits | L-T-P-C |
|---|---|---|---|---|
| 1 | BBA2022 | Supply Chain digitization | 3 | 3-0-0-3 |
| 2 | BBA2021 | E Business | 3 | 3-0-0-3 |
| 3 | BBB2016 | Business Analytics for Management Decisions | 3 | 3-0-0-3 |
| 4 | BBB2015 | Artificial Intelligence for Investments | 3 | 3-0-0-3 |
| 5 | MEC3001 | Design and Development of Product | 1 | 1-0-0-1 |
| 6 | ENG3004 | Perspectives of Neurolinguistics | 1 | 1-0-0-1 |
| 7 | PPS4009 | Working in Contemporary Teams | 1 | 1-0-0-1 |
| 8 | MGT3001 | Data Analysis and Decision Making | 3 | 3-0-0-3 |
| 9 | MEC3001 | Design and Development of Product | 1 | 1-0-0-1 |
| 10 | EEE3105 | Microsensors and Nanosensors | 3 | 3-0-0-3 |
| 11 | CIV3065 | Drone Systems and Cont¯rol | 3 | 3-0-0-3 |
| 12 | ECE3183 | Neural Networks for Signal Processing - I | 3 | 3-0-0-3 |
| 13 | CIVXXXX | Disaster Management | 3 | 3-0-0-3 |

MEC3001 is offered to the students who had 1 credit shortage because of implementation of CBCS system during their 1st year.

ENG3004 is offered to the students who had 2 credits shortage along with the MEC3001 because of implementation of CBCS System during their 1st year.

PPS4009 is offered to only International students in place of Interview Preparedness course of their batch mates.

### 22.Recommended Semester Wise Course Structure / Flow including the Programme / Discipline Elective Paths / Options

| Sl No | Course Code | Course Name | L | T | P | Credits | Contact hours | Basket |
|---|---|---|---|---|---|---|---|---|
| | Semester 1 - Physics Cycle | | | | | **17** | 28 | BSC |
| 1 | MAT1001 | Calculus and Linear Algebra | 3 | 0 | 2 | 4 | 5 | SC |
| 2 | PHY1002 | Optoelectronics and Device Physics | 2 | 0 | 2 | 3 | 4 | SC |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3 | ECE1001 | Elements of Electronics Engineering | 3 | 0 | 2 | 4 | 5 | SC |
| 4 | ENG1002 | Technical English | 1 | 0 | 2 | 2 | 3 | SC |
| 5 | PPS1001 | Introduction to soft skills | 0 | 0 | 2 | 1 | 2 | SC |
| 6 | CSE1004 | Problem Solving Using C | 1 | 0 | 4 | 3 | 5 | SC |
| 7 | CHE1018 | Environmental Science | 1 | 0 | 2 | 0 | 3 | SC |
| 8 | PPS1011 | Introduction to Verbal Ability | 0 | 1 | 0 | 0 | 1 | SC |
| | Semester 2 - Engineering Science Cycle | | | | | **16** | 21 | |
| 1 | MAT1003 | Applied Statistics | 1 | 0 | 2 | 2 | 3 | SC |
| 2 | ECE2007 | Digital Design | 2 | 0 | 2 | 3 | 4 | PC |
| 3 | CIV1008 | Basic Engineering Sciences | 2 | 0 | 0 | 2 | 2 | SC |
| 4 | MEC1006 | Engineering Graphics | 2 | 0 | 0 | 2 | 2 | SC |
| 5 | CSE1006 | Problem Solving using JAVA | 1 | 0 | 4 | 3 | 5 | SC |
| 6 | ENG2001 | Advanced English | 1 | 0 | 2 | 2 | 3 | SC |
| 7 | PPS1012 | Enhancing Personality Throughh Soft Skills | 0 | 0 | 2 | 1 | 2 | SC |
| 8 | ECE2010 | Innovative Projects Using Arduino | - | - | - | 1 | 0 | SC |
| | Course Code | Course Name | L | T | P | Cre dits | | |
| | Semester 3 | | | | | **28** | 33 | |
| 1 | MAT1002 | Transform Techniques, Partial Differential Equations and Their Applications | 3 | 0 | 0 | 3 | 3 | SC |
| 2 | CSE2001 | Data Structures and Algorithms | 3 | 0 | 2 | 4 | 5 | SC |
| 3 | CSE3155 | Data Communications and Computer Networks | 3 | 0 | 2 | 4 | 5 | PC |
| 4 | CSE2009 | Computer Organization and Architecture | 3 | 0 | 0 | 3 | 3 | PC |
| 5 | MAT2004 | Discrete Mathematical Structures | 3 | 0 | 0 | 3 | 3 | SC |
| 6 | CSE3190 | Fundamentals of Data Analytics | 2 | 0 | 2 | 3 | 4 | PC |
| 7 | CSE2014 | Software Engineering | 3 | 0 | 0 | 3 | 3 | PC |
| 8 | ECE2011 | Innovative Projects Using Rasperry Pi | - | - | - | 1 | 0 | SC |
| 9 | CSE1005 | Programming in Python | 1 | 0 | 4 | 3 | 5 | SC |
| 10 | PPS4002 | Introduction to Aptitude | 0 | 0 | 2 | 1 | 2 | SC |
| | Semester 4 | | | | | **23** | 25 | |
| 1 | MAT2003 | Numerical Methods for Engineers | 1 | 0 | 2 | 2 | 3 | SC |
| 2 | CSE2007 | Design and Analysis of Algorithms | 3 | 0 | 0 | 3 | 3 | PC |
| 3 | CSE3156 | Database Management System | 3 | 0 | 2 | 4 | 5 | PC |
| 4 | CSE3351 | Operating Systems | 3 | 0 | 0 | 3 | 3 | PC |
| 5 | CSE3078 | Cryptography and Network Security | 3 | 0 | 0 | 3 | 3 | PC |
| 6 | CSEXXX X | Discipline Elective – I | 3 | 0 | 0 | 3 | 3 | DE |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7 | XXXXXX X | Open Elective – I | 3 | 0 | 0 | 3 | 3 | OE |
| 8 | PPS4004 | Aptitutde Training Intermediate | 0 | 0 | 2 | 1 | 2 | SC |
| 9 | CSE3216 | Mastering Object-Oriented Concepts in Python | 0 | 0 | 2 | 1 | 2 | SC |
| | Semester 5 | | | | | **25** | | |
| 1 | AID2007 | Exploratory Data Analysis | 2 | 0 | 0 | 2 | 2 | PC |
| 2 | AID2008 | Exploratory Data Analysis lab | 0 | 0 | 2 | 1 | 2 | PC |
| 3 | CSD1712 | Statistical Foundations of Data Science | 3 | 0 | 0 | 3 | 3 | PC |
| 4 | CSD2002 | Introduction to Data Science | 3 | 0 | 0 | 3 | 3 | PC |
| 5 | CSEXXX | Discipline Elective – II | 3 | 0 | 0 | 3 | 3 | DE |
| 6 | CSE3512 | Data Mining | 3 | 0 | 0 | 3 | 3 | PC |
| 7 | CSEXXX | Discipline Elective – III | 3 | 0 | 0 | 3 | 3 | DE |
| 8 | CSD2016 | Data Ethics and Privacy: | 2 | 0 | 0 | 2 | 2 | PC |
| 9 | CSD1713 | Statistical Foundations of Data Science Lab | 0 | 0 | 2 | 1 | 2 | PC |
| 10 | AID2004 | Machine Learning for Intelligent data Science | 2 | 0 | 0 | 2 | 2 | PC |
| 11 | CSE7000 | Internship | 0 | 0 | 0 | 2 | 0 | SC |
| 12 | CIV7601 | Universal Human Values and Ethics | 0 | 0 | 0 | 0 | S | School Core |
| 13 | APT 4006 | Logical and Critical Thinking | 0 | 0 | 2 | 0 | 2 | HSMC |
| | **Semester 6** | | | | | **24** | | |
| 1 | CSD2501 | Predictive Analytics | 2 | 0 | 0 | 2 | 2 | PC |
| 2 | AID1705 | Explainable AI (XAI) | 3 | 0 | 0 | 3 | 3 | PC |
| 3 | CSD2014 | Deep Learning for Data Science | 3 | 0 | 0 | 3 | 3 | PC |
| 4 | CSD1705 | Cloud Computing for Data Science | 2 | 0 | 0 | 2 | 2 | PC |
| 5 | CSD1709 | Edge AI and IoT Analytics | 3 | 0 | 0 | 3 | 3 | PC |
| 6 | CSD2502 | Predictive Analytics Lab | 0 | 0 | 2 | 1 | 2 | PC |
| 7 | CSD2015 | Deep Learning for Data Science Lab | 0 | 0 | 2 | 1 | 2 | PC |
| 8 | CSEXXX X | Discipline Elective IV | 3 | 0 | 0 | 3 | 3 | DE |
| 9 | CSE1706 | Cloud Computing for Data Science Lab | 0 | 0 | 2 | 1 | 2 | PC |
| 10 | XXXXXX X | Open Elective – II | 3 | 0 | 0 | 3 | 3 | OE |
| 11 | APT4026 | Aptitude For Employability | 0 | 0 | 2 | 0 | | HSMC |
| 12 | CSE2510 | Competitive Programming and Problem Solving | 0 | 0 | 4 | 2 | 4 | SC |

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|---|---|---|---|---|---|---|---|---|
| 13 | LAW7601 | Indian Constitution | 0 | 0 | 0 | 0 | | School Core |
| | Semester 7 | | | | | **17** | | |
| 1 | XXXXXX X | Open Elective – III | 3 | 0 | 0 | 3 | 3 | OE |
| 2 | AID1707 | Generative AI and Prompt Engineering | 3 | 0 | 0 | 3 | 3 | PC |
| 3 | CSEXXX X | Discipline Elective –V | 3 | 0 | 0 | **3** | **3** | **DE** |
| 4 | CSEXXX X | Discipline Elective –VI | 3 | 0 | 0 | 3 | 3 | DE |
| 5 | CSE7101 | Mini Project | - | - | - | 5 | | SC |
| 6 | PPS 4027 | Preparedness for Interview | 0 | 0 | 2 | 0 | 2 | HSMC |
| | Semester 8 | | | | | 10 | | |
| 1 | CSE7300 | Capstone Project | - | - | - | 10 | | SC |

## Course Catalogue

| **Course Code: MAT1001** | **Course Title: Calculus and Linear Algebra**<br><br>**Type of Course: School Core Lab Integrated** | **L-T- P-C** | **2** | **1** | **2** | **4** |
|---|---|---|---|---|---|---|
| **Version No.** | 3.0 | | | | | |
| **Course Pre-requisites** | Basic Concepts of Limits, Differentiation, Integration | | | | | |
| **Anti-requisites** | **NIL** | | | | | |
| **Course Description** | The course focuses on the concepts of calculus and linear algebra with reference to specific engineering problems. The course is of both conceptual and analytical type in nature. The lab sessions associated with the course are concerned with acquiring an ability to use the MATLAB software. | | | | | |
| **Course Objective** | The objective of the course is **Skill Development** of student by using **Problem Solving Techniques.** | | | | | |
| **Course Out Comes** | On successful completion of the course the students shall be able to:<br>1) Comprehend the knowledge of applications of matrix principles. | | | | | |

| | | | | |
|---|---|---|---|---|
| | 2) Understand the concept of partial derivatives and their applications.<br>3) Apply the principles of integral calculus to evaluate integrals.<br>4) Adopt the various analytical methods to solve differential equations.<br>5) Demonstrate the use of MATLAB software to deal with a variety of mathematical problems. | | | |
| **Course Content:** | | | | |
| **Module 1** | **Linear Algebra** | | | **10 Classes** |
| Review: Types of matrices, elementary transformations, rank of a matrix, normal form, Solution of systems of linear equations: (Homogenous and non-homogenous system) AX = O and AX = B using rank method.<br>**Linear Algebra:**<br>Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.<br>Engineering Applications of Linear Algebra | | | | |
| **Module 2** | **Partial Derivatives** | | | **10 CLASSES** |
| eview: Differential calculus with single variable.<br>**Partial Derivatives:**<br>Homogeneous functions and Euler‘s theorem, Total derivative, Change of variables, Jacobians, Partial differentiation of implicit functions, Taylor‘s series for functions of two variables, Maxima and minima of functions of two variables, Lagrange‘s method of undetermined multipliers.Engineering Applications of partial derivatives. | | | | |
| **Module 3** | **Advanced Integral calculus** | | | **12 Classes** |
| Review: Integral calculus for single integrals.<br>**Advanced Integral calculus:**<br>Beta and Gamma functions–interrelation-evaluation of integrals using gamma and beta functions; error function-properties. Multiple Integrals- Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane | | | | |

curves, evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical polar co-ordinates.

Engineering applications of partial derivatives.

| **Module 4** | **Ordinary Differential Equations** | **Assignment** | **Programming** | **12 Classes** |
|---|---|---|---|---|

Review: First order and first-degree Ordinary Differential Equations, Method of separation of variables, Homogeneous and Non- Homogeneous Equations reducible to Homogeneous form.

Linear Differential Equations, Bernoulli's Differential Equation, Exact and Non- Exact Differential Equations, Higher order Differential Equation with constant coefficients and with right hand side of the form $e^{ax}$, sinax, cosax, $e^{ax}f(x)$, $x^nf(x)$ etc., Linear equations with variable coefficients such as Cauchy Equation and Lagrange's Equation, D-operators and Inverse D- operators, Method of Variation of Parameters.

Engineering applications of differential equations.

**List of Laboratory Tasks:**

Introductory Task: Introduction to usage of the software and simple programming tasks. [ 3 Sessions]
Experiment N0 1: Solution of Simple differentiation with single variable and use of chain Rule.
Experiment No. 2: Solution based on application of Tailors' Series using software
Experiment No. 3: Application of Maxima and Minima condition using software.
Experiment No. 4 Computation of different functions for a specific problem
Experiment No. 5 Computation of Area under a curve.
Experiment No. 6 Solution of a set of simultaneous equations in matrix method
Experiment No. 7 Computation of Eigen Values and Eigen Vectors.
Experiment No. 8 Solution of Partial Differential equation
Experiment No. 9 solution using Cauchy Equation and Lagrange's Equation

Targeted Application & Tools that can be used:
The contents of this course has direct applications in most of the core engineering courses for problem formulations, Problem Solution and system Design.
Tools Used: MatLab, Zylink.

**Assignment:**

1. List at least 3 sets of Matrix Applications concerning the respective branch of

Engineering and obtain the solution using MATLAB.

2. Select any one simple differential equation pertaining to the respective branch of engineering, identify the dependent and independent variable – Obtain the solution and compare the solution sets by varying the values of the dependent variable.

**Text Book**

1. Sankara Rao, Introduction to Partial differential equations, Prentice Hall of India, edition, 2011
2. B. S. Grewal (2017), Higher Engineering Mathematics by, 44th Edition, Khanna Publishers.

**References:**


1. Victor Henner, Tatyana Belozerova, Mickhail Khenner, Ordinary and Partial Differential Equations, CRC Press, Edition, 2013.
2. Walter Ledermann, Multiple integrals, Springer, 1st edition
3. Lay, Linear Algebra ansd its applications, 3rd Ed., 2002, Pearson Education India.
4. Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley and sons, Inc.10th Edition
5. MatLab usage manual


**E-resources/ Web links:**

1. https://nptel.ac.in/courses/109104124

2. https://nptel.ac.in/courses/111106051

3. https://nptel.ac.in/courses/111102137

4. https://www.cuemath.com/learn/mathematics/algebra-vs-calculus/

5. https://stanford.edu/~shervine/teaching/cs-229/refresher-algebra-calculus

6. https://math.hmc.edu/calculus/hmc-mathematics-calculus-online-tutorials/linear-algebra/

7. https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html

8. https://www.scu.edu.au/study-at-scu/units/math1005/2022/

**Topics relevant to the development of Foundation Skills: All solution methods**

**Topics relevant to development of Employability skills: Use of Matlab software.**

| **Course Code:** | **Course Title: Optoelectronics and Device Physics** | L-T-P-C | 2-0-2-3 |
|---|---|---|---|

| | | | |
|---|---|---|---|
| **PHY1002** | **Type of Course: 1] School Core & Laboratory integrated** | | |
| **Version No.** | 1.0 | | |
| **Course Pre-requisites** | **NIL** | | |
| **Anti-requisites** | **NIL** | | |
| **Course Description** | The purpose of this course is to enable the students to understand the fundamentals, working and applications of optoelectronic devices and to develop the basic abilities to appreciate the applications of advanced microscopy and quantum computers. The course develops the critical thinking, experimental and analytical skills. The associated laboratory provides an opportunity to validate the concepts taught and enhances the ability to use the concepts for technological applications. The laboratory tasks aim to develop following skills: **An attitude of enquiry, confidence and ability to tackle new problems, ability to interpret events and results, observe and measure physical phenomena, select suitable equipment, instrument and materials, locate faults in systems.** | | |
| **Course Out Comes** | On successful completion of the course the students shall be able to:<br><br>CO1: Describe the concepts of semiconductors, magnetic materials and superconductors.<br><br>CO2: Apply the concept of materials in the working of optoelectronic and magnetic devices.<br><br>CO3: Discuss the quantum concepts used in advanced microscopy and quantum computers.<br><br>CO4: Explain the applications of lasers and optical fibers in various technological fields.<br><br>CO5: Interpret the results of various experiments to verify the concepts used in optoelectronics and advanced devices. **[Lab oriented].** | | |
| **Course Objective** | The objective of the course is to familiarize the learners with the concepts of "Optoelectronics and device physics "and attain **Skill Development** through **Experiential Learning** techniques | | |

| | | | | |
|---|---|---|---|---|
| **Course Content:** | | | | |
| **Module 1** | **Fundamentals of Materials.** | Assignment | Plotting of magnetization (M) v/s Magnetic field (H) for diamagnetic, paramagnetic and ferromagnetic materials using excel/ origin software. | **No. of Classes: 07** |
| | Topics: Concept of energy bands, charge carriers, carrier concentration, concept of Fermi level, Hall effect, Magnetic materials, Superconductors: | | | |
| **Module 2** | **Advanced Devices and applications** | Assignment | Data collection on efficiency of solar cells. | **No. of Classes: 8** |
| | Topics: p-n junctions, Zener diode, transistor characteristics, Optoelectronic devices:, Solar cells, I-V characteristics, and LEDs | | | |
| **Module 3** | **Quantum concepts and Applications** | Term paper | Seminar on quantum computers. | **No. of classes: 8** |
| | Topics: Planck's quantum theory, applications of Quantum theory: de-Broglie hypothesis, matter waves, properties. de-Broglie wavelength associated with an electron. Heisenberg's uncertainty principle. Schrodinger time independent wave equation. Particle in a box | | | |
| **Module 4** | **Lasers and Optical fibers** | Term paper | Case study on medical applications of Lasers. | **No. of classes :07** |
| | Topics: Interactions of radiations with matter, Characteristics of laser, conditions and requisites of laser, Modern day applications of laser: LIDAR, LASIK, Cutting, Welding and Drilling.<br><br>Principle of optical fibers, Numerical aperture and acceptance angle (Qualitative), Attenuation, Applications: Point to point communication with block diagram, application of optical fibers in endoscopy. | | | |
| | List of Laboratory Tasks:<br>Experiment No. 1: Experimental errors and uncertainty using excel<br>Level 1: Calculation of accuracy and precision of a given data | | | |

| | |
|---|---|
| | Level 2: propagation of errors in addition, subtraction, multiplication and division.<br><br>Experiment N0 2: To determine the wavelength of semiconductor diode Laser and to estimate the particle size of lycopodium powder using diffraction.<br><br>Level 1: Determination of Wavelength of Laser<br>Level 2: Finding the particle size of lycopodium powder.<br>Experiment No. 3: To determine the proportionality of Hall Voltage, magnetic flux density and the polarity of Charge carrier.<br>Level 1: To determine the proportionality of Hall Voltage and magnetic flux density<br>Level 2: To determine the polarity of Charge carrier.<br><br>Experiment No. 4: To study the I-V characteristics of a given zener diode in forward and reverse bias conditions.<br><br>Level 1: To study I –V characteristics of the given Zener diode in reverse bias and to determine break down voltage.<br>Level 2: To study I –V characteristics of the given Zener diode in forward bias and to determine knee voltage and forward resistance.<br><br>Experiment No. 5: To study input and output characteristics of a given Transistor.<br><br>Level 1: To determine the input resistance of a given transistor.<br>Level 2: To determine current transfer characteristics and transistor parameters of a given transistor.<br><br>Experiment No. 6: Determination of Fermi energy and Fermi temperature of a given metal and bimetallic wire.<br><br>Level 1: Determination of Fermi energy and Fermi temperature of given metal wire.<br><br>Level 2: Determination of Fermi energy and Fermi temperature of given bimetallic wire.<br><br>Experiment No. 7: To study the current vs voltage characteristics of CdS photo-resistor at constant irradiance and To measure the photo-current as a function of the irradiance at constant voltage.<br><br>Level 1 To study the current vs voltage characteristics of CdS photo-resistor at constant irradiance.<br>Level 2: To measure the photo-current as a function of the irradiance at constant voltage.<br>Experiment No. 8: To study the I-V characteristics and I-R characteristics of a solar cell as a function of the irradiance.<br>Level 1: To study the I-V characteristics<br>Level 2: I-R characteristics of a solar cell as a function of the irradiance. |

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|---|---|
| | Experiment No. 9: Calculate the numerical aperture and study the losses that occur in optical fiber cable. .<br>Level 1: Calculate the numerical aperture.<br>Level 2: study the losses that occur in optical fiber cable.<br>Experiment No. 10: To determine the magnetic susceptibility of a given diamagnetic and paramagnetic substances using Quincke's method.<br>Level 1: To determine the magnetic susceptibility of a given diamagnetic substance.<br>Level 2: To determine the magnetic susceptibility of a given paramagnetic substance.<br>Experiment No. 11: Plotting I-V characteristics in forward and reverse bias for LEDs<br>and Determination of knee voltage.<br>Level 1: Plotting I-V characteristics in forward and reverse bias for LEDs<br>Level 2: Determination of knee voltage.<br>Experiment No. 12: Determination of Stefan's constant and verification of Stefan-Boltzmann Law.<br>Level 1: Determination of Stefan's constant<br>Level 2: Verification of Stefan-Boltzmann Law. |
| | **Targeted Application & Tools that can be used:**<br>1. Areas of application are optoelectronics industry, Solar panel technologies, quantum computing software, electronic devices using transistors and diodes, memory devices, endoscopy, SQUIDS in MRI, Advanced material characterizations using SEM and STM.<br>**2.** Origin, excel and Mat lab soft wares for programming and data analysis. |
| | **Project work/Assignment: Mention the Type of Project /Assignment proposed for this course** |
| | **Assessment Type**<br>• Midterm exam<br>• Assignment (review of digital/ e-resource from PU link given in references section - mandatory to submit screen shot accessing digital resource.)<br>• Quiz<br>• End Term Exam<br>• Self-Learning<br>1. Prepare a comprehensive report on non-conventional energy resources in Karnataka and their pros and cons.<br>2. Write a report on importance of quantum entanglement in supercomputers. |

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|---|---|
| | **Text Book**<br>1. Engineering Physics by Avadhanalu, Revised edition, S. Chand Publications,2018. |
| | **References:** 1. Elementary Solid state Physics: Principles and Applications by M.A. Omar, 1st Edition, Pearson Publications, 2002.<br>2. Principles of Quantum Mechanics by R Shankar, 2nd edition, springer Publications, 2011.<br>3. Optoelectronics: An Introduction by John Wilson and John Hawkes, 3rd edition, Pearson Publications, 2017.<br>4. Engineering Physics by Gaur and Gupta, Dhanpat Rai Publications, 2012.<br>5. Introduction to Quantum Mechanics, David J Griffiths, Cambridge University Press, 2019 |
| | **E-Resourses:**<br>1. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=553045&site=ehost-live<br>2. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=833068&site=ehost-live<br>3. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=323988&site=ehost-live<br>4. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1530910&site=ehost-live<br>5. https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=486032&site=ehost-live |
| | **Topics relevant to "SKILL DEVELOPMENT": Fundamentals of materials, Lasers and optical fibers.**<br>for Skill Development through Participative Learning Techniques. This is attained through the Assignment/ Presentation as mentioned in the assessment component in course handout. |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Course Code:**<br>**ECE1001** | **Course Title: Elements of Electronics Engineering**<br>**Type of Course: School Core Theory & Integrated Laboratory** | **L-T-P-C** | 3 | 0 | 2 | 4 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | NIL | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Anti-requisites** | Nil | | | | |
| **Course Description** | The purpose of this course is to enable the students to learn the fundamental concepts of electronic devices and circuits. The course aims at nurturing the students with the fundamental principles of electronics engineering, prevailing in various engineering applications. The nature of the course is conceptual and analytical which imparts knowledge of electronic components and their behavior under various operating conditions. The course develops thinking skills of the students, encouraging their quest for knowledge about electronic devices and their usage in higher semester courses.<br><br>The associated laboratory provides an opportunity to validate the concepts taught in theory classes and enable the students to work with basic electronic circuits using electronics components. | | | | |
| **Course Objectives** | The objective of the course is to familiarize the learners with the concepts of Elements of Electronics Engineering and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING<br>. | | | | |
| **Course Outcomes** | On successful completion of this course the students shall be able to:<br><br>Identify various electrical and electronic components and basic electrical laws.<br>Explainapplications of Diodes and BJTs.<br>Summarize the concepts of Digital Electronics and Communication Systems.<br>Discuss the basic concepts of microprocessorand computer organization.<br>Perform experiments to familiarizevarious Electrical & Electronic components and equipment.<br>Verify Basic Electrical Circuit configurations and Laws. | | | | |
| **Course Content:** | | | | | |
| **Module 1** | Basic Electrical and Electronic Components | Assignment / Quiz | | Identification of Practical electronic and electrical components / Memory Recall based Quizzes | 10 Sessions |
| Topics:<br><br>ELECTRICAL CIRCUITS AND LAWS:DC Circuits: Classification of Electrical Elements, Ohm's law, Series and Parallel Circuits, Kirchhoff's Voltage and Current laws, Power and Energy, Transformers and their types.<br><br>ELECTRONIC MATERIALS AND COMPONENTS: Conductors, Insulators, Semi-Conductor Material, P-N Junction diode, Characteristics and Parameters, Ideal Diode approximations, DC load line. | | | | | |
| **Module 2** | Applications of Diodes and Introduction to BJT | Assignment / Quiz | | Simulation Task/ Memory Recall based Quizzes | 12 Sessions |

Topics:

RECTIFIERS: Half-wave rectifier, Two-diode Full-wave rectifier, Bridge rectifier, Capacitor filter circuit (only qualitative approach).

ZENER DIODE: Zener diode, Zener Characteristics, Zener diode as a voltage regulator.

BIPOLAR JUNCTION TRANSISTORS: BJT Construction and Operation, BJT Voltages and Currents, Common Base, Common Emitter Configuration and Characteristics, Current amplification Factor alpha and beta, DC Load line w.r.t. fixed bias circuit (Q-Point), AC Analysis.

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|---|---|---|---|---|---|
| **Module 3** | Digital Electronics and Communication System | Assignment / Quiz | | Simulation Task / Memory Recall based Quizzes | 13 Sessions |

Topics:

NUMBER SYSTEMS: Decimal Number System, Binary Number System, Hexadecimal Number System, Conversions: Binary to and from Hexadecimal; Hexadecimal to and from Decimal;1's and 2's Complement of Binary Numbers, Binary Addition.

BOOLEAN ALGEBRA: Boolean Laws and Theorems, De Morgan's theorem. Digital Circuits: Logic gates, NOT Gate, AND Gate, OR Gate, XOR Gate, X-NOR Gate, NAND Gate, NOR Gate.

COMMUNICATION SYSTEM: Block diagram of communication system, Modulation: Definition of Modulation, Need of Modulation, Types of Modulation: Amplitude Modulation and Frequency Modulation (Waveforms only).

| | | | | |
|---|---|---|---|---|
| **Module 4** | Microprocessors and Computer Organization | Assignment / Quiz | Memory recall based Quizzes | 10 Sessions |

Topics:

INTEL 8085 MICROPROCESSOR: Basic Architecture and features of 8085 Microprocessor.

COMPUTER ORGANISATION:Basic structure of Computer Organisation describing the various Computer types, Functional Units, Basic Operational concepts, Bus Structures, Memory System: RAM and ROM.

List of Laboratory Tasks:

Experiment No. 1:Study of Resistors, Measuring instruments and DC Power Supply.

Level 1:Identification of resistor values from color bands and verification with Multimeter.

Level 2:Connecting a resistive circuit to a DC Power Supply and observing the input and output values using Voltmeters, Ammeters and hence calculate resistance values.

Experiment No. 2:Study of Reactive components, Multimeter, CRO and Function Generator.

Level 1:Identification of various types of capacitive and inductive components and verification with Multimeter.

Level 2:Connecting a reactive circuit to a function generator and observing the input and output waveform on CRO and calculation of Reactance and Impedance.

Experiment No. 3: Study of Ohm's Law.

Level 1:Rig up the circuit and verify Ohm's Law.

Level 2: Connect a 100Ω Resistor to a Voltage source of 0-5V. Plot a V- I graph by tabulating the Voltage Vs Current Values accordingly. Repeat the experiment for 1KΩ resistor and compare the results.

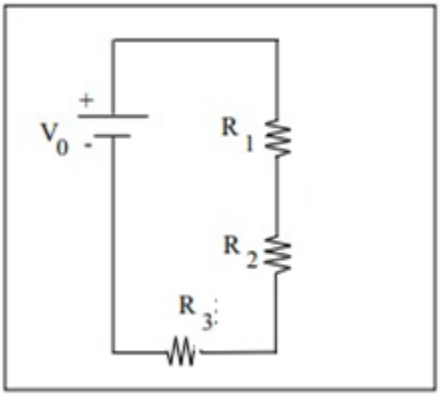
Experiment No. 4:Study of Series and Parallel Resistor Connections.

Level 1:Carry out the equivalent resistance of given four resistors 100Ω each connected in series and parallel combination using breadboard.

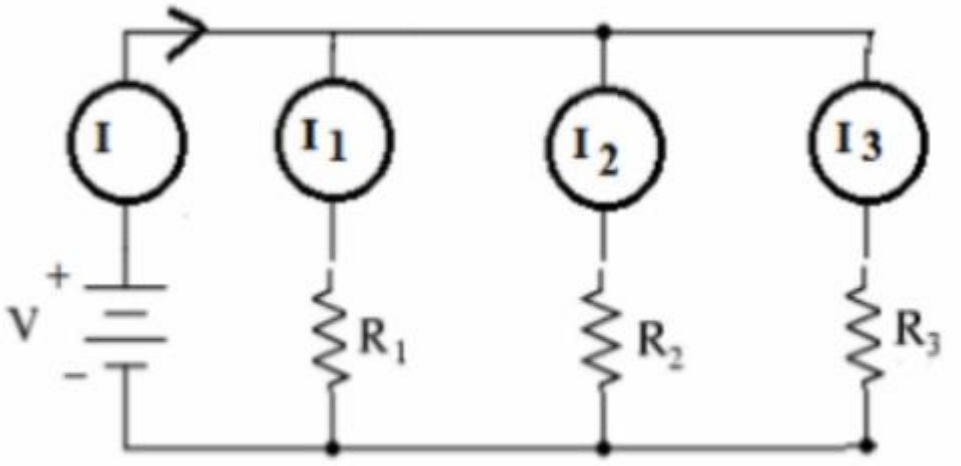
Level 2:Rig up a Current Divider Circuit and a Voltage Divider Circuit and verify the results.

Experiment No. 5:Study of Kirchhoff's Voltage Law and Kirchhoff's Current Law.

Level 1:Verify KVLand KCL with circuit(a) and circuit(b) with #values.

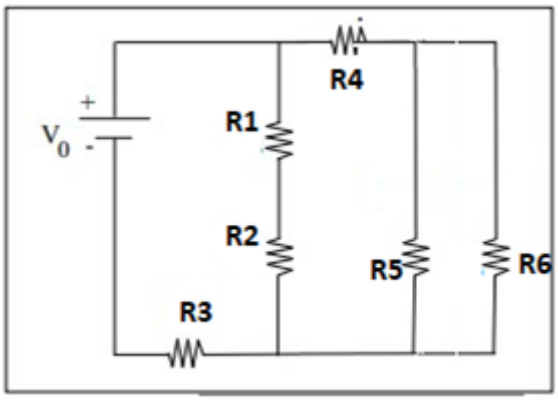



(a)




(b)

Level 2: Verify KCL with the help of given circuit having # values and carry out the equivalent resistance of the circuit by experimental and analytical methods.




Experiment No. 6: Study of PN-Junction Diode Characteristics in Forward and Reverse Bias Conditions.

Level 1:Carry out the experiment to find cut-in voltage on forward characteristics for Silicon P-N Junction diode.

Level 2: Carry out experiment to plot VI Characteristics of Silicon P-N Junction Diode in both forward and reverse biased conditions for Si P-N Junction diode.

Experiment No. 7: Study of Bipolar Junction Transistor in different regions of operation.

Level 1:Carry out the experiment to understand the importance of active, cut off and saturation regions.

Level 2: Carry out the experiment to design and analyze the operation of transistor as switch.

Experiment No. 8: Study of basic Digital Logic Gates using Integrated Chips IC's: NOT, AND, OR, XOR, NAND and NOR Gates

Level 1:Carry out the experiment to study and verify the truth table of logic gates using Digital ICs.

Level 2:Implementation of operation of a basic Boolean expression using basic gates.

Experiment No. 9: Study of Computer Organization: Identification of Components on Motherboard: CPU: Processor Chips (Processor Socket), PCI, Parallel Ports, Universal Serial Bus: USB, I/O Connectors, RAM Slots.

Level 1:Carry out the experiment to familiarize a computer system layout and mark the positions of SMPS, Motherboard, FDD, HDD, CD / DVD drive and add on cards.

Level 2:Study of a Desktop PC and its assembling.

Targeted Application & Tools that can be used:

Student will be able to find career opportunities in various domains such asAnalog Electronics, Digital Electronics, Microprocessors, VLSI Design, Telecommunication, Computers andWireless

Communication. The students will be able to join a profession which involves basics to high level of electronic circuit design.

Professionally Used Software: MultiSim/ PSpice

Besides these software tools hardware equipment such as Multimeters, Function Generators, Power Supplies, Oscilloscopes etc., can be used to perform component/circuit testing and analysis.

Textbook(s):

T1. John Hiley, Keith Brown and Ian McKenzie Smith, *"Hughes Electrical and Electronic Technology",* Pearson,12th Edition

T2.William Stallings,"Computer Organization and Architecture Designing for Performance", Pearson Education, 10th Edition.

Reference(s):

Reference Book(s):

R1. Smarajit Ghosh, *"Fundamentals of Electrical and Electronics Engineering*", PHI, 2nd Edition

R2. D.P. Kothari, I. J. Nagrath, *"Basic Electronics",* McGraw Hill Education, 1st Edition

R3. Rajendra Prasad, *"Fundamentals of Electronics Engineering",* Cengane Learning, 3rd Edition

Online Resources (e-books, notes, ppts, video lectures etc.):

Video lectures on "BASIC ELECTRONICS" by Prof. Dr. Chitralekha Mahanta, Department of Electronics and communication Engineering, IIT Guwahati": https://nptel.ac.in/courses/117/103/117103063/

Lecture Series on " Useful Laws in Basic Electronics" by Prof. T.S.Natarajan, Department of physics, IIT Madras: https://www.youtube.com/watch?v=vfVVF58FtCc

Lecture Series on "Introduction to Bipolar Junction Transistors BJT " by All About Electronics Youtube Channel: https://www.youtube.com/watch?v=-VwPSDQmdjM&list=PLwjK_iyK4LLDoFG8FeiKAr3IStRkPSxqq

Lecture Series on " PN Junction Diode " by All About Electronics Youtube Channel: https://www.youtube.com/watch?v=USrY0JspDEg

Lecture Series on "Introduction to Digital Electronics" by All About Electronics Youtube Channel: https://www.youtube.com/watch?v=DBTna2ydmC0&list=PLwjK_iyK4LLBC_so3odA64E2MLgIRKafl

Lecture Series on "Introduction to Microprocessors" by Bharat Acharya Education :https://www.youtube.com/watch?v=0M74z5jEAyA

Lecture Notes on : "Electronic Devices", Bipolar Junction Transistors, 2nd Chapter, by Shree Krishna Khadka (PDF) Bipolar Junction Transistor (researchgate.net)https://www.researchgate.net/publication/323384291_Bipolar_Junction_Transistor

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|---|
| E-content:<br><br>V. Milovanovic, R. van der Toorn, P. Humphries, D. P. Vidal and A. Vafanejad, "Compact model of Zener tunneling current in bipolar transistors featuring a smooth transition to zero forward bias current," *2009 IEEE Bipolar/BiCMOS Circuits and Technology Meeting*, 2009, pp. 99-102, doi: 10.1109/BIPOL.2009.5314134. https://ieeexplore.ieee.org/document/5314134<br><br>M. Oueslati, H. Garrab, A. Jedidi and K. Besbes, "The advantage of silicon carbide material in designing of power bipolar junction transistors," 2015 IEEE 12th International Multi-Conference on Systems, Signals & Devices (SSD15), 2015, pp. 1-6. https://ieeexplore.ieee.org/document/7348149<br><br>H. Luo, F. Iannuzzo, F. Blaabjerg, X. Wang, W. Li and X. He, "Elimination of bus voltage impact on temperature sensitive electrical parameter during turn-on transition for junction temperature estimation of high-power IGBT modules," *2017 IEEE Energy Conversion Congress and Exposition (ECCE)*, 2017, pp. 5892-5898 https://ieeexplore.ieee.org/document/8096974<br><br>F. Bauer, I. Nistor, A. Mihaila, M. Antoniou and F. Udrea, "Super junction IGBT Filling the Gap Between SJ MOSFET and Ultrafast IGBT," in *IEEE Electron Device Letters*, vol. 33, no. 9, pp. 1288-1290, Sept. 2012 https://ieeexplore.ieee.org/document/6246672<br><br>https://presiuniv.knimbus.com/user#/home |
| Topics relevant to "SKILL DEVELOPMENT": Electrical & Electronic component and laws, Fundamentals of Digital Electronics, Communication Systems, Microprocessors and Computer Organization for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout. |

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|---|---|---|---|
| **Course Code: ENG1002** | **Course Title: Technical English**<br>**Type of Course:1] School Core**<br>**2] Laboratory integrated** | **L-T-P-C** | 1-0-2-2 |
| **Version No.** | 1.0 V. 3 | | |
| **Course Pre-requisites** | Intermediate Level English | | |
| **Course Anti-requisites** | NIL | | |
| **Course Description** | Technical English course is designed to equip students with the language skills necessary for effective communication in technical and scientific contexts. The course focuses on the specialized vocabulary, writing styles, and communication techniques used in various technical fields, including engineering and information technology. | | |
| **Course Objectives** | The objective of this course is to develop the learners' **EMPLOYABILITY SKILLS** by using **EXPERIENTIAL LEARNING** and **PARTICIPATIVE LEARNING TECHNIQUES.** | | |

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| **Course Outcomes** | **On successful completion of the course, the students shall be able to:**<br>1. Develop proficiency in using technical vocabulary and terminology.<br>2. Apply language skills for better speaking skills in technical fields.<br>3. Write technical descriptions<br>4. Demonstrate writing skills in writing technical documents such as reports, manuals, and articles. | | | |
| **Course Content:** | | | | |
| **Module 1** | **Fundamentals of Technical Communication** | **Worksheets& Quiz** | **Vocabulary building** | **9 Classes** |
| Introduction to Technical English<br>Differences between Technical English and General English<br>Technical Writing Basics<br>Technical Vocabulary | | | | |
| **Module 2** | **Technical Presentation** | **Presentations** | **Speaking Skills** | **12 Classes** |
| **Introduction ,**Planning the Presentation ,Creating the Presentation ,Giving the Presentation | | | | |
| **Module 3** | **Technical Description** | **Assignment** | **Group Presentation** | **12 Classes** |
| Product Description ,Process Description ,User Manuals ,Transcoding: Diagrams, charts and images | | | | |
| **Module 4** | **Technical Writing** | **Assignment** | **Writing Skills** | **12 Classes** |
| **Email Writing,**Persuasive and Descriptive Language ,Professional Email Etiquette ,Writing clear and concise technical emails<br>Communicating technical information effectively ,**Technical Report Writing,**Types of technical reports (Lab reports, research reports, etc.),Components of technical reports,Writing an abstract and executive summary,Structure and content organization<br>Transcoding: diagrams, charts and images | | | | |
| **List of Laboratory Tasks:**<br>1. Module-1<br>Level 1: Worksheets<br>Level 2: Worksheets<br>2. Module 2<br>Level 1: Preparing Presentation<br>Level 2: Giving Presentation (Individual)<br>3. Module-3<br>Level 1: Product Description & User Manual | | | | |

Level 2: Process Description & Transcoding

4. Module 4

Level 1: Email Writing

Level 2: Report Writing

**Targeted Applications & Tools that can be used:**

1. Flipgrid
2. Quizzes
3. Youtube Videos
4. Podcast

**Project work/Assignment: Mention the Type of Project /Assignment proposed for this course**

**Bring out the essence of technical communication with reference to the conventions of technical communication, with examples**

**Prepare a technical presentation on the importance of Technical Communication and its relevance in a technical field, with real-life examples.**

**The following individual, as well as group Assignments, will be given to the students.**

1. **Presentation**
2. **Describing a product/process**
3. **Individual Reports**

**Text Books**


1. Kumar, Sanjay; Pushpalatha. *English Language and Communication Skills for Engineers.* Oxford University Press. 2018.
2. Brieger, Nick and Alison Paul. *Technical English Vocabulary and Grammar*. https://nmetau.edu.ua/file/technical_english_vocabulary_and_grammar.pdf


**Reference Book:**


Chauhan, Gajendra Singh, and Kashmiramka, Smita, ***Technical Communication.*** Cengage Publication. 2018.

Sunder Jain. *Technical Report Writing*. Centrum Press, 2013.

John Bowden. "Writing a Report: How to Prepare, Write & Present Really Effective Reports?". 9th Edition 2011

Comfort, Jeremy et. al. 1984. *Business Reports in English*. Cambridge University Press.

Sharma, R.C. and K. Mohan. 2011. Business Correspondence and Report Writing, Fourth Edition. Tata McGraw Hill.

**Web Resources:**

1:https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=JSTOR1_3307.

2;https://puniversity.informaticsglobal.com:2282/ehost/detail/detail?vid=5&sid=3a77d69b-abe5-4681-b39d-32dfdcb8f4a5%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=154223466&db=iih

3: Last,Suzan, et. al. ***Technical Writing Essentials.*** University of Victoria, British Columbia, 2019 ( E- Book)

4 Wambui, Tabita Wangare, et al. ***Communication Skills- Volume 1,*** LAP LAMBRET, USA, 2012 ( E Book)

**Topics Relevant to the Development of Employability Skills:**
**Speaking Skills, Writing Skills, Critical Thinking and Critical Analysis, and Group Communication.**

| Course Code: PPS 1001 | **Course Title: Introduction to Soft Skills**<br><br>**Type of Course: Practical Only Course** | L- T-P- C | 0-0-2-1 |
|---|---|---|---|
| Version No. | 1.0 | | |
| Course Pre-requisites | Students are expected to understand Basic English.<br>Students should have desire and enthusiasm to involve, participate and learn. | | |
| Anti-requisites | NIL | | |
| Course Description | This course is designed to enable students understand soft skills concepts and improve confidence, communication and professional skills to give the students a competitive advantage and increase chances of success in the professional world. The course will benefit learners in presenting themselves effectively through various activities and learning methodologies. | | |
| Course Objective | The objective of the course is to **familiarize the learners with the concepts of "Soft Skills" and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.** | | |
| Course Out Comes | **On successful completion of this course the students shall be able to:**<br>CO1: **Recognize** significance of soft skills | | |

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|---|---|---|---|---|
| | CO2: **Illustrate** effective communication while introducing oneself and others<br>CO3: **List** techniques of forming healthy habits<br>CO4: **Apply** SMART technique to achieve goals and increase productivity | | | |
| Course Content: | | | | |
| Module 1 | INTRODUCTION TO SOFT SKILLS | | **Classroom activity** | **04 Hours** |
| **Topics:** Setting Expectations, Ice Breaker, Significance of soft skills, Formal grooming, punctuality | | | | |
| Module 2 | EFFECTIVE COMMUNICATION | | **Individual Assessment** | **10 Hours** |
| **Topics:** Different styles of communication, Difference between hearing and listening, Effective communication for success, Email etiquette, Self-introduction framework, Video introduction, email- writing, Resume Building- Digital, Video, Traditional. | | | | |
| Module 3 | HABIT FORMATION | | **Worksheets & Assignment** | **4 Hours** |
| **Topics:** Professional and personal ethics for success, Identity based habits, Domino effect, Habit Loop, Unlearning, standing up for what is right | | | | |
| Module 4 | Goal setting & Time Management | | **Goal sheet** | **8 Hours** |
| A session where students will be introduced to Time management, setting SMART Goals, Introduction to OKR Techniques, Time Management Matrix, steps to managing time through outbound group activity, making a schedule, Daily Plan and calendars (To Do List), Monitoring/charting daily activity | | | | |
| Targeted Application & Tools that can be used: LMS | | | | |
| Project work/Assignment: Mention the Type of Project /Assignment proposed for this course | | | | |
| 1) Individual Assessment<br>2) LMS MCQ | | | | |
| The topics related to Skill Development: Communication and professional grooming, Goal setting and presentation for skill development through participative learning techniques. This is attained through assessment component mentioned in course handout. | | | | |

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|---|---|---|---|---|---|---|
| Course Code: CSE1004 | Course Title: Problem Solving Using C<br><br>Type of Course: School Core Lab Integrated. | L- T-P-C | 1 | 0 | 4 | 3 |
| Version No. | 1.0 | | | | | |
| Course Pre-requisites | NIL | | | | | |
| Anti-requisites | NIL | | | | | |
| Course Description | The course is designed to provide complete knowledge of C language. Students will be able to develop logics which will help them to create programs and applications in C. AC Also by learning the basic programming constructs they can easily switch over to any other language in future. | | | | | |
| Course Object | The objective of the course is to familiarize the learners with the concepts of Problem Solving Using C and attain Employability through Problem Solving Methodologies. | | | | | |
| Course Outcomes | On successful completion of this course the students shall be able to:<br>1. Write algorithms and to draw flowcharts for solving problems<br>2. Demonstrate knowledge and develop simple applications in C programming constructs<br>3. Develop and implement applications using arrays and strings<br>4. Decompose a problem into functions and develop modular reusable code<br>5. Solve applications in C using structures and Union<br>6. Design applications using Sequential and Random Access File Processing. | | | | | |
| Course Content: | | | | | | |
| Module 1 | Introduction to C Language | Quiz | Problem Solving | 9 Hrs. | | |
| Topics:<br>Introduction to Programming – Algorithms – Pseudo Code - Flow Chart – Compilation – Execution – Preprocessor Directives (#define, #include, #undef) - Overview of C – Constants, Variables and Data types – Operators and Expressions – Managing Input and Output Operations – Decision Making and Branching - Decision Making and Looping. | | | | | | |
| Module 2 | Introduction to Arrays and Strings | Quiz | Problem Solving | 9 Hrs. | | |
| Topics:<br>Arrays: Introduction – One Dimensional Array – Initialization of One Dimensional Arrays – Example Programs – Sorting (Bubble Sort, Selection Sort) – Searching (Linear Search) - Two Dimensional Arrays – Initialization of Two Dimensional Arrays. Example Programs – Matrix operations. Strings: Introduction – Declaring and Initializing String Variables – Reading Strings from Terminal – Writing String to Screen – String Handling Functions. | | | | | | |
| Module 3 | Functions and Pointers | Quiz | Problem Solving | 9 Hrs. | | |

Topics:
Functions: Introduction – Need for User-defined functions – Elements of User-Defined Functions: declaration, definition and function call–Categories of Functions – Recursion. Pointers: Introduction – Declaring Pointer Variables – Initialization of Variables – Pointer Operators – Pointer Arithmetic – Arrays and Pointers – Parameter Passing: Pass by Value, Pass by Reference.

| Module 4 | Structures and Union | Quiz | Problem Solving | 9 Hrs. |
|---|---|---|---|---|

Topics:
Structures: Introduction – Defining a Structure – Declaring Structure Variable – Accessing Structure Members – Array of Structures – Arrays within Structures – Union: Introduction – Defining and Declaring Union – Difference Between Union and Structure.

| Module 5 | File handling | Case Study | Problem Solving | 9 Hrs. |
|---|---|---|---|---|

Topics:
Files: Defining and Opening a File – Closing a File – Input / Output Operations on File – Random Access Files

List of Practical
Tasks Lab
Sheet 1
(Module I)
CHE1018
Lab Sheet 2 (Module II)
Programs using Arrays and Strings
Lab Sheet 3 (Module III)
Programs using Functions and Pointers
Lab Sheet 4 (Module IV)
Programs using Structures and Unions
Lab Sheet 5 (Module V)
Programs using Files

Text Book(s):
1. E. Balaguruswamy, “Programming in ANSI C”, 8th Edition, 2019, McGraw Hill Education, ISBN: 978-93-5316- 513-0.

Reference
Book(s):

1. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
2. ReemaThareja, “Programming in C”, Oxford University Press, Second Edition, 2016.
3. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2015
4. Schildt Herbert, “C: The Complete Reference”, Tata McGraw Hill Education, 4th Edition, 2014.
5. Stephen G. Kochan, “Programming in C”, Addison-Wesley Professional, 4th Edition, 2014.


Web Links and Video Lectures:
1. https://nptel.ac.in/courses/106/105/106105171/
2. https://archive.nptel.ac.in/courses/106/104/106104128/

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|---|---|---|---|---|---|---|
| **Course Code: CHE1018** | **Course Title: Environmental Science**<br><br>**Type of Course: School Core- Theory and Lab** | **L- T-P- C** | 1 | 0 | 2 | 0 |
| **Version No.** | 2.0 | | | | | |
| **Course Pre-requisites** | NIL | | | | | |
| **Anti-requisites** | **NIL** | | | | | |
| **Course Description** | This course emphasizes the need to conserve biodiversity and adopt a more sustainable lifestyle by utilizing resources in a responsible way. Topics covered include basic principles of ecosystem functions; biodiversity and its conservation; human population growth; water resources, pollution; climate change; energy resources, and sustainability; Sustaining human societies, policies, and education.<br><br>**This course is designed to cater to Environment and Sustainability** | | | | | |
| **Course Objective** | The objective of the course is to **familiarize the learners with the concepts of "Environmental Science" and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques.** | | | | | |
| **Course Outcomes** | On successful completion of this course the students shall be able to:<br><br>Appreciate the historical context of human interactions with the environment and the need for eco-balance.<br>Describe basic knowledge about global climate change with particular reference to the Indian context.<br>Understand biodiversity and its conservation<br>Develop an understanding on types of pollution and ways to protect the environment<br>Learn about various strategies on Global environmental management systems | | | | | |
| **Course Content:** | | | | | | |
| **Module 1** | **Humans and the Environment** | Assignment | Data Collection | | **01 class** | |
| **Topics:** The man-environment interaction: Mastery of fire; Origin of agriculture; Emergence of city states; Great ancient civilizations and the environment.<br><br>***Self-learning topics:*** Humans as hunter-gatherers; Industrial revolution and its impact on the environment; Environmental Ethics and emergence of environmentalism. | | | | | | |
| **Module 2** | **Natural Resources and Sustainable Development** | Assignment | | | **03 Classes** | |
| **Topics:**<br>Overview of natural resources: Definition of resource; Classification of natural resources- biotic and abiotic, renewable and non-renewable. **Water resources**: Types of water resources- fresh water and marine resources;**Soil and mineral resources**: Important minerals; Mineral exploitation Soil as a resource and its degradation.**Energy resources**: Sources of energy and their classification, renewable and non-renewable sources of energy; Advantages and disadvantages.<br><br>***Self- learning topics:*** Availability and use of water resources; Environmental impact of over-exploitation, issues and challenges.; Environmental problems due to extraction of minerals and use; Sustainable Development Goals (SDGs)- targets, indicators, and challenges for SDGs. | | | | | | |
| **Module 3** | **Environmental Issues: Local, Regional and Global** | Case study | | | **02 Classes** | |

**Topics:**
**Environmental Pollution**: Types of Pollution- air, noise, water, soil, municipal solid waste, hazardous waste; Trans- boundary air pollution; Acid rain; Smog.

**Land use and Land cover change**: land degradation, deforestation, desertification, urbanization. Global change: Ozone layer depletion; Climate change

***Self -learning topics:*** Environmental issues and scales

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|---|---|---|---|---|---|
| | **Module 4** | **Conservation of Biodiversity and Ecosystems** | Assignment | | **02 Classes** |

**Topics:**
**Biodiversity-**Introduction, types, Species interactions, Extinct, endemic, endangered and rare species, Threats to biodiversity: Natural and anthropogenic activities.

**Self-learning topics:** Mega-biodiversity, Hot-spots, Major conservation policies. Biodiversity loss: past and current trends, impact.

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|---|---|---|---|---|---|
| | **Module 5** | **Environmental Pollution and Health** | Case study | | **03 Classes** |

**Topics:**
Pollution, Definition, point and nonpoint sources of pollution, **Air pollution**- sources, major air pollutants, health impacts of air pollution.

**Water pollution**– Pollution sources, adverse health impacts on human and aquatic life and mitigation, Water quality parameters and standards.

**Soil pollution and solid waste**- Soil pollutants and their sources, solid and hazardous waste, Impact on human health.

**Self-learning topics:** Noise pollution, Thermal and radioactive pollution.

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|---|---|---|---|---|---|
| | **Module 6** | **Climate Change: Impacts, Adaptation and Mitigation** | Assignment/case | | **02 Classes** |

**Topics:**
**Understanding climate change**: Natural variations in climate; Projections of global climate change with special reference to temperature, rainfall and extreme events; Importance of 1.5 °C and 2.0 °C limits to global warming; Impacts

**Vulnerability and adaptation to climate change**: Observed impacts of climate change on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Indigenous knowledge for adaptation to climate change.

**Self-learning topics:** Mitigation of climate change: Synergies between adaptation and mitigation measures; National and international policy instruments for mitigation.

| | | | | | |
|---|---|---|---|---|---|
| | **Module 7** | **Environmental Management** | Case study | Data analysis | **02 Classes** |

**Topics:**
Environmental management system: ISO 14001; Environmental risk assessment Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability.

**Self-learning topics:** Environmental audit and impact assessment; Eco labeling /Eco mark scheme

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|---|---|---|---|---|---|
| | **Module 8** | **Environmental Treaties and Legislation** | Case study | Data analysis | **01 Classes** |

**Topics**:
Major International Environmental Agreements: Convention on Biological Diversity (CBD), Major Indian Environmental Legislations: Environmental Protection Act, Forest Conservation Act, Public awareness.

**Self-learning topics:** Paris Agreement, Conference of the Parties (COP), India's status as a party to major conventions: Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act.

**List of laboratory tasks : Any eight experiments will be conducted**

ermination of total alkalinity of a water sample (knowledge)
Estimation of water hardness by EDTA method and its removal (by zeolite/ ion exchange method) (Comprehensive)
mation of copper from industrial effluents by colorimetric method (Comprehensive)
mation of iron from industrial effluents by titrimetric method/potentiometric method (Comprehensive)
mation of nickel from industrial effluents by titrimetric method (Comprehensive)
mation of chloride in drinking water by titrimetric method (Comprehensive)
mation of fluoride in ground water by colorimetric method (Comprehensive)
ermination of calcium in aqueous solution (Comprehensive)
ermination of Total Dissolved Salts, conductivity and pH of a water samples (Knowledge)
Determination of Chemical oxygen demand in the industrial effluent. (Comprehensive)
Biological oxygen demand of waste water sample (Comprehensive)
Determination of dissolved oxygen of an industrial effluent (Comprehensive)
Quality monitoring analysis of a soil sample (knowledge)
Flame photometric estimation of Sodium and potassium (Application)
Gas Chromatographic analysis of volatile organic compounds (Application)

**Targeted Application & Tools that can be used:**
Application areas are Energy, Environment and sustainability
**Tools:** Statistical analysis of environmental pollutants using excel, origin etc.

**Project work/Assignment:**

**Assessment Type**
**term exam**
**Assignment (review of digital/ e-resource from PU link given in references section - mandatory to submit screenshot accessing the digital resource.)**
**evaluation/Assignment**
**Term Exam**
**-learning**
**Assignment 1: Write a Statement of Environment report of your town/city/state/country**

**Assignment 2:** Individual students will carry out the analyses of polluted solid, liquid, and gaseous samples and propose suitable mitigation measures. A detailed and in-depth report needs to be submitted for each case. This may include preparation of reagents, sample preparation (extraction), chemical analysis carried out, instruments and tools used, data collected and processed, inferences made and conclusions arrived at. Necessary support is given in the form of
lab manual and reference links to e-books.

**Text Book**

yler Miller and Scott Spoolman (2020), Living in the Environment, 20th Edition, Cengage Learning, USA
nnamurthy, K.V. (2003) Text book of Biodiversity, Science Publishers, Plymouth, UK.
Jackson, A.R. & Jackson, J.M. (2000), Environmental Science: The natural environment and human impact, Pearson Education.

**Reference Books**

Fisher, Michael H. (2018) An Environmental History of India- From Earliest Times to the Twenty-First Century, Cambridge University Press.

William P. Cunningham and Mary Ann Cunningham (2017), Principles of Environmental Science: Inquiry & Applications, 8th Edition, McGraw-Hill Education, USA.

a N., (2020) Wild and Wilful. Harper Collins, India.

www.ipcc.org; https://www.ipcc.ch/report/sixth-assessment-report-cycle/

Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.

Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.

**E-resources:**

**https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_18126**
**https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_8761**
**https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAJ_1_02082022_3333**
**https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_3063**
**https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_20719**
**https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_16824**
**https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_3954**
**https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAB_1_06082022_491**
**https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=CUSTOM_PACKAGE_16012023_WORLD_BUSINESS_COUNCIL_SUSTAINABLE_488**
**https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=CUSTOM_PACKAGE_16012023_WORLD_BUSINESS_COUNCIL_SUSTAINABLE_583**
**https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=SPRINGER_INDEST_1_171**
**https://presiuniv.knimbus.com/user#/searchresult?searchId=3R%20principle&_t=1687427221129**
**https://presiuniv.knimbus.com/user#/searchresult?searchId=eco%20labelling&_t=1687427279979**
**https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=TEXTBOOK_LIBRARY01_06082022_395&xIndex=4**
**https://www.ugc.gov.in/oldpdf/modelcurriculum/env.pdf**

**Topics relevant to Skill Development:**

Industrial revolution and its impact on the environment, Environmental impact of over-exploitation of water resources, pollution and ill effects, lab experiments for Skills development through Problem solving Techniques. This is attained through assessment component mentioned in course handout.

All topics in theory component are relevant to Environment and Sustainability.

| | | | | | | |
|---|---|---|---|---|---|---|
| Course Code: **PPS 1011** | **Course Title: Introduction to Verbal Ability Type of Course: Theory Only Course** | L- T- P- C | 0 | 1 | 0 | 0 |
| Version No. | 1.0 | | | | | |
| Course Pre-requisites | Students are expected to understand Basic English.<br>Students should have desire and enthusiasm to involve, participate and learn. | | | | | |
| Anti-requisites | NIL | | | | | |
| Course Description | This course is designed to enable students understand the importance of Verbal Ability and improve confidence, communication and professional skills to give them a competitive advantage and increase chances of success in the professional world. The course will benefit learners in presenting themselves effectively through various worksheets and learning methodologies. | | | | | |
| Course Objective | The objective of the course is to **familiarize the learners with the concepts of "Verbal Ability" and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.** | | | | | |
| Course Out Comes | **On successful completion of this course the students shall be able to:**<br>CO1: **Recognize** significance of verbal ability<br>CO2: **Utilize** the rules of communication<br>CO3: **Apply** techniques of vocabulary building to showcase effective communication | | | | | |
| Course Content: | | | | | | |
| Module 1 | INTRODUCTION TO VERBAL ABILITY | **Individual Assessment** | | | | **01 Hour** |
| **Topics:** Setting Expectations, Ice Breaker, Significance of verbal ability, pre-assessment | | | | | | |
| Module 2 | EFFECTIVE VERBAL COMMUNICATION | **Practice Worksheets** | | | | **06 Hours** |
| **Topics:** Different rules of grammar and application, Subject-Verb Agreement, Tenses | | | | | | |
| Module 3 | VOCABULARY BUILDING | **Practice Worksheets** | | | | **04 Hours** |
| **Topics:** Root words, Synonyms and antonyms, analogies, para-jumbles | | | | | | |
| Module 4 | READING COMPREHENSION | **Individual Assessment** | | | | **02 Hours** |

| |
|---|
| A session where students will be introduced to speed reading and comprehension, **post-assessment** |
| Targeted Application & Tools that can be used: LMS |
| Project work/Assignment: Mention the Type of Project /Assignment proposed for this course |
| Individual Assessment<br>LMS MCQ |
| The topics related to Skill Development: Communication, grammar rules, vocabulary building, effective presentation for skill development through participative learning techniques. This is attained through **learning and practicing the rules of effective communication through worksheets** as mentioned in the assessment component. |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Course Code: MAT1003** | **Course Title: Applied Statistics**<br><br>**Type of Course:** School Core | **L T P C** | 1 | 0 | 2 | 2 |
| **Version No.** | 3.0 | | | | | |
| **Course Pre-requisites** | None | | | | | |
| **Anti-requisites** | None | | | | | |
| **Course Description** | The goal of this course is to provide a firm understanding of probability and statistics by means of a thorough treatment of descriptive statistics, probability and probability distributions keeping in mind the future courses having statistical, quantitative and probabilistic components. The course covers topics such as descriptive statistics, probability, rules for probability, random variables and probability distributions, standard discrete and continuous probability distributions. | | | | | |
| **Course Objective** | The objective of the course is to **familiarize the learners with the concepts of "**Applied Statistics" and attain **Skill Development Through Problem Solving techniques**. | | | | | |
| **Expected Outcome:** | At the end of this course, students will be in a position to apply the techniques of descriptive statistics effectively interpret the ideas of probability and conditional probability<br><br>demonstrate the knowledge of probability distributions | | | | | |

| | | | | |
|---|---|---|---|---|
| | Compute statistical parameters, correlation and regression, probability and sampling distributions using R software. | | | |
| **Module 1** | **Descriptive Statistics** | Assignment | Coding needed | **10 classes** |
| Introduction to Statistics, Data and statistical thinking, review of basic statistical parameters, Covariance, Correlation, Types of Measures of Correlation - Karl Pearson's Correlation Coefficient, Spearman Rank Correlation, linear regression, Multi linear regression **.** | | | | |
| **Module 2** | **Probability** | | | **6 classes** |
| Introduction to Probability, Probability of an event, Addition Principle, Multiplication law, Conditional Probability, Total Probability and Baye's theorem with examples | | | | |
| | | | | |
| **Module 3** | **Random Variables and Probability Distributions** | | Coding needed | **14 classes** |
| Introduction to Random variables, Discrete Random Variables and Continuous Random Variables, Probability Distributions, Probability Mass Function and Probability Density Function, Various Probability distributions, Binomial, **Negative Binominal (Self Study)**, Poisson, Normal and Exponential distributions | | | | |
| | | | | |
| **Module 4** | **Sampling Theory** | | Coding needed | **15 classes** |
| Introduction to Sampling Theory, Population, Statistic, Parameter, Sampling Distribution, Standard Error. Testing of Hypothesis, Types of Errors, Critical Region, level of Significance. Difference between Parametric and Non-parametric Tests, Large Sample Tests: Z-Test for Single Mean and **Difference of Means (Self Study)**, Small Sample Tests: Student's t-Test for Single Mean and **Difference of Means,** F-Test, Chi-Square Test. | | | | |
| **Targeted Application & Tools that can be used:**<br><br>The objective of the course is to familiarize students with the theoretical concepts of probability and statistics and to equip them with basic statistical tools to tackle engineering and real-life problems.<br><br>Tools used: R Software / MS-Excel | | | | |
| **Text Book** | | | | |

1. Ronald E Walpole, Raymond H Myers, Sharon L Myers, and Keying E Ye, Probability and Statistics for Engineers and Scientists, Pearson Education, 2016.

**References**

1. James T. McClave, P. George Benson and Terry Sincich, Statistics for Business and Economics, 2018.
2. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Essentials of Modern Business Statistics with Microsoft Excel, 2020.
3. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Essentials of Statistics for Business and Economics, 2019.
4. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley and Sons, 2018.
5. Richard A. Johnson, Miller and Freund's Probability and Statistics for Engineers, 2018.
6. Kishor S Trivedi, Probability and Statistics with reliability, Queuing and Computer Science Applications, John Wiley & Sons, 2008.

**Topics relevant to SKILL DEVELOPMENT**: The goal of this course is to provide a firm understanding of probability and statistics by means of a thorough treatment of descriptive statistics, probability and probability distributions keeping in mind the future courses having statistical, quantitative and probabilistic components. The course covers topics such as descriptive statistics, probability, rules for probability, random variables and probability distributions, standard discrete and continuous probability distributions for **Skill Development through Problem Solving methodologies.** This is attained through assessment component mentioned in course handout.

| **Course Code: ECE2007** | **Course Title: Digital Design<br>Type of Course: Theory &Integrated Laboratory** | **L- T-P- C** | **2** | **0** | **2** | **3** |
|---|---|---|---|---|---|---|
| **Version No.** | 2.0 | | | | | |
| **Course Pre-requisites** | **[1] Elements of Electronics/Electrical Engineering, 2] Basic concepts of number representation, Boolean Algebra** | | | | | |
| **Anti-requisites** | **NIL** | | | | | |

<table>
<tr><td>Course Description</td><td colspan="4">The purpose of this course is to enable the students to appreciate the fundamentals of digital logic circuits and Boolean algebra focusing on both combinational and sequential logic circuits. The course emphasizes on minimization techniques for making canonical and low-cost digital circuit implementations. This course deals with analysis and design of digital electronic circuits. The course also creates a foundation for future courses which includes Computer Architecture, Microprocessors, Microcontrollers, and Embedded Systems etc.<br><br>The course enhances the Design, Implementation and Programming abilities through laboratory tasks. The associated laboratory provides an opportunity to verify the theoretical knowledge.</td></tr>
<tr><td>Course Objective</td><td colspan="4">The objective of the course is to familiarize the learners with the concepts of Digital Design and attain the SKILL DEVELOPMENT through EXPERIENTIAL LEARNING.</td></tr>
<tr><td>Course Outcomes</td><td colspan="4">On successful completion of this course the students shall be able to:<br><br>i. Describe the concepts of number systems, Boolean algebra and logic gates.<br>ii. Apply minimization techniques to simplify Boolean expressions.<br>iii. Demonstrate the Combinational circuits for a given logic<br>iv. Demonstrate the Sequential and programmable logic circuits<br>v. Implement various combinational and sequential logic circuits using gates.</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Fundamentals of Number systems- Boolean algebra and digital logic</td><td>Application Assignment</td><td>Data Analysis task</td><td>06 classes</td></tr>
<tr><td colspan="5">Topics:<br><br>Review of Number systems and logic gates, Number base conversions, Overview of Boolean functions and simplifications, two, three, four variable K-Maps- Don’t care conditions- Both SOP and POS- Universal Gates (NAND & NOR) Implementations. Introduction to HDL.</td></tr>
<tr><td>Module 2</td><td>Boolean function simplification</td><td>Application Assignment</td><td>Data Analysis task</td><td>08 Classes</td></tr>
<tr><td colspan="5">Topics:<br><br>Introduction to Combinational circuits, Analysis, Design procedure, Binary Adder and Subtractor, Magnitude comparator, Parity generator and checker, Multiplexers-Demultiplexers, Decoders, Encoders and Priority Encoders, HDL Models of combinational circuits.</td></tr>
<tr><td>Module 3</td><td>Combinational Logic circuits:</td><td>Application Assignment</td><td>Programming Task & Data Analysis task</td><td>08 Classes</td></tr>
<tr><td colspan="5">Topics:</td></tr>
</table>

Introduction to sequential circuits, Storage elements: latches and flip flops, Characteristic tables and equations, excitation table, Analysis of clocked sequential circuits, Mealy & Moore Models of finite state machines - Registers & Counters. HDL Models of Sequential circuits.

**List of Laboratory Tasks:**

**Experiment N0 1:** Verify the Logic Gates truth table
**Level 1: By using Digital Logic Trainer kit**
**Level 2: By using Analog devices like RPS, Volt meter, Resistors and ICs**

**Experiment No. 2:** Verify the Boolean Function and Rules
**Level 1: By using Digital Logic Trainer kit**
**Level 2: By using Analog devices like RPS, Volt meter, Resistors and ICs**

**Experiment No. 3:** Design and Implementations of HA/FA
**Level 1: By using basic logic gates and Trainer Kit**
**Level 2: By using Universal logic gates and Trainer Kit**

**Experiment No. 4:** Design and Implementations of HS/FS
**Level 1: By using basic logic gates and Trainer Kit**
**Level 2: By using Universal logic gates and Trainer Kit**

**Experiment No. 5:** Design and Implementations of combinational logic circuit for specifications
**Level 1: Specifications given in the form of Truth table**
**Level 2: Specification should be extracted from the given scenario**

**Experiment No. 6:** Study of Flip flops

**Experiment No. 7:** Design and Implementations of sequential logic circuit for specifications
**Level 1: Specifications given in the form of Truth table**
**Level 2: Specification should be extracted from the given scenario**

**Experiment No.8:** HDL coding for basic combinational logic circuits
**Level 1: Gate level Modeling**
**Level 2: Behavioral Modeling**

**Experiment No.9:** HDL coding for basic sequential logic circuit
**Level 1: Gate level Modeling**
**Level 2: Behavioral Modeling**

**Targeted Application & Tools that can be used:**

**Digital electronics is the foundation of all modern electronic devices such as cellular phones, MP3 players, laptop computers, digital cameras, high definition televisions, Home Automation, Communication in systems in industries**

**Professionally Used Software: HDL/VHDL/Verilog HDL/ OOPS**

**Text Book(s):**

1. Mano, M. Morris and Ciletti Michael D., *"Digital Design"*, Pearson Education, 6th edition
2. Thomas L. Floyd "DIGITAL LOGIC DESIGN" , Pearson Education, fourth edition.

**Reference(s):**

**Reference Book(s):**

R1. Jain, R. P., "Modern Digital Electronics", McGraw Hill Education (India), 4th Edition

R2. Roth, Charles H., Jr and Kinney Larry L., "Fundamentals of logic Design", Cengage Learning, 7th Edition

**Online Resources (e-books, notes, ppts, video lectures etc.):** Book Free Download (studymaterialz.in)

1. **eBook1**: Mano, M. Morris and Ciletti Michael D., *"Digital Design"*, Pearson Education.
2. {[PDF] Digital Design By M. Morris Mano, Michael D Ciletti Book Free Download

}

3. **eBook2:**Floyd "DIGITAL LOGIC DESIGN" fourth edition- ePub, eBook- [PDF] DIGITAL LOGIC DESIGN FOURTH EDITION FLOYD | abri.engenderhealth.org.
4. NPTEL Course- NPTEL :: Electrical Engineering - NOC:Digital Electronic Circuits
5. Digital Logic Design PPT Slide 1 (iare.ac.in)
6. Lab Tutorial: Multisim Tutorial for Digital Circuits - Bing video

CircuitVerse - Digital Circuit Simulator online

Learn Logisim➠ Beginners Tutorial | Easy Explanation! - Bing video

Digital Design 5: LOGISIM Tutorial & Demo

**7. https://presiuniv.knimbus.com/user#/home**

**E-content:**

1. Z. Xin-Li and W. Hong-Ying, "The Application of Digital Electronics in Networking Communication," 2016 Eighth International Conference on Measuring Technology and Mechatronics Automation (ICMTMA), 2016, pp. 684-687, doi: 10.1109/ICMTMA.2016.168.
2. An encoding technique for design and optimization of combinational logic circuit DipayanBhadra;Tanvir Ahmed Tarique;Sultan Uddin Ahmed;Md. Shahjahan;KazuyukiMurase2010 13th International Conference on Computer and Information Technology (ICCIT)
3. A. Matrosova and V. Provkin, "Applying Incompletely Specified Boolean Functions for Patch Circuit Generation," 2021 IEEE East-West Design & Test Symposium (EWDTS), 2021, pp. 1-4, doi: 10.1109/EWDTS52692.2021.9581029.
4. A. Matrosova, V. Provkin and E. Nikolaeva, "Masking Internal Node Faults and Trojan Circuits in Logical Circuits," *2019 IEEE East-West Design & Test Symposium (EWDTS)*, 2019, pp. 1-4, doi: 10.1109/EWDTS.2019.8884434.

**Topics relevant to "SKILL DEVELOPMENT":** Adders, Multiplexers, Decoders / Encoders; Flip-Flops, Counters and Registers for **Skill Development** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout.

| | | | | | | |
|---|---|---|---|---|---|---|
| **Course Code: CIV1008** | **Course Title: Basic Engineering Sciences Type of Course: Theory Only** | **L-T-P-C** | 2 | 0 | 0 | 2 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | **NIL** | | | | | |
| **Anti-requisites** | **NIL** | | | | | |
| **Course Description** | This basic course on engineering science is designed to introduce students to the fields of civil, mechanical and petroleum engineering. Student will be exposed to various fields in civil engineering and different manufacturing techniques in addition to machinery for power production and consumption. Additionally, students will be getting an overview of various sectors of oil & gas industries. This course acquaints students to basics of Industry 4.0 and Construction 4.0. The course aims to enable students to appreciate the multidisciplinary nature of engineering design and operations in the current era with mechanization and digitization transforming every aspect of engineering. | | | | | |
| **Course Objective** | The objective of the course is skill development of student by using Participative Learning techniques. | | | | | |
| **Course Outcomes** | On successful completion of this course the students shall be able to:<br>1] Recognize the significance of various disciplines in Civil Engineering<br>2] Discuss the recent evolutions in Civil Engineering<br>3] Explain various energies, energy generating machineries and energy consumption machineries<br>4] Describe the fundamental concept and terminology associated with the Petroleum Industry<br>5] Distinguish between conventional and modern manufacturing techniques. | | | | | |
| **Course Content:** | | | | | | |

| | | | | |
|---|---|---|---|---|
| **Module 1** | **Introduction to various fields in Civil Engineering** | Assign ment | Case studies on different Civil Engineering Projects | **6 Sessions** |
| Topics: Introduction to Civil Engineering: Definition, scope and branches of Civil Engineering, Role of Civil Engineer, Overview of Infrastructure. | | | | |
| **Module 2** | **Current Trends and Evolution in Civil Engineering** | Assign ment | Article Review | **6 Sessions** |
| Topics: Mechanization in Construction, Application of Digital Technologies in Planning, Design, execution, monitoring and maintenance of Construction. Overview of Smart Cities. | | | | |
| **Module 3** | **Power Production and Consumption Machinery** | Assign ment & Quiz | Data Collection | **6 Sessions** |
| Topics: Energy and its types, Engines and their applications, Pumps-Compressors and their applications. | | | | |
| **Module 4** | **Overview of Petroleum Engineering** | Assign ment & Quiz | Article Review | **6 Sessions** |
| Overview of the Petroleum Industry, Importance of Petroleum Engineering, lifecycle of Petroleum products, Classifications of E&P activities: Key difference between Offshore and Onshore, Onshore facilities, offshore platforms, Digitization of petroleum engineering | | | | |
| **Module 5** | **Industry 4.0** | Assign ment & Quiz | Data Collection | **6 Sessions** |
| Topics: Conventional manufacturing process: Metal forming, metal removal and metal joining process.<br>Modern Manufacturing process: 3D Printing / Additive Manufacturing. | | | | |
| **Targeted Application & Tools that can be used:**<br>Application Areas include design and implementation of Smart City projects, Infrastructure maintenance, Power production, IC engines, Electric vehicles, onshore and offshore exploration and production activities | | | | |
| **Project work/Assignment:** | | | | |
| Assignment 1: Collect data and prepare report on various Mega Projects in Civil Engineering | | | | |

Assignment 2: Review Articles on current evolutions in Civil Engineering.
Assignment 3: Collect data related to renewable energy generation (Wind, Solar)
Assignment 4: Prepare an energy consumption chart for a compressor or pumps.
Assignment 5: Prepare a report on role of 3D printing across various industries.
Assignment 6: Prepare an assignment on geopolitical influence on oil and gas industries.

**Text Book:**


T1. Elements of Civil and Mechanical Engineering, L.S. Jayagopal & R Rudramoorthy, Vikas Publishers

T2. Elements of Mechanical Engineering, by VK Manglik

T3. Fundamentals of Oil & Gas Industry for Beginners by Samir Dalvi, Notion Press; 1st edition


**References**


1. K.P. Roy, S.K. Hajra Choudhury, Nirjhar Roy, "Elements of Mechanical Engineering", Media Promoters and Publishers Pvt Ltd, Mumbai.
2. Nontechnical Guide to Petroleum Geology, Exploration, Drilling & Production by Norman J. Hyne, PennWell Books; 3rd Revised edition


**Web-resources:**

1. Basic Civil Engineering

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2706932&site=ehost-live

2. Post-parametric Automation in Design and Construction

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1155197&site=ehost-live

3. Smart Cities : Introducing Digital Innovation to Cities

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1993146&site=ehost-live

4. Innovation Energy: Trends and Perspectives or Challenges of Energy Innovation

https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2323766&site=ehost-live

5. Mechanical Engineering
   https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO106_REDO_1705
6. Additive Manufacturing: Opportunities, Challenges, Implications
   https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1134464&site=ehost-live
7. Society of Petroleum Engineers (SPE)
   https://www.spe.org/en/

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| 8. PetroWiki: A comprehensive online resource created by the Society of Petroleum Engineers that provides information on various aspects of petroleum engineering. https://petrowiki.spe.org/PetroWiki<br>9. Rigzone: A resource for news and information about the oil and gas industry, including job postings and industry trends. https://www.rigzone.com/ |
| **Topics relevant to the development of SKILLS:**<br><br>Engines-Turbines and their applications.<br><br>Mechanization in Construction.<br>Digitization in Petroleum Industries |

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|---|---|---|---|
| **Course Code: MEC1006** | **Course Title: Engineering Graphics**<br>**Type of Course: School Core & Theory Only** | **L- T-P- C** | 2-0-0-2 |
| **Version No.** | 1.2 | | |
| **Course Pre-requisites** | **NIL** | | |
| **Anti-requisites** | **NIL** | | |
| **Course Description** | The course is designed with the objective of giving an overview of engineering graphics. It is introductory in nature and acquaints the students with the techniques used to create engineering drawings. The course emphasizes on projection of points, lines, planes and solids and isometric projections. | | |
| **Course Objective** | The objective of the course is to familiarize the learners with the concepts of "**Engineering Graphics**" and attain **SKILL DEVELOPMENT** through Problem solving methodologies. | | |

<table>
<tr><td>Course Outcomes</td><td colspan="4">On successful completion of this course the students shall be able to:<br><br>(1) Demonstrate competency of Engineering Graphics as per BIS conventionsand standards.<br>(2) Comprehend the theory of projection for drawing projections of Points, Lines andPlanes under different conditions.<br>(3) Prepare multiview orthographic projections of Solids by visualizing them indifferent positions.<br>(4) Prepare pictorial drawings using the principles of isometric projections to visualizeobjects in three dimensions.</td></tr>
<tr><td colspan="5">Course Content:</td></tr>
<tr><td>Module 1</td><td>Introduction to Drawing</td><td>Assignment</td><td>Standard technical drawing</td><td>02 Sessions</td></tr>
<tr><td colspan="5">Topics:<br>Introduction, drawing instruments and their uses, relevant BIS conventions and standards, Lettering, Lineconventions, dimensioning, Selection of drawing sheet size and scale.<br>[02 Hours: Comprehension Level]</td></tr>
<tr><td>Module 2</td><td>Orthographic projections of Points, Straight Linesand Plane Surfaces</td><td>Assignment</td><td>Projection methods Analysis</td><td>10 Sessions</td></tr>
<tr><td colspan="5">Topics:<br>Introduction, Definitions – Elements of projection and methods of projection, Planes of projection, reference line and conventions adopted. First angle and third angle projections. Projection of Points inall 4 quadrants.<br>Projections of Straight Lines (located in first quadrant/first angle projection only): True and apparent lengths, true and apparent Inclinations to reference planes. (No application problems). Projection of Plane surfaces (First angle projection): Regular plane surfaces – triangle, square, rectangle, pentagon, hexagon and circle – in different positions inclined to both the planes using change of position method only.<br>[10 Hours: Application Level]</td></tr>
<tr><td>Module 3</td><td>Orthographic Projections of Solids</td><td>Assignment</td><td>Multi-view drawing Analysis</td><td>10 Sessions</td></tr>
<tr><td colspan="5">Topics:<br>Introduction, Projection of right regular prisms, pyramids, cone, hexahedron and tetrahedron in different positions (Problems resting on HP only and First angle projection).<br>[10 Hours: Application Level]</td></tr>
</table>

| | | | | |
|---|---|---|---|---|
| **Module 4** | Isometric Projections of Solids (Using isometric scale only) | Assignment | Spatial Visualization | **8 Sessions** |

**Topics:**

Introduction, Isometric scale, Isometric projections of right regular prisms, cylinders, pyramids, cones and their frustums, spheres and hemispheres, hexahedron (cube), and combination of 2 solids, conversion of orthographic view to isometric projection of simple objects.

**[8 Hours: Application Level]**

**Text Book:**

1.N. D. Bhatt, "Engineering Drawing: Plane and Solid Geometry," Charotar Publishing House Pvt. Ltd.

**References:**

**1.** K.R. Gopalakrishna, "Engineering Graphics", Subhash Publishers, Bangalore.

**2.** D. M. Kulkarni, A. P. Rastogi, A. K. Sarkar, "Engineering Graphics with AutoCAD," Prentice Hall.

**3.** D. A. Jolhe, "Engineering Drawing with Introduction to AutoCAD," Tata McGraw Hill.

**Web resources:**

**https://nptel.ac.in/courses/112103019**

**Topics relevant to "SKILL DEVELOPMENT":** Projection in first and third angle for **SKILL DEVELOPMENT** through **Problem Solving methodologies**. This is attained through the assessment component mentioned in the course handout.

| **Course Code:** CSE1006 | **Course Title:** Problem Solving using JAVA<br>**Type of Course: Lab Integrated** | **L- T-P-C** | 1 | 0 | 4 | 3 |
|---|---|---|---|---|---|---|
| **Version No.** | 2.0 | | | | | |
| **Course Pre-requisites** | CSE1004 – Problem-Solving Using C | | | | | |
| **Anti-requisites** | Nil | | | | | |
| **Course Description** | This course introduces the core concepts of object-oriented programming. This course has theory and lab component which emphasizes understanding the implementation and application of object-oriented programming paradigm. It helps the student to build real-time secure applications by applying these concepts and also for | | | | | |

| | | | | |
|---|---|---|---|---|
| | effective problem-solving. The students interpret and understand the need for object-oriented programming to build applications. | | | |
| **Course Objective** | The objective of the course is to familiarize the learners with the concepts of Problem-Solving using JAVA and attain **SKILL DEVELOPMENT** through **EXPERIENTIAL LEARNING** techniques | | | |
| **Course Out Comes** | **On successful completion of the course, the students shall be able to:**<br>**C.O. 1:** Describe the basic programming concepts. [Knowledge]<br>**C.O. 2:** Apply the concept of classes, objects and methods to solve problems. [Application]<br>**C.O. 3:** Apply the concept of arrays and strings. [Application]<br>**C.O. 4:** Implement inheritance and polymorphism in building secure applications. [Application]<br>**C.O. 5:** Apply the concepts of interface and error handling mechanism. [Application] | | | |
| **Course Content:** | | | | |
| **Module 1** | **Basic Concepts of Programming and Java** | Assignment | Data Collection/Interpretation | **12 Sessions** |
| **Topics:** Introduction to Principles of Programming: Process of Problem Solving, Java program structure, Download Eclipse IDE to run Java programs, Sample program, Data types, Identifiers, Variables, Constants in java, Operators, Assignments and Expression, Basic Input/ Output functions, Control Statements: Branching and Looping. | | | | |
| **Module 2** | **Classes, objects, methods and Constructors** | Case studies / Case let | Case studies / Case let | **12 Sessions** |
| **Topics:** Classes, Objects and Methods: Introduction to object Oriented Principles, defining a class, adding data members and methods to the class, access specifiers, instantiating objects, reference variable, accessing class members and methods.<br>Static Polymorphism: Method overloading, constructors, constructor overloading, this keyword, static keyword, Nested classes, Accessing members in nested classes. | | | | |
| **Module 3** | **Arrays, String and String buffer** | Quiz | Case studies / Case let | **14 Sessions** |

| | | | | |
|---|---|---|---|---|
| **Topics:** Arrays: Defining an Array, Initializing & Accessing Array, Multi–Dimensional Array, Array of objects. String: Creation & Operation. String builder class, methods in String Buffer. | | | | |
| **Module 4** | **Inheritance and Polymorphism** | Quiz | Case studies / Case let | **14 Sessions** |
| **Topics:** Inheritance: Defining a subclass, Types of Inheritance, super keyword. Dynamic Polymorphism: Method overriding. Final keyword: with data members, with member functions and with class. Abstract keyword: with data members, with member functions and with class, Exception handling. | | | | |
| **Module 5** | **Input & Output Operation in Java** | Quiz | Case studies / Case let | **14 Sessions** |
| Input/output Operation in Java(java.io Package), Streams and the new I/O Capabilities, Understanding Streams, working with File Objects, File I/O Basics, Reading and Writing to Files, Buffer and Buffer Management, Read/Write Operations with File Channel, Serializing Objects, Observer and Observable Interfaces. | | | | |

**List of Laboratory Tasks:**

**P1 - Problem Solving using Basic Concepts.**

**P2 - Problem Solving using Basic Concepts and Command Line Arguments.**

**P3 - Programming assignment with class, objects, methods and Constructors.**

**P4 - Programming assignment with method overloading.**

**P5 - Programming assignment with constructor overloading.**

**P6 - Programming assignment with Static members and static methods.**

**P7 - Programming assignment with Nested classes.**

**P8 - Programming assignment using Arrays.**

**P9 - Programming assignment using Strings.**

**P10 - Programming assignment using String Builder.**

**P11 - Programming assignment using Inheritance and super keyword.**

**P12 - Programming assignment using Method overriding and Dynamic method invocation.**

**P13 - Programming assignment using Final keywords.**

**P14 - Programming assignment using Abstract keywords.**

**P15 - Programming assignment using Interface.**

**P16 - Programming assignment using Interface.**

**P17 - Programming assignment CharacterStream Classes**

**P18 - Programming assignment Read/Write Operations with File Channel**

**Targeted Application & Tools that can be used :** JDK /eclipse IDE/ net Beans IDE.

**Text Book**

**T1** Herbert Schildt, "The Complete Reference Java 2", Tata McGraw Hill Education.

**References**

**R1**: Cay S Horstmann and Cary Gornell, "CORE JAVA volume I-Fundamentals", Pearson

James W. Cooper

, "Java TM Design Patterns – A Tutorial", Addison-Wesley Publishers.

**E book link R1: http://rmi.yaht.net/bookz/core.java/9780134177373-Vol-1.pdf**

**E book link R2:** Java(tm) Design Patterns: A Tutorial( [PDF] [7qmsenjl97t0] (vdoc.pub)

Web **resources**

ps://youtube.com/playlist?list=PLu0W_9lII9agS67Uits0UnJyrYiXhDS6q

ps://puniversity.informaticsglobal.com:2229/login.aspx

**Topics relevant to the development of "Skill Development":**

1. Static Polymorphism
2. Method overloading, constructors
3. constructor overloading
4. this keyword
5. static keyword and Inner classes
6. Inheritance and Polymorphism.

for **Skill Development** through **Experiential Learning** techniques. This is attained through the assessment component mentioned in the course handout.

| ENG2001 | Advanced English | L- T- P- C | 1 | 0 | 2 | 2 |
|---|---|---|---|---|---|---|
| Version No. | 1.3 | | | | | |

| | |
|---|---|
| **Course Pre-requisites** | ENG1002 Technical English |
| **Anti-requisites** | **NIL** |
| **Course Description** | The course emphasizes on technical communication at advanced level by exploring critical reading, technical presentation and review writing. The purpose of the course is to enable learners to review literature in any form or any technical article and deliver technical presentations. Extensive activities in practical sessions equip to express themselves in various forms of technical communications. Technical presentations and the module on career setting focus on learners' area of interests and enhance their English language writing skills to communicate effectively. |
| **Course Out Come** | On successful completion of the course the students shall be able to:<br>1. Develop a critical and informed response reflectively, analytically, discursively, and creatively to their reading.<br>2. Communicate effectively, creatively, accurately and appropriately in their writing.<br>3. Deliver technical presentations<br>4. Design resume and create professional portfolio to find a suitable career |

**Course Content: Theory**

| | | | | |
|---|---|---|---|---|
| **Module 1** | **Critical Reasoning and Writing** | **Writing Essays** | **Critical Reading** | **4 Classes** |

Topics:

- A Catalog of Reading Strategies
- The Myth of Multitasking
- A Guide to Writing Essays Speculating about Causes or Effects
- Is Google Making Us Stupid (Self Study)

| | | | | |
|---|---|---|---|---|
| **Module 2** | **Technical Presentation** | **Presentation** | **Oral Skills** | **3 Classes** |

Topics:

- Planning the presentation
- Creating the presentation
- Giving the presentation

| | | | | |
|---|---|---|---|---|
| **Module 3** | **Writing Reviews** | **Prezi** | **Review Writing** | **4 Classes** |

Topics:

- Review Writing
- Short film reviews
- Advanced English Grammar (Self Study)

| **Module 4** | **Starting your Career** | **Online Writing Lab** | **Writing Skills** | **4 Classes** |
|---|---|---|---|---|

Topics**:**

- Preparing a Resume
- Writing Effective Application Letter
- Creating a Professional Portfolio

**Course Content: Practical Sessions**

| **Module 1** | **Critical Reasoning and Writing** | **8 Classes** |
|---|---|---|

1. Reading and Analyzing
   Level 1 – Annotation
   Level 2 - Assumptions
2. Writing Narrative Essays
   Level 1 – Draft 1
   Level 2 – Draft 2

| **Module 2** | **Technical Presentation** | **10 Classes** |
|---|---|---|

3. Fishbowl
   In Fishbowl, students form concentric circles with a small group inside and a larger group outside. Students in the inner circle engage in an in-depth discussion, while students in the outer circle listen and critique content, logic, and group interaction.
   Level 1 – within group
   Level 2 – Among 2 group
4. Technical Group Presentation

| **Module 3** | **Writing Reviews** | **4 Classes** |
|---|---|---|

5. Practice Worksheets
   Level 1 – Eliminating the Passive Voice
   Level 2 – Simple, compound and complex sentences
6. Writing Short Film Reviews

| **Module 4** | **Starting your Career** | **6 Classes** |
|---|---|---|

7. Collaborative Project
   Job search and writing report

Writing Resume

| Module 1-4 | Academic Journal | 2 Classes |
|---|---|---|

8. Academic Journal Writing

   Level 1- Mid Term
   Level 2 – End Term

**Targeted Application & Tools that can be used:** Writing reports, Review writing, Group Discussion, Dyadic interviews, Grammarly.com

**Project work/Assignment:**

**Academic Journal – Assignment**
In Academic Journal (CIJ), students compile task and activities completed in each module and submit to the instructor at the middle and end of the semester.

**References**


1. Hering, Heik. *How to Write Technical Reports: Understanding Structure, Good Design, Convincing Presentation*. Springer.
2. Johnson, Richard. (2010) *Technical Communication Today*. Pearson, 2015
3. Rice B. Adelrod, Charles R. Cooper and Ellen C. Carillo. (2020) *Reading Critically Writing Well: A Reader and Guide*. Beford/St. Martin's Macmillan Learning, New York.
4. The Princeton Review. (2010) *MCAT Verbal Reasoning & Writing*. The Princeton Review, Inc.
5. https://www.hitbullseye.com/Strong-and-Weak-Arguments.php Accessed on 10 Dec 2021
6. https://www.inc.com/guides/how-to-improve-your-presentation-skills.html Accessed on 10 Dec 2021


**Topics Relevant to "employability":** Critical Reasoning, Presentation, Review Writing and Starting Career

**Topics Relevant to "Human Values and Professional Ethics":** Critical reasoning

| Course Code: **PPS1012** | **Course Title: Enhancing Personality through Soft Skills**<br>Type of Course: Practical Only Course | L- T - P- C | 0 | 0 | 2 | 1 |
|---|---|---|---|---|---|---|

| | | | |
|---|---|---|---|
| Version No. | 1.0 | | |
| Course Pre-requisites | • Students are expected to understand Basic English.<br>• Students should have the desire and enthusiasm to be involved, participate and learn. | | |
| Anti-requisites | NIL | | |
| Course Description | This course is designed to enable students to understand soft skills concepts and improve confidence, communication, and professional skills to give the students a competitive advantage and increase chances of success in the professional world. The course will benefit learners in presenting themselves effectively through various activities and learning methodologies. | | |
| **Course Objective** | The objective of the course is to **familiarize the learners with the concepts of "Enhancing Personality through Soft Skills" and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.** | | |
| Course Out Comes | **On successful completion of this course, the students shall be able to:**<br>CO 1 **Identify the stages of** team formation<br>(Remember) CO 2 **Demonstrate** effective<br>presentation skills (Apply) CO3 **Prepare** professional<br>social media profile (Apply) | | |
| Course Content: | | | |
| Module 1 | Professional Brand Building | Brand Framework Activity | **6 Hours** |
| **Topics:** Personal brand definition, Crafting a compelling LinkedIn profile, Networking strategies, Leveraging AI tools for developing content for brand visibility.<br><br>**Activity:** Create a post and enhancing LinkedIn profile | | | |
| Module 2 | Art of Questioning | Role plays | **4 Hours** |
| **Topics:** Framing Questions, 5W1H Technique, Open-ended and Close-ended questions, Funnel technique, Probing questions, Leading questions | | | |
| Module 3 | Presentation Skills | Practice and evaluation of individual/group presentation | **12 Hours** |

| | | | |
|---|---|---|---|
| **Topics:** Content development, Delivery techniques, Audience Analysis, Timing and Pacing, handling questions and challenges.<br><br>**Activity:** Individual presentations or team presentation | | | |
| Module 4 | Team Building | Team building activities | **6 Hours** |
| **Topics:** Importance of team, stages of Team Formation, Trust and collaboration.<br><br>**Activity: Team Building Activity** | | | |
| Module 5 | Recap / Revision /Feedback Session | Discussion, Quiz | **2 Hours** |
| Targeted Applications & Tools that can be used:<br>1. TED Talks<br>2. You Tube Links<br>3. Activities | | | |
| Project work/Assignment: Mention the Type of Project /Assignment proposed for this course | | | |
| 1) Presentation Evaluation<br>2) LinkedIn assessment | | | |
| **Targeted Applications & Tools that can be used:**<br><br>1. TED Talks<br>2. YouTube Links<br>**3.** Videos by L&D Team shared on Edhitch/YouTube.com<br>**4.** LMS | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Course Code:**<br>**ECE2010** | **Course Title: Innovative Projects using Arduino** | **L- T-P- C** | - | - | - | 1 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | NIL | | | | | |
| **Anti-requisites** | NIL | | | | | |

<table>
<tr><td>Course Description</td><td colspan="4">This course is designed to provide an in-depth understanding of Arduino microcontrollers and their application in various real time projects involving sensors. Throughout the course, students will learn the fundamentals of Arduino programming and gain hands-on experience with a wide range of sensors. Students will explore how to connect and interface sensors with Arduino boards, read sensor data, and use it to control various output devices This course is suitable for beginners who are interested in exploring the world of electronics and developing practical applications using Arduino and sensors.</td></tr>
<tr><td>Course Objective</td><td colspan="4">The objective of the course is Employability Skills of student by using PARTICIPATIVE LEARNING techniques.</td></tr>
<tr><td>Course Outcomes</td><td colspan="4">On successful completion of the course the students shall be able to<br>1) Explain the main features of the Arduino prototype board<br>2) Demonstrate the hardware interfacing of the peripherals to Arduino system.<br>3) Understand the types of sensors and its functions<br>4) Demonstrate the functioning of live projects carried out using Arduino system.</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Basic concepts of Arduino</td><td>Hands-on</td><td>Interfacing Task and Analysis</td><td>4 Sessions</td></tr>
<tr><td colspan="5">Topics:<br>Introduction to Arduino, Pin configuration and architecture, Device and platform features, Concept of digital and analog ports, Familiarizing with Arduino Interfacing Board, API's , Introduction to Embedded C and Arduino platform, Arduino Datatypes and variables, Arduino i/o Functions, Arduino Communications, Arduino IDE, Various Cloud Platforms.</td></tr>
<tr><td>Module 2</td><td>Sensory Devices</td><td>Hands-on</td><td>Interfacing Task and Analysis</td><td>4 Sessions</td></tr>
<tr><td colspan="5">Arduino Sensors: Humidity Sensor, Temperature Sensor, Water Detector / Sensor, PIR Sensor, Ultrasonic Sensor, Connecting Switches and actuators, sensor interface with Arduino.<br>Introduction to 3D Printer: 3D Printer technology and its working Principles, Applications. Introduction to online Simulators: Working with Tinkercad Simulator.</td></tr>
<tr><td colspan="5">Topics: Types of Arduino boards, sensors, 3D Printer</td></tr>
<tr><td colspan="5">Targeted Application & Tools that can be used:<br><br>Application Area:</td></tr>
</table>

Home Automation, Environmental Monitoring, Agriculture and Farming, Industrial Automation, Internet of Things (IoT), Robotics, Wearable Devices, Security Systems, Education and Learning. These are just a few examples of the many application areas where Arduino and sensors can be applied. The flexibility and affordability of Arduino, combined with the wide range of sensors available, allow for endless possibilities in creating innovative projects.

**Professionally Used Software:** students can use open SOURCE Softwares Arduino IDE and Tincker CAD

**Project work/Assignment:**

**1. Projects: At the end of the course students will be completing the project work on solving many real time issues.**

**2. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. Presidency University Library Link .**

**3. Presentation: There will be a presentation from interdisciplinary students group, where the students will be given a project on they have to demonstrate the working and discuss the applications for the same**

**Textbook(s):**

**Monk Simon "Programming Arduino: Getting Started with Sketches", Mc Graw Hill Publications Second Edition**

**References**

**Reference Book(s)**

**1. Neerparaj Rai "Arduino Projects for Engineers" BPB publishers,first edition, 2016.**

2. Ryan Turner "Arduino Programming " Nelly B.L. International Consulting Ltd. first edition,2019.

**Online Resources (e-books, notes, ppts, video lectures etc.):**

1. Arduino trending Projects < https://www. https://projecthub.arduino.cc/>
2. Introduction to Arduino < https://onlinecourses.swayam2.ac.in/aic20_sp04/preview>
3. Case studies on Wearable technology< https://www.hticiitm.org/wearables>

**E-content:**

1. Cattle Health Monitoring System Using Arduino and IOT (April 2021| IJIRT | Volume 7 Issue 11 | ISSN: 2349-6002)

2. M H Hemanth Kumar, Ravi Pratap Singh, Nishu Sharma, Pragya Singh" IOT BASED SMART SECURITY SYSTEM USING ARDUINO" 2021 JETIR August 2021, Volume 8, Issue 8.

3. R. Maheswar, P. Jayarajan, S. Vimalraj, G. Sivagnanam, V. Sivasankaran and I. S. Amiri, "Energy Efficient Real Time Environmental Monitoring System Using Buffer Management Protocol," 2018, pp. 1-5, doi: 10.1109/ICCCNT.2018.8494144. https://ieeexplore.ieee.org/document/8494144.
4. Yaser S Shaheen,Hussam., " Arduino Mega Based Smart Traffic Control System ," December 2021 Asian Journal of Advanced Research and Reports 15(12): 43-52, 2021(15(12): 43-52, 2021):15(12): 43-52, 2021.

**Topics relevant to development of "SKILL":** System design for achieving Sustainable Development Goals.

| Course Code: MAT1002 | Course Title: Transform Techniques, Partial Differential Equations and Their Applications<br><br>Type of Course: School Core | L-T-P- C | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|---|
| **Version No.** | 2.0 | | | | | |
| **Course Pre-requisites** | **MAT1001 - Linear Algebra and Calculus** | | | | | |
| **Anti-requisites** | **NIL** | | | | | |
| **Course Description** | This course aims to introduce various transform techniques such as Laplace transform, Fourier transform and Z transform in addition to expressing functions in terms of Fourier series. The course covers applications of Laplace transform to LCR circuits and solution of difference equations using z-transform. The course also deals with the analytical methods for solving partial differential equations and the classical applications of partial differential equations. | | | | | |
| **Course Objective** | The objective of the course is **Skill Development** of student by using **Problem Solving Techniques.** | | | | | |
| **Course Outcomes** | On successful completion of this course the students shall be able to:<br>CO-1: Express functions in terms of uniformly convergent Fourier series.<br>CO-2: Apply Laplace transform technique to solve differential equations.<br>CO-3: Employ z-transform technique to solve difference equations.<br>CO-4: Solve a variety of partial differential equations analytically. | | | | | |
| **Course Content:** | | | | | | |
| **Module 1** | **Fourier Series** | | | | | **10 CLASSES** |
| Fourier series: Fourier series - Euler's formulae - Dirichlet's conditions - Change of Interval - half range series – RMS value – Parseval's identity – Computation of harmonics.<br>Engineering Applications of Fourier series. | | | | | | |
| **Module 2** | **Integral Transforms** | | | | | **15 Classes** |
| **Laplace Transform:** Definition and Laplace transforms of elementary functions. Properties of Laplace transform. Laplace transform of periodic function, unit-step function and impulse function and the related problems. Inverse Laplace transform of standard functions and problems, initial and final value theorems. Convolution theorem, solution of linear ordinary differential equations, LCR circuit problems.<br>**Fourier Transform:** Integral transforms, infinite Fourier transforms, Fourier sine and cosine transforms, inverse Fourier transforms.<br>Engineering Applications of Fourier transform. | | | | | | |
| **Module 3** | **Z Transform and Difference Equations** | | | | | **8 Classes** |
| | | | | | | |

Definition of Z-transform, Z transforms of standard functions and the related problems, standard inverse Z transforms and problems, computation of inverse Z-transform by partial fraction and convolution methods, solution of difference equations using Z-transforms.
Business and Engineering Applications of Z transform.

| | | | | |
|---|---|---|---|---|
| **Module 4** | **Partial Differential Equations** | | | **12 Classes** |

**Partial Differential Equations:** Formation of PDEs, solution of non-homogeneous PDEs by direct integration, solution of homogeneous PDEs involving derivatives with respect to only one independent variable, method of separation of variables, solution of the Lagrange's PDE of the type Pp + Qq = R.

**Applications of PDEs**: Various possible solutions of the one dimensional wave and heat equations by the method of separation of variables, D'Alembert's solution of the wave equation, solution of related boundary value problems.

**Targeted Applications & Tools that can be used:**

Applications to electrical engineering, vibrational analysis, acoustics, optics, signal processing, image processing, quantum mechanics, econometrics and shell theory by means of Fourier Series and integral transforms.

Opens up new approaches in terms of Z-transform to solving one of the central problems of modern science involving difference equations.

Finding the solutions of boundary value problems involving PDEs with reference to wave, heat, and Laplace equations.

**Assignment: Mention the Type of Project /Assignment proposed for this course**

**Two Assignments** based on the applications of the concepts leading to a minimum of 5 engineering problems from a common pool of problems.

**Text Book**

Erwin Kreyszig, 2017: " Advanced Engineering Mathematics", 10th Edition, John Wiley.

**References:**


6. B. S. Grewal, 2017: "Higher Engineering Mathematics" 45th Edition, Khanna Publishers.
7. Peter V O'Neil, 2015: "Advanced Engineering Mathematics", 7th Edition, Cengage Learning.
8. Glyn James, 2016: "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education.
9. Michael D. Greenberg, 2018: "Advanced Engineering Mathematics", 2nd Edition, Pearson Education.


**Topics relevant to the development of Foundation Skills: All the solution methods.**

**Topics relevant to development of Employability skills: Use of relevant scientific application packages.**

| Course Code: CSE2007 | Course Title: Design and Analysis of Algorithms<br><br>Type of Course: Program Core & Theory only | L- T- P- C | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|---|

| | | |
|---|---|---|
| **Version No.** | | 2.1 |
| **Course Pre-requisites** | | CSE2001, Data Structure and Algorithms |
| **Anti-requisites** | | **NIL** |
| **Course Description** | | This intermediate course enables students to design and analyze efficient algorithms to solve problems. This course covers typical design methods such as divide-and-conquer, dynamic programming and greedy method to solve problems. The students shall develop strong analytical skills as part of this course. |
| **Course Objectives** | | This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies. |
| **Course Outcomes** | | **On successful completion of the course the students shall be able to:**<br>**1] Identify the efficiency of a given algorithm. [Comprehension]**<br>**2] Employ divide and conquer approach to solve a problem. [Application]**<br>**3] Illustrate dynamic programming approach to solve a given problem. [Application]**<br>**4] Solve a problem using the greedy method. [Application]**<br>**5] Discuss the techniques to solve a real-world problem based on its complexity classes. [Comprehension]** |
| **Course Content:** | | |

| | | | | | |
|---|---|---|---|---|---|
| **Module 1** | Introduction to Algorithms | Assignment | | Problem Solving | **06 Sessions** |
| | **Topics:**<br>Algorithm Design and efficiency, measuring of running time of algorithms. Insertion sort and merge sort, Asymptotic Growth and Notations. Recurrences--Masters method.<br>**Assignment:** Comparatively evaluate bubble sort, insertion sort and mergesort. | | | | |
| **Module 2** | Review of Searching and Sorting techniques | Assignment | | Programming/ Problem Solving | **12 Sessions** |
| | **Topics:**<br>**Divide and Conquer:** Examples. Strassen's Matrix multiplication. | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | **Sorting:** Quicksort, Heapsort, Lower bound of comparison-based sorting, non-comparison-based sorting: Radix sort.<br>**Search:** Review of Linear Search and Binary Search, Hashing and hash tables.<br>**Assignment:** Design and develop an algorithm using Divide and Conquer technique for a given scenario. | | | | |
| **Module 3** | Greedy Algorithms | Assignment | | Programming/ Problem Solving | **09 Sessions** |
| | **Topics:**<br>Introduction, Fractional Knapsack Problem, Minimal Spanning Tree: Prim's Algorithm and Kruskal's Algorithm, Single-source Shortest Path: Dijkstra's Algorithm. Huffman Codes.<br>**Assignment:** Design and Develop a solution to a given scenario using greedy method. | | | | |
| **Module 4** | Dynamic Programming | Assignment | | Programming/ Problem Solving | **09 Sessions** |
| | **Topics:**<br>Introduction with examples, Principles of Memoization, 0-1 Knapsack Problem, Bellman-Ford algorithm, Floyd-Warshall's Algorithms. Optimal Binary Search Trees, Chain Matrix Multiplication.<br>**Assignment:** For a given scenario, attempt the three design paradigms learned so far and argue the best approach to solve the problem | | | | |
| **Module 5** | Complexity Classes and Heuristics | Assignment | | Programming/ Problem Solving | **09 Hours** |
| | **Topics:**<br>plexity classes: P, NP, and NP-Complete Problems. Backtracking: n-Queens. Branch and bound: Travelling Salesman Problem.<br>**Assignment:** Apply backtracking algorithmic designing technique for solving queen's problems for 4, 8 and 16 inputs. | | | | |
| | **Targeted Application & Tools that can be used:**<br>**Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers.**<br>**Professionally Used Software: GCC compiler.** | | | | |
| | **Project work/Assignment:** | | | | |
| **1.** | **2. Problem Solving: Design of Algorithms and implementation of programs.**<br>**3. Programming: Implementation of given scenario using Java.** | | | | |
| | **Text Book:**<br>T1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, *'Introduction to Algorithms'*, MIT Press, 2022. | | | | |

| | |
|---|---|
| | T2. J. Kleinberg and E. Tardos, *'Algorithm Design'*, Addison-Wesley, 2005. |
| | **References**<br>R1. Anany Levitin, *'Introduction to the Design and Analysis of Algorithms'*, Pearson Education, 2003.<br>R2. Tim Roughgarden, *'Algorithms Illuminated'* (books 1 through 3), Soundlikeyourself Publishing, 2017,18,19 respectively.<br>R3. AV Aho, J Hopcroft, JD Ullman, *'The Design and Analysis of Algorithms'*, Addison-Wesley, 1974. |

| **Course Code:**<br>**CSE3155** | **Course Title: Data Communications and Computer Networks**<br><br>**Type of Course: Program Core Theory–Laboratory integrated** | **L-T-P-C**<br>**3-0-2-4** | 3 | 0 | 2 | 4 |
|---|---|---|---|---|---|---|
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | Digital Design | | | | | |
| **Anti-requisites** | NIL | | | | | |
| **Course Description** | The objective of this course is to provide knowledge in data communications and computer networks, its organization and its implementation, and gain practical experience in the installation, monitoring, and troubleshooting of LAN systems. .<br>The associated laboratory is designed to implement and simulate various networks using Cisco packet tracer, NS2. All the lab exercises will focus on the fundamentals of creating multiple networks, topologies and analyzing the network traffics. | | | | | |
| **Course Objective** | The objective of the course is to familiarize the learners with the concepts of Data Communications and Computer Networks and attain **Employability** through **Problem Solving** Methodologies. | | | | | |
| **Course Out Comes** | On successful completion of the course, the students shall be able to:<br>1] I<br>llustrate the Basic Concepts Of Data Communication and Computer Networks.<br>2] Analyze the functionalities of the Data Link Layer.<br>3] Apply the Knowledge of IP Addressing and Routing Mechanisms in Computer Networks.<br>4] Demonstrate the working principles of the Transport layer and Application Layer. | | | | | |
| **Course Content:** | | | | | | |

| | | | | |
|---|---|---|---|---|
| **Module 1** | Introduction and Physical Layer- CO1 | Assignment | Problem Solving | 07 Classes |

Introduction to Computer Networks and Data communications, Network Components – Topologies, Transmission Media –Reference Models -OSI Model – TCP/IP Suite.

Physical Layer -Analog and Digital Signals – Digital and Analog Signals – Transmission - Multiplexing and Spread Spectrum.

| | | | | |
|---|---|---|---|---|
| Module 2 | Reference Models and Data Link Layer – CO2 | Assignment | Problem Solving | **7 Classes** |

Data Link Layer - Error Detection and Correction – Parity, LRC, CRC, Hamming Code, Flow Control and Error Control, Stop and Wait, ARQ, Sliding Window, Multiple Access Protocols, CSMA/CD,CSMA/CA, IEEE 802.3, IEEE 802.11 Ethernet.

| | | | | |
|---|---|---|---|---|
| Module 3 | Network Layer – CO 3 | Assignment | Problem Solving | **10 Classes** |

Network Layer Services - Network Layer Services, Switching Techniques, IP Addressing methods- IPv4 IPV6 – Subnetting. Routing, - Distance Vector Routing – RIP-BGP-Link State Routing –OSPF- Multi cast Routing-MOSPF- DVMRP – Broad Cast Routing. EVPN-VXLAN, VPLS, ELAN.

| | | | | |
|---|---|---|---|---|
| Module 4 | Transport and Application Layer - CO3 | Assignment | Problem Solving | **10 Classes** |

Transport Layers - Connection management – Flow control – Retransmission, UDP, TCP, congestion control, – Congestion avoidance (DECbit, RED)

The Application Layer: Domain Name System (DNS), Domain Name Space, SSH, FTP, Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – – SNMP, Web Services, Virtual Networking.

List of Laboratory Tasks:
Lab sheet -1, M-1, 3 [2 Hours]
Experiment No 1:
Level 1: Study of basic network commands and network configuration commands.
Lab sheet -2, M-1[2 Hours]
Experiment No 1:
Level 1: Identify and explore Network devices, models and cables. Introduction to Cisco packet tracer.
Experiment No. 2:
Level 2 – Create various network topologies using a cisco packet tracer.

Lab sheet -3, M-2,3 [2 Hours]
Experiment No. 1:
Level 2 - Basic Configuration of switch/router using Cisco packet tracer.
Experiment No. 2:
Level 2 -Configure the privilege level password and user authentication in the switch/router.

Lab sheet – 4, M-3 [2 Hours]
Experiment No. 1:

Level 2 - Configure the DHCP server and wireless router and check the connectivity

Lab sheet – 5, M-3 [2 Hours]
Experiment No. 1:
Level 2 - Configure the static routing in the Cisco packet tracer.
Experiment No. 2:
Level 2 - Configure the dynamic routing protocol in the Cisco packet tracer.

Lab sheet – 6, M-4 [2 Hours]
Experiment No. 1: Configuration of DNS Server with Recursive & Integrative approach in Cisco packet tracer.

Lab sheet – 7, M-4 [2 Hours]
Experiment No. 1:
Configure the telnet protocol in the router using the Cisco packet tracer.
Lab sheet – 8, M-4[2 Hours]
Experiment No. 1:
Level1- Introduction to NS2 and basic TCL program.
Lab sheet – 9, M-4 [2 Hours]
Experiment No. 1:
Level 1: Simulate three node Point to point network using UDP in NS2.
Experiment No. 2:
Simulate transmission of Ping message using NS2.
Lab sheet – 10, M-4[2 Hours]
Experiment No. 1:
Simulate Ethernet LAN using N-node in NS2.
Experiment No. 2:
Simulate Ethernet LAN using N-node using multiple traffic in NS2
Lab sheet –11, M-3,4 [2 Hours]
Experiment No. 1:
Level 1- Introduction to Wire Shark.
Experiment No. 2:
Level 2- Demonstration of packet analysis using wire shark.

Lab sheet –12, M-1,2,3 [2 Hours]
Experiment No. 1:
Level 2- Demonstration of switch and router configuration using real devices

**Targeted Application & Tools that can be used:** Cisco Packet Tracer, Wireshark, and NS2.

**Case Study/Assignment: Choose and analyze a network from any organization/Assignment proposed for this course in CO1-CO4**

**Problem Solving: Choose and appropriate devices and implement various network concepts.**

**Programming: Simulation of any network using NS2.**

**Text Book**

**Behrouz A. Forouzan, "Data Communications and Networking 5E", 5th Edition, Tata McGraw-Hill, 2017.**

| |
|---|
| **Andrew S Tanenbaum, Nick Feamster & David J Wetherall, "Computer Networks" Sixth Edition, Pearson Publication, 2022** |
| **References**<br><br>**"Computer Networking: A Top-Down Approach", Eighth Edition, James F. Kurose, Keith W. Ross, Pearson publication, 2021.**<br><br>**William Stallings, Data and Computer Communication, 8th Edition, Pearson Education, 2007.**<br><br>**Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2007.**<br><br>**E-Resources:**<br><br>**1.https://archive.nptel.ac.in/courses/106/105/106105183/**<br><br>**2. http://www.nptelvideos.com/course.php?id=393**<br><br>**3.https://www.youtube.com/watch?v=3DZLItfbqtQ**<br><br>**4.https://www.youtube.com/watch?v= fIdQ4yfsfM**<br><br>**5. https://www.digimat.in/keyword/106.html**<br><br>**https://puniversity.informaticsglobal.com/login** |

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|---|---|---|---|---|---|---|
| **Course Code:**<br>CSE3351 | **Course Title: Operating Systems**<br><br>**Type of Course: Program Core and Theory Only** | **L-T- P- C** | 3 | 0 | 0 | 3 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | CSE2009- Computer Organization, Problem solving using C<br><br>Students should have basic knowledge on computers, computer software & hardware, and Computer Organization. Prior programming experience in C is recommended. | | | | | |
| **Anti-requisites** | **NIL** | | | | | |
| **Course Description** | This course introduces the concepts of operating system operations, operating system structure and its design and implementation. It covers the classical operating systems internal algorithms such as process scheduling, synchronization, deadlocks detection and recovery and memory management. The course also enhances the problem solving, systems programming ability and case studies. | | | | | |

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| **Course Object** | The objective of the course is to familiarize the learners with the concepts of Operating Systems and attain **Employability** through **Problem Solving** Methodologies. | | | |
| **Course Out Comes** | On successful completion of the course the students shall be able to:<br>1] Describe the fundamental concepts of operating Systems and case studies. [**Knowledge**]<br>2] Demonstrate various CPU scheduling algorithms. .[ **Application** ]<br>3] Apply various tools to handle synchronization problems.[**Application**]<br>4] Demonstrate deadlock detection and recovery methods **[Application ]**<br>5] Illustrate various memory management techniques.[ **Application** ] | | | |
| **Course Content:** | | | | |
| **Module 1** | Introduction to Operating System | Assignment | Programming | **9 Hours** |
| Topics:<br>Introduction to OS , Operating-System Operations, Operating System Services, , System Calls and its types, Operating System Structure, System Program and its types, Linkers and Loaders, Overview of OS design and implementation, Open-source operating system | | | | |
| **Module 2** | Process Management | Assignment/Case Study | Programming/Simulation | **11 Hours** |
| Topics:<br>Process Concept, Operations on Processes, Inter Process Communication, Communication in client-server systems (sockets, RPC, Pipes), Introduction to threads - Multithreading Models, Thread Libraries, Threading Issues, Process Scheduling– Basic concepts, Scheduling Criteria, Scheduling Algorithms: FCFS, SJF, SRTF, RR and Priority. | | | | |
| **Module 3** | Process Synchronization and Deadlocks | Assignment | Programming | **11 Hours** |
| Topics:<br>The Critical-Section Problem- Peterson's Solution, Synchronization hardware, Semaphores, Classic Problems of Synchronization with Semaphore Solution- Producer-Consumer Problem, Reader-Writer problems, Dining Philosopher's Problem, . Introduction to Deadlocks, Necessary conditions for deadlock, Resource allocation Graph, Methods for handling deadlock: Deadlock Prevention and Implementation, Deadlock Avoidance and Implementation, Deadlock detection & Recovery from Deadlock. | | | | |
| **Module 4** | Memory Management | Assignment | Programming/Simulation | **10 Hours** |

Topics: Introduction to Memory Management, Basic hardware-Base and Limit Registers, Memory Management Unit(MMU), Dynamic loading and linking, Swapping, Contiguous and Non-Contiguous Memory Allocation, Segmentation, Paging - Structure of the Page Table – Virtual Memory and Demand Paging – Page Faults and Page Replacement Algorithms, Copy-on-write, Allocation of Frames, Thrashing

Introduction to File system management: File System Interface (access methods, directory structures), File system implementation.

**Targeted Application:**

**Application area is traffic management system, banking system, health care and many more systems where in there are resources and entities that use and manage the resources.**

**Software Tools:**

Oracle Virtual Box/VMWare Virtualization software [Virtual Machine Managers]. Used to install and work on multiple guest Operating Systems on top of a host OS.

Intel Processor identification utility: This software is used to explain about multi-core processors. It helps to identify the specifications of your Intel processor, like no of cores, Chipset information, technologies supported by the processor etc.

**Project work/Assignment**

**Demonstrate process concepts in LINUX OS.**

**Simulation of CPU scheduling algorithms.**

**Develop program to demonstrate use of Semaphores in threads.**

**Develop program to demonstrate use of deadlock avoidance algorithms.**

**Develop program to demonstrate use of page replacement algorithms.**

**Simulation of memory allocation strategies [first fit, best fit and worst fit].**

**Text Book**

Silberschatz A, Galvin P B and Gagne G , “Silberschatz's Operating System Concepts”, Paperback, Global Edition Wiley, 2019

**References**

Silberschatz A, Galvin P B and Gagne G, “Operating System Concepts”, 10th edition Wiley, 2018.
William Stallings, “Operating Systems”,Ninth Edition, By Pearson Paperback ,1 March 2018.
Sundaram RMD, Shriram K V, Abhishek S N, B Chella Prabha, “ Cracking the Operating System skills”, Dreamtech, paperback, 2020
Remzi H. Arpaci-Dusseau Andrea C. Arpaci-dusseau , “Operating Systems: Three Easy Pieces, Amazon digital Services”, September 2018.

**E-resources/Weblinks**

https://www.os-book.com/OS9/
https://pages.cs.wisc.edu/~remzi/OSTEP/
https://codex.cs.yale.edu/avi/os-book/OS10/index.html

| Course Code: CSE 215 / CSE 3078 | Cryptography and Network Security | L-T- P- C | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|---|
| Version No. | 2.0 | | | | | |

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| **Course Pre-requisites** | Basic Knowledge in Number Theory, Binary Operations | | | |
| **Anti-requisites** | **NIL** | | | |
| **Course Description** | The Course deals with the principles and practice of cryptography and network security, focusing in particular on the security aspects of the web and Internet. | | | |
| **Course Objective** | The objective of the course is to familiarize the learners with the concepts of **Cryptography and Network Security above** and attain **Skill Development** through **Problem Solving** methodologies. | | | |
| **Course Outcomes** | On successful completion of this course the students shall be able to:<br>1. Describe the basic concept of Cryptography<br>2. Classify different types of Cryptographic Algorithms<br>3. Solve Mathematical problems required for Cryptography<br>4. Illustrate Network Security concepts | | | |
| **Course Content:** | | | | |
| **Module 1** | **Introduction to Cryptography** | Assignment | Recognize the techniques | 07 Sessions |
| Topics:<br>Introduction to Cryptography, Model of Network Security, OSI Security architecture, Security Attacks: active attacks, passive attacks, services: Authentication, Access Control, Data Confidentiality, Data Integrity, Nonrepudiation, Substitution Ciphers : Play-fair and Hill Cipher, Vigenere cipher, Introduction to Block Cipher and Stream Cipher, Feistel Structure, ECB modes of block cipher | | | | |
| **Module 2** | **Symmetric Encryption Algorithms** | Assignment | Analysis of results | 09 Sessions |
| Topics:<br>Symmetric Encryption Algorithms : Data Encryption Standard, Introduction to Galois Field, Advanced Encryption Standard, Modular Arithmetic, Prime numbers, Fermat's little theorem, Applications of Fermat's little theorem in modular athematic, brief about primality testing and factorization, Euclidean and Extended Euclidean Algorithm, Euler Totient Function, Chinese remainder theorem. | | | | |
| **Module 3** | **Public Key Cryptography** | Assignment | Analysis of solutions | 09 Sessions |
| Topics:<br>Overview of Public Key Cryptography, RSA, Diffie-Helman Key exchange, Man in the middle attack, Cryptographic Hash functions, Secure Hash Algorithm, Message Authentication Codes – HMAC, Digital Signature, Ei-gamal Encryption, Elliptic curve cryptography overview | | | | |
| **Module 4** | **Network Security** | Assignment | Analysis of solutions | 05 Sessions |
| Topics:<br>Network Security fundamentals, Network Security applications: Authentication: Kerberos, PKI, Network Security applications: e-mail security: PGP, MIME, Network Security applications: IP Security: IPSec architecture, Network Security applications: DNS Security. | | | | |
| **Targeted Application & Tools that can be used:**<br>Students get the knowledge about cryptography techniques followed, the algorithms used for encryption and decryptions & the techniques for authentication and confidentiality of messages. | | | | |
| **Textbooks:**<br>**T1** William Stallings, "Cryptography and Network Security - Principles and Practices", 7th Edition, Pearson publication, ISBN: 978-93-325-8522-5, 2017 | | | | |

**References:**
**R1** Bruice Schneier, "Applied Cryptography – Protocols, Algorithms and Source code in C", Second Edition, Wiley Publication, ISBN: 978-81-265-1368-0, 2017
**R2** Cryptography and Network Security, Express Learning, ITL Education Solution Limited.
**R3** e-pg pathshala UGC lecture series

Web references: https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2233842&site=ehost-live https://nptel.ac.in/courses/106105031.

**Topics relevant to "Skill Development": Topics relevant to "Skill Development":**

1. Play-fair and Hill Cipher
2. Euclidean and Extended Euclidean Algorithm
3. Secure Hash Algorithm
4. Diffie-Helman Key exchange
5. Totient Function.
6. Fermat's little theorem

| **Course Code: PPS4004** | **Course Title: Aptitude Training-Intermediate**<br>**Type of Course: Practical Only Course** | **L-T P- C** | 0 | 0 | 2 | 1 |
|---|---|---|---|---|---|---|
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | Students should have the basic concepts of Quantitative aptitude along with its applications in real life problems. | | | | | |
| **Anti-requisites** | Nil | | | | | |
| **Course Description** | This is a skill-based training program for the students (Undergraduate). This course is designed to enable the students to enhance their skills in Quantitative Aptitude. | | | | | |
| **Course Objective** | The objective of the course is to familiarize the learners with the concepts of Aptitude and attain Skill Development through Problem Solving techniques. | | | | | |
| **Course Outcomes** | On successful completion of the course the students shall be able to:<br>CO1] **Understand** all the concepts.<br>CO2] **Apply** the concepts in problem solving (Bloom's taxonomy Level 3) | | | | | |
| **Course Content:** | | | | | | |

| **Module 1** | Quantitative Ability | Assignment | | **24 Hours** |
|---|---|---|---|---|
| Topics:<br>Number System, Percentage, Ratio and Proportion, Average, Mixture and Allegation, Time and Work, Profit and Loss, Time Speed and Distance, Boats and Streams, Simple Interest and Compound Interest, Probability, Permutation and Combination. | | | | |
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**Targeted Areas**
Application area: Placement activities and Competitive examinations.

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| Tools: LMS |
| **Text Book**<br>Fast Track Objective by Rajesh Verma<br>R S Aggarwal<br>Rakesh Yadav |
| **References**<br>www.indiabix.com<br>www.testbook.com<br>www.youtube.com/c/TheAptitudeGuy/videos |
| **Topics relevant to Skill development:** Quantitative aptitude for Skill Development through Problem solving Techniques. This is attained through assessment component mentioned in course handout. |
| **Evaluation – Continuous Evaluation (Topic wise evaluation Mid-Term & End term)** |

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|---|---|---|---|---|
| **Course Code:**<br>**CSE3216** | **Course Title:** Mastering Object- Oriented Concepts in Python<br>**Type of Course:** Lab | | **L- T- P- C** | 0-0-2-1 |
| **Version No.** | 1 | | | |
| **Course Pre-requisites** | CSE1005 – Programming in Python | | | |
| **Anti-requisites** | NIL | | | |
| **Course Description** | This course covers mastering object-oriented concepts in Python, including classes, inheritance, polymorphism, and encapsulation. Students will learn to design and implement robust, reusable code using real-world examples. Ideal for those with basic Python knowledge, it enhances problem-solving skills and software development proficiency. | | | |
| **Course Objective** | **The objective of the course is to familiarize the learners with the concepts of Mastering Object Oriented Concepts in Python and attain Skill Development through Experiential Learning.** | | | |
| **Course Out Comes** | **CO1:** Explain features of Oops along with creation of Python classes and objects to represent real world Objects. **[Understand]**<br>**CO2:** Demonstrate inheritance, polymorphism, and abstraction in Python to build maintainable and extendable software systems.**[Apply]**<br>**CO3:** Demonstrate exception handling in Python to build robust error-handling mechanisms and debugging tool and Assess various file handling techniques in Python. **[Apply]** | | | |
| **Course Content:** | | | | |
| **Module 1** | **Introduction to OOPS, Classes and Objects** | MCQ | Assignment | **10 Sessions** |
| **Topics:** | | | | |

**Introduction to OOPs:** Problems in Procedure Oriented Approach, Specialty of Python Language, Features of OOPS - Classes and Objects, Encapsulation, Abstraction, Inheritance and Polymorphism.

**Classes and Objects:** Creating a Class, The Self Variable, Constructor, Destructors, Types of Variables, Namespaces, Types of Methods - Instance Methods, Class Methods, Static Methods, Passing Members of One Class to Another Class, Inner Classes.

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| **Module 2** | **Inheritance and Polymorphism** | MCQ | Assignment | **10 Sessions** |

Constructors in Inheritance, Overriding Super Class Constructors and Methods, The Super() Method, Types of Inheritance – Single Inheritance, Multiple Inheritance, Method Resolution Order(MRO), Polymorphism, Duck Typing Philosophy of Python, Operator Overloading, Method Overloading, Method Overriding.

**Abstract Classes and Interfaces:** Abstract Method and Abstract Class, Interfaces in Python, Abstract Classes vs. Interfaces.

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|---|---|---|---|---|
| **Module 3** | **Exceptions and Files in Python** | MCQ | Assignment | **10 Sessions** |

**Exceptions:** Errors in a Python Program – Compile-Time Errors, Runtime Errors, Logical Errors. Exceptions, Exception Handling, Types of Exceptions, The Except Block, The assert Statement, User-Defined Exceptions, Logging the Exceptions.

**Files in Python:** Files, Types of Files in Python, Opening a File, Closing a File, Working with Text Files Containing Strings, Knowing whether a File Exists or Not, Working with Binary Files, The with Statement, Pickle in Python, The seek() and tell() Methods.

**Targeted Application & Tools that can be used:**

Python, PyCharm

**Project work/Assignment:**

**Assignment:**

Module 1 Assignment: Design and implement a Python application that simulates a banking system using classes and methods for customers and accounts.

Module 2 Assignment: Develop a Python application that simulates Library management system that demonstrates inheritance, polymorphism and abstraction concepts.

Module 3 Assignment: Develop a Python program that handles different types of exceptions while processing user input for a movie ticket booking system showcasing exception handling and File handling concepts.

**Text Book**

Dr. R Nageshwara Rao, “Core Python Programming”, Dreamtech Press, 3rd Edition, 2021.

**References**

Alex Martelli, Anna Ravenscroft & Steve Holden, “Python in a Nutshell The Definitive Reference”, O'Reilly Media, 3rd edition, 2017.

Luciano Ramalho, “Fluent Python Clear, Concise, and Effective Programming”, O'Reilly Media, 2nd edition, 2022.

Mark Lutz, “Learning Python: Powerful Object-Oriented Programming”, O'Reilly Media, 5th edition, 2013.

David Beazley, Brian K. Jones, “Python Cookbook: Recipes for Mastering Python 3”, O'Reilly Media, 3rd edition, 2013.

**Weblinks:**

www.learnpython.org

https://realpython.com/python3-object-oriented

https://www.tutorialspoint.com/python/python_oops_concepts.htm

**Topics relevant to “SKILL DEVELOPMENT”:**

Building Real-World Applications Using OOPS Concepts, Error Handling and Debugging Techniques, Concurrency in Python, Advanced File Handling Techniques, Creating and Managing Python Packages and Modules, Designing and Implementing Python Interfaces

**This is attained through assessment component mentioned in course handout.**

| **Course Code:** **CSE1700** | **Course Title:** Essentials of AI<br>**Type of Course:** Theory | **L- T-P- C** | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|---|
| **Version No.** | 2.0 | | | | | |
| **Course Pre-requisites** | NIL | | | | | |
| **Anti-requisites** | **NIL** | | | | | |
| **Course Description** | This course is a comprehensive introductory course designed to equip learners with the fundamental Python programming skills necessary to work with artificial intelligence (AI) technologies. This course is aimed at individuals who are new to AI but have a basic understanding of programming concepts. It combines Python programming fundamentals with hands-on experience in implementing AI techniques such as machine learning, neural networks, and natural language processing. | | | | | |
| **Course Objective** | The objective of the course is to Understand Python Programming Fundamentals, Manipulate and Process Data with Python, Implement Machine Learning Algorithms and Build and Train Neural Networks for AI Applications. | | | | | |
| **Course Outcomes** | On successful completion of the course the students shall be able to:<br>CO 1: Apply Python Programming to AI Projects<br>CO 2: Build and Train Machine Learning Models<br>CO 3: Develop Deep Learning Models with Neural Networks<br>CO 4: Deploy AI Solutions and Understand Ethical Implications | | | | | |

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| **Course Content:** | | | | |
| **Module 1** | Introduction to Python Programming for AI | Assignment | Implementation | **10 Sessions** |

Topics:

Python Basics: Variables, Data Types, Operators, and Control Flow Functions, Loops, and Conditionals statements, Data Structures: Lists, Tuples, Dictionaries, Sets ,Introduction to Libraries: NumPy and Pandas for data manipulation, Basic Input/Output and File Handling

Introduction to Python for AI: Libraries and Frameworks Overview

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|---|---|---|---|---|
| **Module 2** | Data Processing, Visualization | Assignment | Implementation | 10 Sessions |

Topics:

cleaning and preprocessing with Pandas,Handling missing data, outliers, and duplicates, Data transformation (Normalization, Encoding), Introduction to Matplotlib and Seaborn for Data Visualization, Exploratory Data Analysis (EDA), Visualizing datasets to understand patterns and relationships.

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| **Module 3** | Introduction to Machine Learning | Mini - Project | Implementation | 10 Sessions |

Topics:

What is Machine Learning? Types of ML algorithms Supervised Learning: Regression, Classification, Unsupervised Learning: Clustering, Key ML Algorithms: Linear Regression, Decision Trees, K-Means ,Introduction to Scikit-learn library

Model evaluation (Accuracy, Precision, Recall, Confusion Matrix)

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|---|---|---|---|---|
| **Module 4** | Neural Networks and Deep Learning | Quiz | Implementation | 10 Sessions |

Topics:

Introduction to Neural Networks and Deep Learning, Perceptron Model and Backpropagation

Deep Neural Networks and Activation Functions, Introduction to TensorFlow and Keras, Building and Training Neural Networks for Image and Text Classification, Overview of Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs)

**Targeted Application & Tools that can be used:**

**Applications**:

- **Data Preprocessing**: Clean and manipulate data from various sources such as CSV, Excel, SQL databases, and APIs.

- **Exploratory Data Analysis (EDA)**: Gain insights into datasets by identifying trends, patterns, and outliers.
- **Predictive Modeling**: Build models for classification (e.g., spam detection) and regression (e.g., house price prediction).
- **Clustering**: Group data into clusters for unsupervised learning tasks (e.g., customer segmentation).
- **Model Evaluation**: Assess model performance using appropriate metrics such as accuracy, precision, recall, and F1-score.

**Tools**:

- **Pandas**: For data manipulation and cleaning (e.g., handling missing values, merging datasets).
- **NumPy**: For numerical operations and working with arrays and matrices.
- **Matplotlib**: For creating static, animated, and interactive visualizations.
- **Seaborn**: For advanced data visualizations (e.g., heatmaps, pair plots).
- **Plotly**: For creating interactive visualizations, especially useful for large datasets.
- **Scikit-learn**: The go-to library for implementing machine learning algorithms (e.g., linear regression, decision trees, k-means clustering).
- **XGBoost**: For advanced gradient boosting models, particularly for large-scale machine learning tasks.
- **TensorFlow** (for deep learning in Module 4): A powerful open-source library for building machine learning and deep learning models.
- **Keras**: High-level neural network API, built on top of TensorFlow, to easily create deep learning models.

**NLTK**: The Natural Language Toolkit for various text processing tasks like tokenization, stemming, and part-of-speech tagging.

**spaCy**: A fast NLP library for advanced NLP tasks such as named entity recognition and dependency parsing.

**Transformers (by Hugging Face)**: A powerful library for using pre-trained Transformer-based models like BERT, GPT, and others for advanced NLP tasks.

**Text Book(s):**

T1: **Essentials of Python for Artificial Intelligence and Machine Learning** by Pramod Gupta and Anupam Bagchi

**Reference(s):**


1. "Artificial Intelligence with Python" – Prateek Joshi
2. "Python Machine Learning" – Sebastian Raschka & Vahid Mirjalili
3. "Hands-On Artificial Intelligence with Python" – Teet Straus
4. "Deep Learning for Coders with Fastai and PyTorch" – Jeremy Howard & Sylvain Gugger

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|---|---|---|---|---|---|---|
| **Course Code:**<br>**CSE2021** | **Course Title: Data Mining**<br>**Type of Course: Program Core/ Theory Only Course** | | **L- T-P- C** | 3 | 0 | 0 | 3 |
| **Version No.** | | 2.0 | | | | | |
| **Course Pre-requisites** | | | | | | | |
| **Anti-requisites** | | **NIL** | | | | | |
| **Course Description** | | Introduction, Applications, issues in data mining, data pre-processing techniques, data mining tasks, association rules, advanced association rules, classification, different approaches for classification, clustering, outlier detection. Recent trends in data mining. | | | | | |
| Course Objective | | The objective of the course is to familiarize the learners with the concepts of **Data Mining** and attain **Employability** through **Problem Solving** Methodologies | | | | | |
| **Course Out Comes** | | **On successful completion of the course the students shall be able to:**<br>• Apply the various pre-processing techniques needed for a data mining task.<br>• Understand the functionality of the various data mining algorithms.<br>• Appreciate the strengths and limitations of various data mining models.<br>• Understand the advances in data mining for real life applications. | | | | | |
| **Course Content:** | | | | | | | |
| **Module 1** | **Introduction to Data Mining** | | Assignment | | Data Collection | | **5 Sessions** |
| | **Topics:**<br>Introduction to Data mining – Data Mining Goals– Stages of the Data Mining Process–Data Mining Techniques– Merits and Demerits. | | | | | | |
| **Module 2** | **Data preprocessing** | | Quiz | | Problem Solving | | **9 Sessions** |
| | **Topics:**<br>Types of data – Pre Processing steps – Data Preprocessing Techniques – Similarity and Dissimilarity measures. | | | | | | |
| **Module 3** | **Data Mining – Frequent Patterns** | | Assignment | | Problem Solving | | **7 Sessions** |

<table>
<tr><td></td><td colspan="5">Topics:<br>Market Basket Analysis, item sets – Generating frequent item sets and rules efficiently – Apriori Algorithm– FPGrowth.</td></tr>
<tr><td>Module 4</td><td>Classification and clustering</td><td>Assignment</td><td></td><td>Problem Solving</td><td>11 Sessions</td></tr>
<tr><td></td><td colspan="5">Classification and Clustering Decision tree Induction – Bayesian classification –Classification by Back Propagation - Lazy learners – Modern evaluation and selection techniques to improve classification accuracy. Clustering Analysis – portioning method – Hierarchical methods – Density based method</td></tr>
<tr><td>Module 5</td><td>Outlier detection & Data mining trends</td><td>Assignment</td><td></td><td>Problem Solving</td><td>5 Sessions</td></tr>
<tr><td></td><td colspan="5">Anomaly detection preliminaries - Different Outlier detection techniques-Web mining- Text mining-Demonstration of Weka tool.</td></tr>
<tr><td></td><td colspan="5">Project work/Assignment:</td></tr>
<tr><td></td><td colspan="5">Assignments<br>1. From the dataset given, find the Entropy, Gain value of the attributes and also draw the decision tree using entropy for the given dataset.<br><br>2. Transactional Data Base, D given below which contains set of items find the frequent item set using the Apriori Algorithm and generate the Association Rules. Minimum Support count is 2%. Minimum confidence is 60%.<br><br>
<table>
<tr><th>$T_{id}$</th><th>Items</th></tr>
<tr><td>10</td><td>1, 3, 4</td></tr>
<tr><td>20</td><td>2, 3, 5</td></tr>
<tr><td>30</td><td>1, 2, 3, 5</td></tr>
<tr><td>40</td><td>2, 5</td></tr>
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<tr><td></td><td colspan="5">Text Book<br>T1 T1. Tan P. N., Steinbach M & Kumar V. “Introduction to Data Mining” ,Pearson Education, 2016.</td></tr>
<tr><td></td><td colspan="5">References<br>R1 Han J & Kamber M, “Data Mining: Concepts and Techniques”, Elsevier, Second Edition, 2006<br>R2 G K Gupta, “Introduction to Data Mining with Case Studies”, PHI, Third Edition, 2014.<br>R3 Alex Berson and Stephen J. Smith, “Data Warehousing, Data Mining and OLAP”, Tata McGraw – Hill<br><br>Additional web-based resources<br>W1. https://onlinecourses.swayam2.ac.in/cec20_cs12/preview Text book of Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamber and Jian Pei, Morgan Kaufmann Publishers, 2012.</td></tr>
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| | W2.https://puniversity.informaticsglobal.com:2284/ehost/detail/detail?vid=7&sid=e2d7362a-fd3049a98f0393e963521dbd%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=377411&db=nlebk<br>3. https://nptel.ac.in/courses/105105157 |
| | **Topics relevant to "EMPLOYABILITY SKILLS":** Data Mining Techniques, FP Growth for developing **Employability Skills** through **Participative Learning** techniques. This is attained through the assessment component mentioned in the course handout. |

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|---|---|---|---|---|---|---|
| **Course Code:** CSE1701 | **Course Title:** Essentials of AI Lab<br>**Type of Course:** Lab | **L- T-P- C** | 0 | 0 | 4 | 2 |
| **Version No.** | 2.0 | | | | | |
| **Course Prerequisites** | Basic Java Programming Knowledge, Mathematics: Linear Algebra and Probability, Basic Data Structures and Algorithms, Familiarity with Libraries and Tools, Understanding of Basic Machine Learning Concepts. | | | | | |
| **Anti-requisites** | **NIL** | | | | | |
| **Course Description** | This course introduces students to the essential concepts and techniques of Artificial Intelligence (AI) with a focus on practical implementation using Python. Students will explore core AI topics such as search algorithms, knowledge representation, machine learning, and neural networks, while gaining proficiency in using popular Python libraries like NumPy, pandas, scikit-learn, and TensorFlow. Through a series of lab exercises and projects, students will apply AI principles to solve real-world problems, develop intelligent applications, and understand how AI systems function at a foundational level. | | | | | |
| **Course Objective** | The primary objectives of the course are to Gain Proficiency in AI Concepts and Python Implementation, Develop and Implement Machine Learning Models, Understand and Build Neural Networks, Apply AI to Real-World Problems | | | | | |
| **Course Outcomes** | On successful completion of the course the students shall be able to:<br>1. Proficiency in Implementing AI Algorithms Using Python<br>2. Ability to Build and Evaluate Machine Learning Models<br>3. Hands-on Experience with Neural Networks and Deep Learning<br>4. Practical Application of AI to Solve Real-World Problems | | | | | |
| **Course Content:** | | | | | | |
| **Module 1** | nIntroduction to AI and ython for AI | ssignment | mplementation | | **10 Sessions** | |

**Lab Assignment 1: Setting Up the Python Environment**

- **Objective:** Get familiar with setting up a Python environment for AI projects.
- **Tasks:**
  1. Install Python, Anaconda, and Jupyter Notebook.
  2. Set up a virtual environment for AI development.
  3. Install essential Python libraries: numpy, pandas, matplotlib, and scikit-learn.
  4. Write and execute simple Python code to verify installation (e.g., print a "Hello AI" message).

**Lab Assignment 2: Basic Python Programming for AI**

- **Objective:** Understand and practice the basic Python syntax and data structures used in AI.
- **Tasks:**
  1. Write Python code to work with basic data types (integer, float, string, boolean).
  2. Implement and manipulate Python lists, tuples, sets, and dictionaries.
  3. Create basic control flow structures: if-else, for loops, while loops.
  4. Use functions and lambda functions to solve small AI-related problems, such as calculating factorial or Fibonacci numbers.

**Lab Assignment 3: Data Exploration and Preprocessing**

- **Objective:** Learn how to work with data for AI models.
- **Tasks:**

1. Load a dataset (e.g., Titanic or Iris dataset) using pandas.
2. Clean the dataset by handling missing values, removing duplicates, and converting data types if needed.
3. Explore the dataset by visualizing it using matplotlib and seaborn.
4. Perform basic data preprocessing tasks such as feature scaling, encoding categorical variables, and splitting data into training and testing sets.

| Module 2 | Data Processing, Visualization | Assignment | Implementation | 10 Sessions |
|---|---|---|---|---|

**Lab Assignment 1: Data Preprocessing with Pandas**
**Objective:**
Learn the fundamentals of data preprocessing, including cleaning, handling missing values, and performing basic transformations using **Pandas**.
**Tasks:**

1. **Load and Inspect the Dataset:**
   - Load a dataset (e.g., **Iris**, **Titanic**, **Wine Quality** dataset) using pandas.read_csv() or pandas.read_excel().
   - Inspect the first few rows of the dataset using .head() and check basic information using .info().
2. **Handle Missing Values:**
   - Identify missing values in the dataset using .isnull() or .isna().
   - Handle missing data by imputing with mean, median, or mode using SimpleImputer from sklearn, or remove rows with missing data using .dropna().
3. **Data Transformation:**
   - Convert categorical variables to numerical values using one-hot encoding or label encoding.
   - Normalize/standardize numerical columns using StandardScaler or MinMaxScaler from sklearn.
4. **Subset and Filter Data:**
   - Create subsets based on certain conditions (e.g., select rows where a specific feature value is greater than a threshold).
   - Filter outliers from numerical data using interquartile range (IQR).

**Lab Assignment 2: Data Aggregation and Grouping with Pandas**
**Objective:**
Master aggregation and grouping techniques using **Pandas** for summarizing data.
**Tasks:**

1. **Group Data by Category:**
   - Group data by one or more categorical features (e.g., "class" in the Iris dataset or "embarked" in Titanic dataset).
   - Use .groupby() to calculate aggregate statistics such as mean, median, sum, and count.
2. **Pivot Tables:**
   - Create a pivot table to summarize data (e.g., aggregate the average age of passengers in the Titanic dataset by class and gender).
   - Use .pivot_table() to perform multi-dimensional aggregation.
3. **Data Aggregation and Custom Functions:**
   - Apply custom aggregation functions to the grouped data (e.g., calculate custom metrics or perform complex transformations within each group).
4. **Sorting and Ranking Data:**
   - Sort the dataset by multiple columns (e.g., sorting by "age" or "fare").
   - Rank data based on specific metrics (e.g., assign ranks to passengers by fare in the Titanic dataset).

**Lab Assignment 3: Data Visualization with Matplotlib and Seaborn**
**Objective:**
Learn to visualize datasets using **Matplotlib** and **Seaborn** for better understanding and insights.

**Tasks:**

1. **Basic Plotting with Matplotlib:**
   - Create simple plots like line plots, bar plots, and histograms using **Matplotlib**.
   - Customize the plots by setting titles, labels, and legends.
   - Create scatter plots to visualize relationships between two variables.
2. **Advanced Plotting with Seaborn:**
   - Use **Seaborn** to create advanced visualizations like pair plots, heatmaps, box plots, and violin plots.
   - Customize visualizations with color palettes, styling, and themes.
   - Create a correlation heatmap to visualize correlations between features in the dataset.
3. **Distribution Visualizations:**
   - Plot distributions of continuous variables using **Seaborn's** distplot() or kdeplot().
   - Create bar plots for categorical variables to understand their frequency distribution.
4. **Multi-Plot Grid Layouts:**
   - Use **Matplotlib's** subplots() function to create multiple plots in a grid layout for comparison (e.g., scatter plot and histogram in the same figure).

**Lab Assignment 4: Visualizing Relationships and Feature Importance**

**Objective:**

Understand how to visualize relationships between features and evaluate feature importance for predictive models.

**Tasks:**

1. **Scatter Plot Matrix:**
   - Use **Seaborn's** pairplot() to create a scatter plot matrix to visualize the relationships between multiple features.
   - Analyze the pairwise relationships between features and identify any patterns or correlations.
2. **Heatmap of Correlation Matrix:**
   - Use **Pandas** to calculate the correlation matrix of numeric features.
   - Visualize the correlation matrix using **Seaborn's** heatmap() to understand feature correlations and multicollinearity.
3. **Feature Importance from Models:**
   - Train a decision tree or random forest model using **scikit-learn** on a dataset (e.g., **Iris** or **Titanic**).
   - Visualize feature importance using a bar chart to understand which features have the most impact on the model.
4. **Visualizing Predictions vs. Actual Values:**
   - For regression tasks, visualize the predicted values against the actual values using a scatter plot.
   - For classification tasks, visualize the classification results with a confusion matrix.

**Lab Assignment 5: Time Series Data Visualization and Processing**

**Objective:**

Learn how to process and visualize time series data, which is common in AI applications like forecasting and trend analysis.

**Tasks:**

1. **Load and Preprocess Time Series Data:**
   - Load a time series dataset (e.g., stock market data, weather data).
   - Parse dates properly and set the date column as the index using pd.to_datetime() and .set_index().
2. **Plot Time Series Data:**
   - Plot a time series line chart using **Matplotlib** to visualize trends over time.
   - Create rolling averages (e.g., 7-day, 30-day) to smooth out short-term fluctuations in the time series data.
3. **Seasonal Decomposition of Time Series:**
   - Use **statsmodels** to decompose a time series into seasonal, trend, and residual components.

- Visualize the decomposed components to understand seasonal variations.

4. **Forecasting with Simple Models:**
   - Use simple forecasting models (e.g., moving average, ARIMA) to predict future values.
   - Visualize the forecasted data along with actual historical data.

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| **Module 3** | Introduction to Machine Learning | Assignments | Implementation | 10 Sessions |

**Lab Assignment 3: Implementing Linear Regression**

- **Tasks:**
  1. Load a real-world dataset (e.g., **Boston Housing Price** dataset).
  2. Train a **Linear Regression** model using LinearRegression() from scikit-learn.
  3. Evaluate the model using **Mean Squared Error (MSE)** and **R-squared Score**.
  4. Visualize the regression line using Matplotlib.

**Lab Assignment 4: Logistic Regression for Classification**

- **Tasks:**
  1. Load the **Iris** or **Breast Cancer** dataset.
  2. Preprocess the dataset (handle missing values, encode categorical variables, scale data).
  3. Train a **Logistic Regression** model using LogisticRegression().
  4. Evaluate performance using **Accuracy, Precision, Recall, F1-score**.
  5. Plot the **Confusion Matrix** and **ROC Curve**.

**Lab Assignment 5: Implementing K-Nearest Neighbors (KNN)**

- **Tasks:**
  1. Load the **Iris dataset** and split it into training and testing sets.
  2. Train a **KNN classifier** using KNeighborsClassifier().
  3. Experiment with different values of **K** and evaluate performance.
  4. Visualize decision boundaries using a **scatter plot**.

**Lab Assignment 6: Decision Trees and Random Forests**

- **Tasks:**
  1. Train a **Decision Tree classifier** on the Titanic dataset.
  2. Visualize the tree structure using plot_tree().
  3. Train a **Random Forest classifier** and compare performance with the decision tree.
  4. Determine the **feature importance** using feature_importances_.

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| **Module 4** | Neural Networks and Deep Learning | Quiz | Implementation | 10 Sessions |

**Lab Assignment 7: Introduction to Perceptron and Activation Functions**

**Tasks:**

1. Implement a **single-layer perceptron** using NumPy.
2. Train the perceptron to classify **AND, OR, XOR** gates.
3. Experiment with different **activation functions** (Sigmoid, ReLU, Tanh).
4. Visualize decision boundaries.

**Lab Assignment 8: Building a Simple Neural Network with Keras**

**Tasks:**

1. Load the **MNIST dataset** from keras.datasets.
2. Preprocess the data (normalize pixel values, reshape input).
3. Create a **fully connected neural network** using Sequential API.
4. Train and evaluate the model using **categorical cross-entropy loss** and **accuracy**.

**Lab Assignment 9: Implementing CNN from Scratch**

**Tasks:**

1. Load the **CIFAR-10 dataset**.
2. Build a CNN with **Conv2D, MaxPooling2D, Flatten, Dense, Dropout** layers.

3. Use **Adam optimizer** and **categorical cross-entropy loss**.
4. Train and visualize loss/accuracy curves.

**Lab Assignment 10: Image Augmentation & Regularization**
**Tasks:**
1. Apply **data augmentation** (rotation, zoom, flipping) using ImageDataGenerator.
2. Add **dropout and batch normalization** to prevent overfitting.
3. Compare model performance with and without augmentation.

**Lab Assignment 11: Transfer Learning with Pre-trained Models**
**Tasks:**
1. Use **VGG16 or ResNet50** pre-trained on ImageNet.
2. Replace the output layer to classify **new images**.
3. Freeze earlier layers and fine-tune deeper layers.
4. Evaluate the model on a custom **dataset (e.g., Cats vs. Dogs)**.

**Lab Assignment 12: Implementing RNN for Text Classification**
**Tasks:**
1. Load **IMDB movie reviews dataset** from keras.datasets.
2. Preprocess text (tokenization, padding sequences).
3. Build an **RNN** with **Embedding, SimpleRNN, Dense** layers.
4. Train and evaluate the model.

**Lab Assignment 13: Building an LSTM for Time Series Prediction**
**Tasks:**
1. Load a **time series dataset** (e.g., stock prices, temperature data).
2. Preprocess the data (normalize, reshape).
3. Build an **LSTM-based model**.
4. Predict future values and visualize trends.

**Targeted Application & Tools that can be used:**
**Applications**:
- **Data Preprocessing**: Clean and manipulate data from various sources such as CSV, Excel, SQL databases, and APIs.
- **Exploratory Data Analysis (EDA)**: Gain insights into datasets by identifying trends, patterns, and outliers.
- **Predictive Modeling**: Build models for classification (e.g., spam detection) and regression (e.g., house price prediction).
- **Clustering**: Group data into clusters for unsupervised learning tasks (e.g., customer segmentation).
- **Model Evaluation**: Assess model performance using appropriate metrics such as accuracy, precision, recall, and F1-score.

**Tools**:
- **Pandas**: For data manipulation and cleaning (e.g., handling missing values, merging datasets).
- **NumPy**: For numerical operations and working with arrays and matrices.
- **Matplotlib**: For creating static, animated, and interactive visualizations.
- **Seaborn**: For advanced data visualizations (e.g., heatmaps, pair plots).
- **Plotly**: For creating interactive visualizations, especially useful for large datasets.
- **Scikit-learn**: The go-to library for implementing machine learning algorithms (e.g., linear regression, decision trees, k-means clustering).
- **XGBoost**: For advanced gradient boosting models, particularly for large-scale machine learning tasks.
- **TensorFlow** (for deep learning in Module 4): A powerful open-source library for building machine learning and deep learning models.

- **Keras**: High-level neural network API, built on top of TensorFlow, to easily create deep learning models.

**NLTK**: The Natural Language Toolkit for various text processing tasks like tokenization, stemming, and part-of-speech tagging.

**spaCy**: A fast NLP library for advanced NLP tasks such as named entity recognition and dependency parsing.

**Transformers (by Hugging Face)**: A powerful library for using pre-trained Transformer-based models like BERT, GPT, and others for advanced NLP tasks.

**Text Book(s):**

*T1: **Essentials of Python for Artificial Intelligence and Machine Learning** by Pramod Gupta and Anupam Bagchi*

**Reference(s):**

1. "Artificial Intelligence with Python" – Prateek Joshi
2. "Python Machine Learning" – Sebastian Raschka & Vahid Mirjalili
3. "Hands-On Artificial Intelligence with Python" – Teet Straus
4. "Deep Learning for Coders with Fastai and PyTorch" – Jeremy Howard & Sylvain Gugger

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| **Catalogue prepared by** | |
| **Recommended by the Board of Studies on** | |
| **Date of Approval by the Academic Council** | |

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|---|---|---|---|---|---|
| **Course Code:** **CSD1712** | **Course Title: Statistical Foundations for Data Science**<br>**Type of Course: Theory** | **L-T-P-C** | 3 | 0 0 | 3 |
| **Version No.** | 1.0 | | | | |
| **Course Pre-requisites** | NIL | | | | |
| **Anti-requisites** | NIL | | | | |
| **Course Description** | This course provides an in-depth introduction to statistics and machine learning theory, methods, and algorithms for data science. Topics include multiple regression, kernel learning, sparse regression, generalized linear models, supervised and unsupervised learning, deep learning, covariance learning, factor models, principal component analysis, and more. The course emphasizes the applicability and limitations of these methods using mathematical statistics and real-world data sets. | | | | |
| **Course Objective** | The objective of the course is to familiarize the learners with the concepts of **Statistical Foundations for Data Science** and attain **Employability** through **Participative Learning** techniques. | | | | |
| **Course Out Comes** | On successful completion of the course the students shall be able to:<br>1. Understand the rise and significance of Big Data in various fields such as Biological Sciences, Health Sciences, Computer and Information Sciences, Economics and Finance, Business and Program Evaluation, Earth Sciences, and Astronomy.<br>2. Develop a strong foundation in multiple linear regression and the Gauss-Markov theorem.<br>3. Apply linear regression with random design and partial linear regression.<br>4. Apply the power method and learn about factor models and structured covariance learning. | | | | |

| Course Content: | | | | |
|---|---|---|---|---|
| **Module 1** | Introduction | Assignment | Programming | **No. of Classes:10** |

**Topics:**

Introduction to bigdata, Rise of Big Data and Dimensionality in -Biological Sciences ,Health Sciences , Computer and Information Sciences , Economics and Finance, Business and Program Evaluation, Earth Sciences and Astronomy - Impact of Big Data - Impact of Dimensionality , Computation of Noise Accumulation , Spurious Correlation , Statistical theory - Aim of High-dimensional Statistical Learning.

| **Module 2** | Multiple Linear Regression | Assignment | Programming | **No. of Classes:12** |
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Topics:

Multiple Linear Regression, The Gauss-Markov Theorem , Statistical Tests - Weighted Least-Squares , Box-Cox Transformation , Model Building and Basis Expansions, Polynomial Regression - Spline Regression , Multiple Covariates , Ridge Regression - Bias-Variance Tradeoff - Penalized Least Squares - Bayesian Interpretation - Ridge Regression Solution Path - Kernel Ridge Regression , Exponential family 231 5.1.2 Elements of generalized linear models , Maximum likelihood , Computing MLE: Iteratively reweighed least squares , Deviance and Analysis of Deviance, Regularization parameters, Refitted Cross-validation, Extensions to Nonparametric Modeling.

| **Module 3** | Inference in linear regression | Assignment | Programming | **No. of Classes:14** |
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**Topics:**

Inference in linear regression - Debias of regularized regression estimators , Choices of weights , Inference for the noise level , Inference in generalized linear models , Desparsified Lasso , Decorrelated score estimator - Test of linear hypotheses , Numerical comparison - Asymptotic efficiency 345 7.3.1 Statistical efficiency and Fisher information, Linear regression with random design , Partial linear regression , Gaussian graphical models - Inference via penalized least squares , Sample size in regression and graphical models , General solutions , Local semi-LD decomposition , Data swap , Gradient approximation

| **Module 4** | Principal Component Analysis | Assignment | Programming | **No. of Classes:9** |
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**Topics:**

Principal Component Analysis -Introduction to PCA , Power Method , Factor Models and Structured Covariance Learning , Factor model and high-dimensional PCA-Cluster Analysis - K-means clustering , Hierarchical clustering , Model-based clustering , Spectral clustering , Data-driven choices of the number of clusters , Variable Selection in Clustering , Sparse K-means clustering , Sparse model-based clustering , Sparse Mixture of Experts Model, Correlation Screening, Generalized and Rank Correlation Screening, Nonparametric Screening, Sure Screening and False Selection.

**Targeted Application & Tools that can be used:**

**Tools**: Torch, Google Colaboratory, Spider, Jupiter Notebook

**Project work/Assignment:**

**Text Book**

**TextBook(s):**

**T1** Fan, J., Li, R., Zhang, C.-H., and Zou, H. (2020). Statistical Foundations of Data Science. CRC Press.

**T2** Wainwright, M. J. (2019). *High-dimensional statistics: A non-asymptotic viewpoint.* Cambridge University Press.

**References**

**R1.** James, G., Witten, D., Hastie, T.J., Tibshirani, R. and Friedman, J. (2013). *An Introduction to Statistical Learning with Applications in R* . Springer, New York.

**R2**. Hastie, T.J., Tibshirani, R. and Friedman, J. (2009). *The elements of Statistical Learning: Data Mining, Inference, and Prediction* (2nd ed). Springer, New York.

**R3.** Buehlmann, P. and van de Geer, S. (2011). *Statistics for High-Dimensional Data: Methods, Theory and Applications*. Springer, New York.

**Book link**

**R1:** Fan, J., Li, R., Zhang, C.-H., and Zou , Statistical Foundations of Data Science. CRC Press.

**E book link**

**R2:** W. N. Venables, D. M. Smith and the R Core Team, https://cran.r-roject.org/doc/manuals /R-intro.pdf, October,2022

**eb resources:**

**W1. https://www.youtube.com/playlist?list=PLOU2XLYxmsIK9qQfztXeybpHvru-TrqAP**

**https://presiuniv.knimbus.com/user#/**

**Topics relevant to "EMPLOYABILITY SKILLS":** - Asymptotic efficiency 345 7.3.1 Statistical efficiency and Fisher information, Linear regression with random design , Partial linear regression **for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout..**

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| **Catalogue prepared by** | Ms.Radhika Sreedharan |
| **Recommended by the Board of Studies on** | |
| **Date of Approval by the Academic Council** | |

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|---|---|---|---|---|---|---|
| **Course Code:CSD1703** | **Course Title: Introduction to Data Science**<br>**Type of Course: Program Core** | **L-P-C** | 3 | 0 | 0 | 3 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | NIL | | | | | |
| **Anti-requisites** | NIL | | | | | |
| **Course Description** | This course offers a comprehensive introduction to the interdisciplinary field of Data Science. Students will explore the data science lifecycle, beginning with data acquisition and progressing through cleaning, exploratory analysis, visualization, and basic predictive modeling. Emphasis is placed on using Python-based tools (Pandas, NumPy, Matplotlib, Seaborn, Scikit-learn) to perform real-world data tasks. The course fosters critical thinking, statistical reasoning, and data-driven decision-making essential for modern data science roles. | | | | | |
| **Course Objectives** | To introduce students to the fundamentals and workflow of Data Science<br>To impart practical experience with Python tools used in data analysis<br>To develop understanding of data exploration, transformation, and visualization techniques<br>To build foundational knowledge of statistical methods and basic predictive modeling | | | | | |
| **Course Out Comes** | CO1: Describe the stages of the data science lifecycle and tools used<br>CO2: Perform data wrangling, cleaning, and exploratory analysis with Python<br>CO3: Create and interpret data visualizations for effective communication<br>CO4: Apply basic statistical concepts and develop predictive models | | | | | |
| **Course Content:** | | | | | | |
| **Module 1** | **Introduction to Data Science** | **Quiz** | **Knowledge based** | | **10 Hours** | |
| Introduction to Data Science: Definitions and Applications, Data Science Lifecycle, Python for Data Science: Syntax, Variables, Data Types, Control Flow, Setting up Environment: Jupyter Notebook, Anaconda, Google Colab, Working with Python Libraries: NumPy and Pandas Basics, Real-world applications of Data Science (case studies from healthcare, finance, and social media) | | | | | | |

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| **Module 2** | **Data Wrangling and Exploration** | **Assignment** | **Implementation** | **12 Hours** |
| DataFrames and Series in Pandas , Data Cleaning: Missing Values, Duplicates, Data Type Conversion, Data Transformation: Sorting, Filtering, Merging, Grouping,Feature Engineering Basics, Exploratory Data Analysis (EDA): Descriptive Statistics, Distributions, Outlier Detection, Hands-on: Analyzing a public dataset (e.g., Titanic, Iris) | | | | |
| **Module 3** | **Data Visualization and Communication** | **Term paper/Assignment** | **Implementation** | **11 Hours** |
| Introduction to Data Visualization: Importance & Principles,Visualization with Matplotlib and Seaborn Line Charts, Bar Charts, Histograms, Boxplots, Pairplots, Heatmaps, KDE plots, and advanced visualizations, Creating Dashboards using Plotly or Streamlit (Intro), Data Storytelling: How to Present Data Insights Effectively , Project: Create an interactive EDA dashboard | | | | |
| **Module 4** | **Introduction to Statistics & Predictive Modeling** | **Term paper/Assignment** | **Implementation** | **12 Hours** |
| Descriptive Statistics: Mean, Median, Mode, Variance, Standard Deviation, Probability Basics and Distributions , Hypothesis Testing: t-Test, p-value, Confidence Intervals, Correlation and Causation, Introduction to Regression:<br>• Simple and Multiple Linear Regression<br>• Classification Overview: Logistic Regression<br>Introduction to Model Evaluation: Accuracy, Confusion Matrix, Precision, Recall, Case Study: Predictive modeling on a real dataset | | | | |
| Textbook(s):<br>**Title:** *Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter* ,**Author:** Wes McKinney,**Publisher:** O'Reilly Media, **Edition:** 3rd Edition, 2023 | | | | |
| **References:**<br>1. **Title:** *Practical Statistics for Data Scientists: 50+ Essential Concepts,***Authors:** Peter Bruce, Andrew Bruce, Peter Gedeck, **Publisher:** O'Reilly Media, 2nd Edition (2021)<br>2. **Title:** *Doing Data Science,* **Authors:** Cathy O'Neil, Rachel Schutt, **Publisher:** O'Reilly Media<br>3. **Title:** *An Introduction to Statistical Learning with Applications in R,***Authors:** Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, **Publisher:** Springer, 2nd Edition (2021) | | | | |
| **Catalogue prepared by** | Dr.Saira Banu | | | |
| **Recommended by the Board of Studies on** | | | | |
| **Date of Approval by the Academic Council** | Academic Council Meeting No. | | | |

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|---|---|---|---|---|---|---|
| **Course Code: CSE1701** | **Course Title:** Essentials of AI Lab<br>**Type of Course:** Lab | **L- T-P- C** | 0 | 0 | 4 | 2 |
| **Version No.** | 2.0 | | | | | |
| **Course Prerequisites** | Basic Java Programming Knowledge, Mathematics: Linear Algebra and Probability, Basic Data Structures and Algorithms, Familiarity with Libraries and Tools, Understanding of Basic Machine Learning Concepts. | | | | | |
| **Anti-requisites** | **NIL** | | | | | |
| **Course Description** | This course introduces students to the essential concepts and techniques of Artificial Intelligence (AI) with a focus on practical implementation using Python. Students will explore core AI topics such as search algorithms, knowledge representation, machine learning, and neural networks, while gaining proficiency in using popular Python libraries like NumPy, pandas, scikit- | | | | | |

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| | learn, and TensorFlow. Through a series of lab exercises and projects, students will apply AI principles to solve real-world problems, develop intelligent applications, and understand how AI systems function at a foundational level. |
| **Course Objective** | The primary objectives of the course are to Gain Proficiency in AI Concepts and Python Implementation, Develop and Implement Machine Learning Models, Understand and Build Neural Networks, Apply AI to Real-World Problems |
| **Course Outcomes** | On successful completion of the course the students shall be able to:<br>1. Proficiency in Implementing AI Algorithms Using Python<br>2. Ability to Build and Evaluate Machine Learning Models<br>3. Hands-on Experience with Neural Networks and Deep Learning<br>4. Practical Application of AI to Solve Real-World Problems |
| **Course Content:** | |

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|---|---|---|---|---|
| **Module 1** | InIntroduction to AI and Python for AI | Assignment | Implementation | **10 Sessions**<br>I |

**Lab Assignment 1: Setting Up the Python Environment**

- **Objective:** Get familiar with setting up a Python environment for AI projects.
- **Tasks:**

1. Install Python, Anaconda, and Jupyter Notebook.
2. Set up a virtual environment for AI development.
3. Install essential Python libraries: numpy, pandas, matplotlib, and scikit-learn.
4. Write and execute simple Python code to verify installation (e.g., print a "Hello AI" message).

**Lab Assignment 2: Basic Python Programming for AI**

- **Objective:** Understand and practice the basic Python syntax and data structures used in AI.
- **Tasks:**

1. Write Python code to work with basic data types (integer, float, string, boolean).
2. Implement and manipulate Python lists, tuples, sets, and dictionaries.
3. Create basic control flow structures: if-else, for loops, while loops.
4. Use functions and lambda functions to solve small AI-related problems, such as calculating factorial or Fibonacci numbers.

**Lab Assignment 3: Data Exploration and Preprocessing**

- **Objective:** Learn how to work with data for AI models.
- **Tasks:**

1. Load a dataset (e.g., Titanic or Iris dataset) using pandas.
2. Clean the dataset by handling missing values, removing duplicates, and converting data types if needed.
3. Explore the dataset by visualizing it using matplotlib and seaborn.
4. Perform basic data preprocessing tasks such as feature scaling, encoding categorical variables, and splitting data into training and testing sets.

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| **Module 2** | Data Processing, Visualization | Assignment | Implementation | 10 Sessions |

**Lab Assignment 1: Data Preprocessing with Pandas**

**Objective:**

Learn the fundamentals of data preprocessing, including cleaning, handling missing values, and performing basic transformations using **Pandas**.

**Tasks:**

1. **Load and Inspect the Dataset:**
   - Load a dataset (e.g., **Iris**, **Titanic**, **Wine Quality** dataset) using pandas.read_csv() or pandas.read_excel().
   - Inspect the first few rows of the dataset using .head() and check basic information using .info().

2. **Handle Missing Values:**
   - Identify missing values in the dataset using .isnull() or .isna().
   - Handle missing data by imputing with mean, median, or mode using SimpleImputer from sklearn, or remove rows with missing data using .dropna().
3. **Data Transformation:**
   - Convert categorical variables to numerical values using one-hot encoding or label encoding.
   - Normalize/standardize numerical columns using StandardScaler or MinMaxScaler from sklearn.
4. **Subset and Filter Data:**
   - Create subsets based on certain conditions (e.g., select rows where a specific feature value is greater than a threshold).
   - Filter outliers from numerical data using interquartile range (IQR).

**Lab Assignment 2: Data Aggregation and Grouping with Pandas**
**Objective:**
Master aggregation and grouping techniques using **Pandas** for summarizing data.
**Tasks:**

1. **Group Data by Category:**
   - Group data by one or more categorical features (e.g., "class" in the Iris dataset or "embarked" in Titanic dataset).
   - Use .groupby() to calculate aggregate statistics such as mean, median, sum, and count.
2. **Pivot Tables:**
   - Create a pivot table to summarize data (e.g., aggregate the average age of passengers in the Titanic dataset by class and gender).
   - Use .pivot_table() to perform multi-dimensional aggregation.
3. **Data Aggregation and Custom Functions:**
   - Apply custom aggregation functions to the grouped data (e.g., calculate custom metrics or perform complex transformations within each group).
4. **Sorting and Ranking Data:**
   - Sort the dataset by multiple columns (e.g., sorting by "age" or "fare").
   - Rank data based on specific metrics (e.g., assign ranks to passengers by fare in the Titanic dataset).

**Lab Assignment 3: Data Visualization with Matplotlib and Seaborn**
**Objective:**
Learn to visualize datasets using **Matplotlib** and **Seaborn** for better understanding and insights.
**Tasks:**

1. **Basic Plotting with Matplotlib:**
   - Create simple plots like line plots, bar plots, and histograms using **Matplotlib**.
   - Customize the plots by setting titles, labels, and legends.
   - Create scatter plots to visualize relationships between two variables.
2. **Advanced Plotting with Seaborn:**
   - Use **Seaborn** to create advanced visualizations like pair plots, heatmaps, box plots, and violin plots.
   - Customize visualizations with color palettes, styling, and themes.
   - Create a correlation heatmap to visualize correlations between features in the dataset.
3. **Distribution Visualizations:**
   - Plot distributions of continuous variables using **Seaborn's** distplot() or kdeplot().
   - Create bar plots for categorical variables to understand their frequency distribution.
4. **Multi-Plot Grid Layouts:**
   - Use **Matplotlib's** subplots() function to create multiple plots in a grid layout for comparison (e.g., scatter plot and histogram in the same figure).

**Lab Assignment 4: Visualizing Relationships and Feature Importance**

**Objective:**
Understand how to visualize relationships between features and evaluate feature importance for predictive models.

**Tasks:**

1. **Scatter Plot Matrix:**
   - Use **Seaborn's** pairplot() to create a scatter plot matrix to visualize the relationships between multiple features.
   - Analyze the pairwise relationships between features and identify any patterns or correlations.
2. **Heatmap of Correlation Matrix:**
   - Use **Pandas** to calculate the correlation matrix of numeric features.
   - Visualize the correlation matrix using **Seaborn's** heatmap() to understand feature correlations and multicollinearity.
3. **Feature Importance from Models:**
   - Train a decision tree or random forest model using **scikit-learn** on a dataset (e.g., **Iris** or **Titanic**).
   - Visualize feature importance using a bar chart to understand which features have the most impact on the model.
4. **Visualizing Predictions vs. Actual Values:**
   - For regression tasks, visualize the predicted values against the actual values using a scatter plot.
   - For classification tasks, visualize the classification results with a confusion matrix.

**Lab Assignment 5: Time Series Data Visualization and Processing**

**Objective:**
Learn how to process and visualize time series data, which is common in AI applications like forecasting and trend analysis.

**Tasks:**

1. **Load and Preprocess Time Series Data:**
   - Load a time series dataset (e.g., stock market data, weather data).
   - Parse dates properly and set the date column as the index using pd.to_datetime() and .set_index().
2. **Plot Time Series Data:**
   - Plot a time series line chart using **Matplotlib** to visualize trends over time.
   - Create rolling averages (e.g., 7-day, 30-day) to smooth out short-term fluctuations in the time series data.
3. **Seasonal Decomposition of Time Series:**
   - Use **statsmodels** to decompose a time series into seasonal, trend, and residual components.
   - Visualize the decomposed components to understand seasonal variations.
4. **Forecasting with Simple Models:**
   - Use simple forecasting models (e.g., moving average, ARIMA) to predict future values.
   - Visualize the forecasted data along with actual historical data.

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| **Module 3** | Introduction to Machine Learning | Assignments | Implementation | 10 Sessions |

**Lab Assignment 3: Implementing Linear Regression**

- **Tasks:**

1. Load a real-world dataset (e.g., **Boston Housing Price** dataset).
2. Train a **Linear Regression** model using LinearRegression() from scikit-learn.
3. Evaluate the model using **Mean Squared Error (MSE)** and **R-squared Score**.
4. Visualize the regression line using Matplotlib.

**Lab Assignment 4: Logistic Regression for Classification**

- **Tasks:**

1. Load the **Iris** or **Breast Cancer** dataset.

2. Preprocess the dataset (handle missing values, encode categorical variables, scale data).
3. Train a **Logistic Regression** model using LogisticRegression().
4. Evaluate performance using **Accuracy, Precision, Recall, F1-score**.
5. Plot the **Confusion Matrix** and **ROC Curve**.

**Lab Assignment 5: Implementing K-Nearest Neighbors (KNN)**

- **Tasks:**

1. Load the **Iris dataset** and split it into training and testing sets.
2. Train a **KNN classifier** using KNeighborsClassifier().
3. Experiment with different values of **K** and evaluate performance.
4. Visualize decision boundaries using a **scatter plot**.

**Lab Assignment 6: Decision Trees and Random Forests**

- **Tasks:**

1. Train a **Decision Tree classifier** on the Titanic dataset.
2. Visualize the tree structure using plot_tree().
3. Train a **Random Forest classifier** and compare performance with the decision tree.
4. Determine the **feature importance** using feature_importances_.

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| **Module 4** | Neural Networks and Deep Learning | Quiz | Implementation | 10 Sessions |

**Lab Assignment 7: Introduction to Perceptron and Activation Functions**

**Tasks:**

1. Implement a **single-layer perceptron** using NumPy.
2. Train the perceptron to classify **AND, OR, XOR** gates.
3. Experiment with different **activation functions** (Sigmoid, ReLU, Tanh).
4. Visualize decision boundaries.

**Lab Assignment 8: Building a Simple Neural Network with Keras**

**Tasks:**

1. Load the **MNIST dataset** from keras.datasets.
2. Preprocess the data (normalize pixel values, reshape input).
3. Create a **fully connected neural network** using Sequential API.
4. Train and evaluate the model using **categorical cross-entropy loss** and **accuracy**.

**Lab Assignment 9: Implementing CNN from Scratch**

**Tasks:**

1. Load the **CIFAR-10 dataset**.
2. Build a CNN with **Conv2D, MaxPooling2D, Flatten, Dense, Dropout** layers.
3. Use **Adam optimizer** and **categorical cross-entropy loss**.
4. Train and visualize loss/accuracy curves.

**Lab Assignment 10: Image Augmentation & Regularization**

**Tasks:**

1. Apply **data augmentation** (rotation, zoom, flipping) using ImageDataGenerator.
2. Add **dropout and batch normalization** to prevent overfitting.
3. Compare model performance with and without augmentation.

**Lab Assignment 11: Transfer Learning with Pre-trained Models**

**Tasks:**

1. Use **VGG16 or ResNet50** pre-trained on ImageNet.
2. Replace the output layer to classify **new images**.
3. Freeze earlier layers and fine-tune deeper layers.
4. Evaluate the model on a custom **dataset (e.g., Cats vs. Dogs)**.

**Lab Assignment 12: Implementing RNN for Text Classification**
**Tasks:**

1. Load **IMDB movie reviews dataset** from keras.datasets.
2. Preprocess text (tokenization, padding sequences).
3. Build an **RNN** with **Embedding, SimpleRNN, Dense** layers.
4. Train and evaluate the model.

**Lab Assignment 13: Building an LSTM for Time Series Prediction**
**Tasks:**

1. Load a **time series dataset** (e.g., stock prices, temperature data).
2. Preprocess the data (normalize, reshape).
3. Build an **LSTM-based model**.
4. Predict future values and visualize trends.

**Targeted Application & Tools that can be used:**
**Applications**:

- **Data Preprocessing**: Clean and manipulate data from various sources such as CSV, Excel, SQL databases, and APIs.
- **Exploratory Data Analysis (EDA)**: Gain insights into datasets by identifying trends, patterns, and outliers.
- **Predictive Modeling**: Build models for classification (e.g., spam detection) and regression (e.g., house price prediction).
- **Clustering**: Group data into clusters for unsupervised learning tasks (e.g., customer segmentation).
- **Model Evaluation**: Assess model performance using appropriate metrics such as accuracy, precision, recall, and F1-score.

**Tools**:

- **Pandas**: For data manipulation and cleaning (e.g., handling missing values, merging datasets).
- **NumPy**: For numerical operations and working with arrays and matrices.
- **Matplotlib**: For creating static, animated, and interactive visualizations.
- **Seaborn**: For advanced data visualizations (e.g., heatmaps, pair plots).
- **Plotly**: For creating interactive visualizations, especially useful for large datasets.
- **Scikit-learn**: The go-to library for implementing machine learning algorithms (e.g., linear regression, decision trees, k-means clustering).
- **XGBoost**: For advanced gradient boosting models, particularly for large-scale machine learning tasks.
- **TensorFlow** (for deep learning in Module 4): A powerful open-source library for building machine learning and deep learning models.
- **Keras**: High-level neural network API, built on top of TensorFlow, to easily create deep learning models.

**NLTK**: The Natural Language Toolkit for various text processing tasks like tokenization, stemming, and part-of-speech tagging.
**spaCy**: A fast NLP library for advanced NLP tasks such as named entity recognition and dependency parsing.
**Transformers (by Hugging Face)**: A powerful library for using pre-trained Transformer-based models like BERT, GPT, and others for advanced NLP tasks.

**Text Book(s):**
*T1: **Essentials of Python for Artificial Intelligence and Machine Learning** by Pramod Gupta and Anupam Bagchi*

**Reference(s):**

1. "Artificial Intelligence with Python" – Prateek Joshi
2. "Python Machine Learning" – Sebastian Raschka & Vahid Mirjalili

3. "Hands-On Artificial Intelligence with Python" – Teet Straus
4. "Deep Learning for Coders with Fastai and PyTorch" – Jeremy Howard & Sylvain Gugger

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| **Catalogue prepared by** | |
| **Recommended by the Board of Studies on** | |
| **Date of Approval by the Academic Council** | |

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| **Course Code: CSD1713** | Course Title: Statistical Foundations for Data Science<br>Type of Course: Discipline elective Lab Integrated | **L-T-P-C** | 0 | 0 | 2 | 1 |

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| **Version No.** | NIL |
| **Course Pre- requisites** | NIL |
| **Anti-requisites** | NIL |
| **Course Description** | This course provides an in-depth introduction to statistics and machine learning theory, methods, and algorithms for data science. Topics include multiple regression, kernel learning, sparse regression, generalized linear models, supervised and unsupervised learning, deep learning, covariance learning, factor models, principal component analysis, and more. The course emphasizes the applicability and limitations of these methods using mathematical statistics and real-world data sets. |
| **Course Objectives** | The objective of the course is to familiarize the learners with the concepts of **Statistical Foundations for Data Science** and attain **Employability** through **Participative Learning** techniques. |
| **Course Out Comes** | On successful completion of this course, students can expect to achieve the following outcomes:<br>CO1: Understand the rise and significance of Big Data in various fields such as Biological Sciences, Health Sciences, Computer and Information Sciences, Economics and Finance, Business and Program Evaluation, Earth Sciences, and Astronomy. [Understand]<br>CO2: Develop a strong foundation in multiple linear regression and the Gauss-Markov theorem. [Apply]<br>CO3: Apply linear regression with random design and partial linear regression. [Apply]<br>CO4: Apply the power method and learn about factor models and structured covariance learning. [Apply] |

**Course Content:** **No. of Sessions: 15 (30 hours)**

**List of Programs**

Experiment 1: Use big data to predict patient outcomes.
Experiment 2: Predict stock market trends using big data.
Experiment 3: Segment customers based on purchasing behavior.
Experiment 4: Apply statistical learning techniques to high-dimensional data.
Experiment 5: The Gauss-Markov Theorem
Experiment 6: Statistical Tests - Weighted Least-Squares
Experiment 7: Box-Cox Transformation

Experiment 8: Ridge Regression - Bias-Variance Tradeoff
Experiment 9: Ridge Regression Solution Path - Kernel Ridge Regression
Experiment 10: Debias of Regularized Regression Estimators
Experiment 11: Inference in Generalized Linear Models (GLMs)
Experiment 12: Partial Linear regression
Experiment 13: Power Method: To implement the Power Method for finding the largest eigenvalue and corresponding eigenvector.
Experiment 14: Factor model and high-dimensional PCA

Experiment 15: Hierarchical clustering

**Targeted Application & Tools that can be used:**

Torch, Google Colaboratory, Spider, Jupiter Notebook

**Project work/Assignment: Mention the Type of Project /Assignment proposed for this course**

Sentiment analysis of Facebook and Twitter data

Dataset resource link:

https://www.kaggle.com/datasets

**REFERENCE MATERIALS:**

**Textbook(s):**

**T1** Fan, J., Li, R., Zhang, C.-H., and Zou, H. (2020). Statistical Foundations of Data Science. CRC Press.

**T2** Wainwright, M. J. (2019). *High-dimensional statistics: A non-asymptotic viewpoint.* Cambridge University Press.

**Reference Book(s):**

**R1.** James, G., Witten, D., Hastie, T.J., Tibshirani, R. and Friedman, J. (2013). *An Introduction to Statistical Learning with Applications in R* . Springer, New York.

**R2**. Hastie, T.J., Tibshirani, R. and Friedman, J. (2009). *The elements of Statistical Learning: Data Mining, Inference, and Prediction* (2nd ed). Springer, New York.

**R3.** Buehlmann, P. and van de Geer, S. (2011). *Statistics for High-Dimensional Data: Methods, Theory and Applications*. Springer, New York.

**R1:** Fan, J., Li, R., Zhang, C.-H., and Zou , Statistical Foundations of Data Science. CRC Press.

**E book link**

**R2:** W. N. Venables, D. M. Smith and the R Core Team, https://cran.r-roject.org/doc/manuals /R-intro.pdf, October,2022

**eb resources:**

**W1. https://www.youtube.com/playlist?list=PLOU2XLYxmsIK9qQfztXeybpHvru-TrqAP**

**https://presiuniv.knimbus.com/user#/**

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|---|---|---|---|---|---|---|
| **Course Code:** **AID1701** | **Course Title: Machine Learning for Intelligent Data Science** **Type of Course: Theory** | **L-T- P- C** | 2 | 0 | 0 | 2 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | Basic programming (Python/Java/R), Linear Algebra, Probability & Statistics, Intro to Data Science | | | | | |
| **Anti-requisites** | NIL | | | | | |
| **Course Description** | Through the study of incident response and contingency planning, including incident response plans, disaster recovery plans, and business continuity plans, this course aims to help students comprehend the principles of risk management. This course explores the intersection of machine learning and intelligent data science, focusing on how learning algorithms empower smart, data-driven systems. Students will gain a solid foundation in supervised and unsupervised learning, delve into deep learning, and learn how to apply these techniques to build intelligent applications across domains such as healthcare, finance, and IoT. With a blend of theory and hands-on practice, the course emphasizes model interpretability, ethical AI, and real-world problem-solving using intelligent automation. Students will work with modern tools and frameworks (such as Python, Scikit-learn, TensorFlow, and PyTorch) to build robust, scalable models that drive intelligent decision-making. By the end of the course, learners will be equipped to design, implement, | | | | | | |

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| | and evaluate machine learning pipelines within intelligent data science systems, making them well-prepared for roles in data science, applied AI, and analytics. |
| Course Objective | The objective of the course is to familiarize the learners with the concepts of **Machine Learning for Intelligent Data Sciencey** and attain **Employability** through **Participative Learning** techniques. |
| **Course Out Comes** | **On successful completion of the course the students shall be able to:**<br>1. Understand and apply the fundamental concepts of machine learning within intelligent data science systems.<br>2. Design and implement supervised learning models to solve real-world intelligent system problems.<br>3. Apply intelligent data preprocessing and feature engineering techniques to enhance model performance<br>4. Analyze and implement intelligent data science solutions for domain-specific applications. |
| **Course Content:** | |

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| **Module 1: Foundations of Machine Learning and Intelligent Systems** | | **10 Sessions** |
| | Introduction to Machine Learning in the context of Intelligent Data Science- Types of Learning: Supervised, Unsupervised, Semi-supervised, Reinforcement- Model evaluation metrics (Accuracy, Precision, Recall, F1-Score, ROC-AUC)- Bias-Variance Tradeoff and Overfitting/Underfitting- Cross-validation and Model Selection. Data preprocessing: handling missing data, encoding, feature scaling. | |
| **Module 2: Supervised Learning for Smart Systems** | | **10 Sessions** |
| | Linear and Logistic Regression - Decision Trees, Random Forests, Gradient Boosting (XGBoost, LightGBM)- Support Vector Machines- k-Nearest Neighbors- Neural Networks: Basics of Feedforward and Backpropagation-Hyperparameter tuning (Grid Search, Random Search, Bayesian Optimization**)** | |
| **Module 3 Intelligent Data Processing and Feature Engineering** | | **12 Sessions** |
| | Smart Data Preprocessing (Outlier Detection, Noise Handling, Missing Data Imputation) - Feature Engineering using AI: Automated Feature Selection, Transformation, and Extraction- Dimensionality Reduction (PCA, LDA, t-SNE, Autoencoders)-Introduction to Feature Stores and MLOps Pipelines-<br>Data Annotation and Labeling Tools (for supervised tasks) | |
| **Module 4 Applications and Case Studies of Intelligent Data Science** | | **8 Sessions** |
| | Intelligent Data Science in: Smart Healthcare (e.g., disease prediction, patient monitoring) - Finance (e.g., fraud detection, credit scoring) - Marketing (e.g., personalized targeting, churn prediction)- Smart Cities & IoT (e.g., traffic forecasting, energy optimization)-End-to-End Project: Design and Deploy an Intelligent Data Science System -Introduction to DataOps & ModelOps | |

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| | **Text Book** *"Intelligent Systems for Machine Learning: A Modern Approach to Automated AI"* **Author:** Dr. Zhiyao Duan, Dr. Sameer Singh, and Dr. Anna Koop,**Publisher:** Springer Nature,**Edition:** 1st Edition (2023),I**SBN:** 9783031325843 |
| | **References**<br>1. Alice Zheng and Amanda Casari "Feature Engineering for Machine Learning: Principles and Techniques for Data Scientists" by -Edition: 1st Edition (2018)-Publisher: O'Reilly Media<br>2. Christopher M. Bishop "Pattern Recognition and Machine Learning" Edition: 1st Edition (2006).Publisher: Springer<br>3. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective" Edition: 1st Edition (2012) *Publisher*: MIT Press<br>4. Yoshua Bengio, and Aaron Courville "Deep Learning" by Ian Goodfellow, Edition: 1st Edition (2016) Publisher: MIT Press<br>5. Foster Provost and Tom Fawcett "Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" Edition: 1st Edition (2013) Publisher: O'Reilly Media<br>**Web resources:**<br>6. NPTEL Course – Introduction to Machine Learning<br>https://nptel.ac.in/courses/106/106/106106202/<br>7. Google Machine Learning Crash Course<br>https://developers.google.com/machine-learning/crash-course<br>8. Coursera – Machine Learning by Andrew Ng (Supervised Models)<br>https://www.coursera.org/learn/machine-learning |
| | **Topics relevant to "EMPLOYABILITY SKILLS":** Data Preprocessing (Missing data handling, encoding, scaling)- Dimensionality Reduction Techniques (PCA, t-SNE, Autoencoders) **for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.** |

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| **Course Code:**<br>**CSD1714** | **Course Title:** Predictive Analytics<br>**Type of Course: Program Core** | **L- P- C** | 2 | 0 | 2 |
| **Version No.** | 1 | | | | |
| **Course Pre-requisites** | Fundamentals of Data Analytics | | | | |
| **Anti-requisites** | NIL | | | | |
| **Course Description** | Predictive Analytics subject is conceptual in nature. The students will be benefited in this course to know about modern data analytic concepts and develop the skills for analyzing and synthesizing data sets for decision making in the firms. | | | | |

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| Course Objective | The objective of the course is skill development of student by using Learning techniques | | | |
| **Course Out Comes** | **On successful completion of the course the students shall be able to:**<br>• CO 1: **Define** the nature of analytics and its applications. (Remember)<br>• CO 2: **Summarize** the concepts of predictive analytics and data mining.( Understand)<br>• CO 3: **Construct** the analytical tools in business scenarios to achieve competitive advantage.(Apply)<br>• CO 4: **Build** the real-world insights in decision trees and time series analysis methods in dynamic business environment.(Apply) | | | |
| **Course Content:** | | | | |
| **Module 1** | Introduction to Predictive Analytics | Self-Learning | Applications of analytics | **7 Sessions** |
| **Topics:**Analytics- Definition, importance, Analytics in decision making, Applications, Challenges, Experts perception on analytics; Popularity in Analytics; Predictive analytics in business Scenarios- case studies | | | | |
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| **Module 2** | **Principles and Techniques** | Case analysis | | **8 Sessions** |
| **Topics:**<br>Predictive modeling: Propensity models, cluster models, collaborative filtering, applications and limitations - Statistical analysis: Univariate Statistical analysis, Multivariate Statistical analysis | | | | |
| **Module 3** | **Model Selection** | Participative Learning & Case Analysis | | **7 Sessions** |
| Preparing to model the data: supervised versus unsupervised methods, statistical and data mining methodology, cross-validation, overfitting, bias-variance trade-off, balancing the training dataset, establishing baseline performance.<br>Measuring Performance in Regression Models - Linear Regression and Its Cousins - Non-Linear Regression Models - Regression Trees and Rule-Based Models<br>Measuring Performance in Classification Models - Discriminant Analysis and Other Linear Classification Models - Non-Linear Classification Models | | | | |
| **Module 4** | **Time Series Analysis** | Discussion & Presentation | | 8 Sessions |
| Time series Model: ARMA, ARIMA, ARFIMA - Temporal mining - Box Jenkinson method, temporal reasoning, temporal constraint networks | | | | |

**Text Book**

1.Jeffrey Strickland, Predictive analytics using R, Simulation educators, Colorado Springs, 2015

2.Max Kuhn and Kjell Johnson, Applied Predictive Modeling, 1st edition Springer, 2013.

**References**

**R1** Dinesh Kumar, U. (2021). Business Analytics: The Science of data-Driven Decision Making.

**R2** Business Analytics - Data Analysis & Decision Making", S. Christian Albright and Wayne L. Winston, Cengage Publication, 5th Edition, 2012

**E book link R1:** Raman, R., Bhattacharya, S., & Pramod, D. (2018). Predict employee attrition by using predictive analytics. Benchmarking: An International Journal. https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/BIJ-03-2018- 0083/full/html

2. **E book link R2:** Jing, Z., Luo, Y., Li, X., & Xu, X. (2022). A multi-dimensional city data embedding model for improving predictive analytics and urban operations. Industrial Management & Data Systems, (ahead-of-print). https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/IMDS-01-2022-0020/full/html

3. **E book link R3:** Singh, R., Sharma, P., Foropon, C., & Belal, H. M. (2022). The role of big data and predictive analytics in the employee retention: a resource-based view. International Journal of Manpower. https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/IJM-03-2021- 0197/full/html

4. **E book link R4:** Mishra, D., Luo, Z., Hazen, B., Hassini, E., & Foropon, C. (2018). Organizational capabilities that enable big data and predictive analytics diffusion and organizational performance: A resource-based perspective. Management Decision. https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/MD-03-2018- 0324/full/html

**Web resources:**

W1.https://www.sas.com/en_in/insights/analytics/predictive-analytics.html
W2. https://www.techtarget.com/searchbusinessanalytics/definition/predictive-analytics
W3. https://www.cio.com/article/228901/what-is-predictive-analytics-transforming-data- intofuture-insights.html
W4. https://www.simplilearn.com/what-is-predictive-analytics-article
W5. https://www.northeastern.edu/graduate/blog/predictive-analytics/
W6.https://www.marketingevolution.com/knowledge-center/the-role-of-predictive-analyticsin-data-driven-marketing

Swayam & NPTEL Video Lecture Sessions on Predictive Analytics

1. https://onlinecourses.swayam2.ac.in/imb20_mg19/preview
2. https://onlinecourses.nptel.ac.in/noc19_mg42/preview

Case References

1. Predictive Analytics Industry Use cases.
2. https://www.rapidinsight.com/blog/11-examples-ofpredictive-analytics/
3. Srinivasan Maheswaran (2017). Predictive Analytics – Employee Attrition Case center.

**Topics relevant to development of "Skill Development":** ": Application of Business Analytics to enhances customer satisfaction and firms' success

**Topics relevant to development of "Environment and sustainability:** Focus on Predictive analytics to minimize the errors in decision making

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| **Course Code: CSD2001** | **Course Title: Applied Data Science**<br>**Type of Course: Program Core** | **L-T-P-C** | 3 | 0 | 0 | 3 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | NIL | | | | | |
| **Anti-requisites** | NIL | | | | | |

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| **Course Description** | The aim of the course is to give complete overview of Python's data analytics tools and techniques. Learning python is a crucial skill for many data science roles, and this course helps to understand and develop feature engineering. With a blended learning approach, Python for data science along with concepts like data wrangling, mathematical computing, and more can be learnt. | | | |
| **Course Objectives** | The objective of the course is to familiarize the learners with the concepts of **Applied Data Science** and attain **Skill Development** through E**xperiential Learning** techniques. | | | |
| **Course Out Comes** | On successful completion of this course the students shall be able to:<br>1. Describe Numpy and Matrix Operations [Remember]<br>2. Summarize the need for data preprocessing and visualization techniques. [Understand]<br>3. Demonstrate the performance of different supervised learning algorithms [Apply]<br>4. Apply unsupervised learning algorithms for grouping the given data. [Apply] | | | |
| **Course Content:** | | | | |
| **Module 1** | **Introduction to Data Science, Python Data Structures, Python Numpy Package** | **Quiz** | **Knowledge based quiz** | **No. Of sessions:11** |
| Data Science: Basics of Data Science, Sources of Data, Data Science Project Life Cycle: OSEMN Framework, Difference between data analysis and data analytics. Python- Variables, data types, control structures, Operators, Simple operations, Array and its operations, Numpy operations, Matrix and its operations. | | | | |
| **Module 2** | **Data preparation and preprocessing using Pandas dataframe, Exploratory Data Analysis, Data Visualization** | **Assignment** | **Data Visualization** | **No. Of sessions:12** |
| Data Quality Assessment, Feature Aggregation, Feature Encoding, Dealing with missing values, Normalization techniques, Statistical description about the data, Relationship between the data, Data Visualization using matplotlib. | | | | |
| **Module 3** | **Supervised Learning Algorithms** | **Design an algorithm using Example** | **Random Forest** | **No. Of sessions:11** |
| Supervised learning techniques: Regression Models- Linear and Logistic Model, Classification Models – Decision Tree, Naïve Bayes, Model Selection and Evaluation criteria: Accuracy, F1 score – Sensitivity – Specificity – AUC. | | | | |
| **Module 4** | **Unsupervised Learning Algorithms** | **Case Study** | **Conduct a case study on how data sets can be gathered and implemented in real time application.** | **No. Of sessions:11** |

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| The Clustering Models – K Means algorithm, K- Medoids Algorithm, types of clustering models, Hierarchical clustering techniques, drawbacks of K Means, case study for different algorithms. |
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| **Textbook(s):**<br>1. Data Science Using Python and R- Chantal D.L & Daniel T.L John Wiley & Sons, Inc. -2019<br>2. Applied Data Science with Python and Jupyter-Alex Galea,Packt Publishing,October2018<br>Data Visualization in Python with Pandas and Matplotlib Paperback –DavidLandup, June 16, 2021 |
| **References:**<br>1.Data Science with Python and Dask- Jesse Daniel,1st Edition,July30,2019<br>**Weblinks:**<br>• https://presiuniv.knimbus.com/user#/home<br>• Udemy: https://www.udemy.com/course/applied-data-science-with-python-specialization-mhm/<br>• NPTEL online course : https://nptel.ac.in/courses/106106179 |
| **Topics relevant to "SKILLS Development":** Data Science, Decision Tree Algorithm for developing **Skills development** through **Experiential Learning techniques.**<br>**This is attained through assessment component mentioned in course handout.** |

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| Course Code:<br>UG COURSE:<br>**CSD 1701** | Course Title: Social Media Analytics<br>Type of Course: Theory | L-T-P-C | 3 | 0 | 0 | 3 |
| Version No. | 1.0 | | | | | |
| Course Pre-requisites | | | | | | |
| Anti-requisites | NIL | | | | | |
| Course Description | This course provides a comprehensive overview of social media analytics, focusing on the techniques and tools used to analyze social media data. Students will learn how to collect, process, and analyze data from various social media platforms to extract valuable insights. The course covers topics such as big data collection, demographic analysis, web analytics, and the use of analytics tools to understand online customer behavior and make data-driven decisions. | | | | | |
| Course Objective | The objective of the course is to familiarize the learners with the concepts Social Media Analytics and attain Skill Development through Experiential Learning techniques. | | | | | |
| | On successful completion of the Social Media Analytics course, students can expect to achieve the following outcomes: | | | | | |

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| Course Out Comes | CO1: Understand the fundamental concepts and importance of social media analytics in modern business contexts. [Remember]<br>CO2: Effectively collect data from various social media platforms, ensuring they can gather relevant and accurate information. [Apply]<br>CO3: Develop the ability to process and analyze social media data, transforming raw data into meaningful insights. [Apply]<br>CO4: Acquire skills in visualizing data, enabling them to present findings in a clear and impactful manner. [Apply] | | | |
| Course Content: | | | | |
| Module 1 | **Introduction to Social Media Analytics** | Assignment | Practical | 11 Sessions Remember |
| The foundation for analytics, Social media data sources, Data sources and Factual Data Sources, Public and Private data, data gathering in social media analytics., Dealing with Unstructured Data, Challenges, Social media Mining Techniques, Social media data, Types of data, Text data formats, Text cleaning, tagging and storing. API: RESTful API, Stream API, OAuth Parsing API. | | | | |
| Module 2 | **Text Mining in Social Networks** | Assignment | Practical | 11 Sessions Apply |
| Introduction, Keyword search, Classification Algorithms, Clustering Algorithms-Greedy Clustering, Hierarchical clustering, k-means clustering, Transfer Learning in heterogeneous Networks, Sampling of online social networks, Comparison of different algorithms used for mining, tools for text mining. | | | | |
| Module 3 | **Network Measures and Behavior Analytics** | Assignment | Practical | 12 Sessions Apply |
| Centrality: Degree Centrality , Eigenvector Centrality, Katz Centrality , PageRank, Between ness Centrality, Closeness Centrality , Similarity: Structural Equivalence, Regular Equivalence, Individual Behavior: Individual Behavior Analysis, Individual Behavior Modeling, Individual Behavior Prediction Collective Behavior: Collective Behavior Analysis, Collective Behavior Modeling, Collective Behavior Prediction | | | | |
| Module 4 | **Analyzing the Social Media Data** | Assignment | Practical | 11 Sessions Apply |
| Mining Facebook: Overview, Exploring Facebook's Social Graph API's, Analyzing Social Graph Connections. Mining Twitter: Overview, Exploring Twitter's API, Analyzing 140 Characters | | | | |

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| REFERENCE MATERIALS:<br>(i) Textbooks<br>T1. Mining the Social Web – Mathew A. Rusell, 3rd Edition, O'Reilly, 2019.<br>T2 : Python Social Media Analytics – Michal Krystyanczuk and Siddhartha Chatterjee, PacktPub, 2017.<br>(ii) Reference Book(s)<br>R1. Charu C. Aggarwal, Social Network Data Analytics, Springer, 2011<br>R2:Mastering Social Media Mining with Python – Macro Bonzanini, PacktPub, 2016.<br>R3; Reza Zafarani Mohammad Ali Abbasi Huan Liu, Social Media Mining, Cambridge University Press, 2014<br><br>W1. NPTEL: https://onlinecourses.nptel.ac.in/noc21_cs28<br>W2. Coursera: https://www.coursera.org/learn/social-media-data-analytics<br>W3.Udemy:https://www.udemy.com/course/introduction-to-social-analytHYPERLINK "https://www.udemy.com/course/introduction-to-social-analytics/"ics/<br><br>W4. Others : https://research.facebook.com/publications/realtime-data-processing-at-facebook/ |
| Topics relevant to Entrepreneurial Skills: Extract and Analyze Social media Data for Entrepreneurship Development through Problem Solving methodologies/Participative Learning Techniques/ Experiential Learning Techniques. |

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|---|---|---|---|---|---|
| **Course Code:**<br>**CSD1705** | **Course Title:** CSD1705 Cloud Computing for Data Science<br>**Type of Course: Program Core** | **L- P- C** | 2 | 0 | 2 |
| **Version No.** | 1 | | | | |
| **Course Pre-requisites** | NIL | | | | |
| **Anti-requisites** | NIL | | | | |
| **Course Description** | **Cloud Computing for Data Science** introduces learners to the integration of cloud platforms with data science workflows. The course covers cloud storage, data pipelines, machine learning deployment, and real-time analytics using AWS, Azure, and GCP. Students will gain hands-on experience with industry tools and scalable cloud services. | | | | |
| Course Objective | The objective of the course is skill development of student by using Learning techniques | | | | |
| **Course Out Comes** | **On successful completion of the course the students shall be able to:**<br>CO1: Understand the core concepts of cloud computing.<br>CO2: Learn to use cloud platforms for storing, processing, and analyzing data.<br>CO3:Implement data science workflows on cloud environments. | | | | |

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| | CO4: Master scalable machine learning and big data tools on the cloud. | | | |
| **Course Content:** | | | | |
| **Module 1** | Fundamentals of Cloud Computing | | | **7 Sessions** |
| **Overview of Cloud Computing, Service Models: IaaS, PaaS, SaaS, Deployment Models: Public, Private, Hybrid, Community,• Virtualization and Containers (Docker, Kubernetes basics);**<br>**Introduction to AWS, Azure, and Google Cloud Platform , Security and Compliance in the Cloud** | | | | |
| **Module 2** | **Cloud Storage & Data Engineering** | | | **8 Sessions** |
| Cloud Storage Services (S3, Google Cloud Storage, Azure Blob);Data Lake vs. Data Warehouse; ETL Pipelines in the Cloud (AWS Glue, Dataflow, Azure Data Factory); Data Migration & Ingestion Tools;Distributed Computing with Hadoop and Spark on Cloud;Cost Optimization Techniques | | | | |
| **Module 3** | **Machine Learning and Analytics on the Cloud** | | | **8 Sessions** |
| Cloud ML Tools (AWS SageMaker, Azure ML, Google Vertex AI); End-to-End ML Pipelines on the Cloud; Model Deployment and Monitoring; AutoML and MLOps; Integrating Notebooks (Jupyter, Colab) with Cloud Environments; Real-Time Analytics with BigQuery, Redshift | | | | |
| **Module 4** | **Time Series Analysis** | Discussion & Presentation | | 7 Sessions |
| Introduction to Serverless Computing (AWS Lambda, Azure Functions) ; Cloud-Native Data Science Tools , Generative AI and LLMs in Cloud , Edge Computing and IoT Integration | | | | |
| **Text Book**<br>1.**"Cloud Computing: Concepts and Technology"** by Thomas Erl, Zaigham Mahmood, and Ricardo Puttini – 2nd Edition (2023)<br>A foundational text covering updated cloud architectures, platforms, and security. | | | | |
| Reference Book | | | | |
| 1. **"Data Science on the Google Cloud Platform: Implementing End-to-End Real-Time Data Pipelines"** by Valliappa Lakshmanan (2023)<br>*Hands-on guide to building scalable data science projects on Google Cloud*.<br>2. **"Machine Learning Engineering with Python: Deploy and Scale ML Models on AWS, Azure, and GCP"** by Andrew P. McMahon (2024)<br>*Recent guide on using cloud platforms for production-level ML systems*. | | | | |

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|---|---|---|---|---|---|---|
| **Course Code:**<br>**CSD1709** | **Course Title: Edge AI and IoT Analytics**<br>**Type of Course: Theory** | **L-T- P- C** | 3 | 0 | 0 | 3 |
| **Version No.** | 1.0 | | | | | |

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| **Course Pre-requisites** | Basics of Machine Learning, IoT fundamentals, and Python programming |
| **Anti-requisites** | NIL |
| **Course Description** | This course provides a comprehensive overview of the convergence between Edge Computing, Artificial Intelligence (AI), and the Internet of Things (IoT). Learners will explore how intelligent analytics can be performed on-device at the edge of the network, reducing latency and enabling real-time decision-making in resource-constrained environments. The course covers core concepts of edge architecture, IoT protocols, AI model optimization, and deployment on edge hardware such as Raspberry Pi, Jetson Nano, and Google Coral. . Real-world use cases from domains such as healthcare, smart cities, and Industry 4.0 are discussed along with emerging trends in DataOps, ModelOps, and Edge-to-Cloud integration. By the end of the course, students will be able to design, build, and deploy secure and efficient edge-AI-powered IoT systems. |
| Course Objective | The objective of the course is to familiarize the learners with the concepts of **Edge AI and IoT Analytics** and attain **Employability** through **Participative Learning** techniques. |
| **Course Out Comes** | **On successful completion of the course the students shall be able to:**<br>1. Understand and analyze the architecture of IoT systems and Edge AI platforms.<br>2. Select and apply appropriate hardware, tools, and optimization techniques for deploying AI models on edge devices.<br>3. Perform real-time analytics on IoT data streams using lightweight ML models and appropriate platforms.<br>4. Design and develop secure, scalable, and intelligent Edge-IoT solutions for real-world applications. |
| **Course Content:** | |

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|---|---|---|
| **Module 1: Fundamentals of Edge AI and IoT Systems** | | **11 Sessions** |
| | Introduction to IoT and Edge Computing- Edge vs Cloud vs Fog Computing-Architectures of IoT & Edge Devices-Key Communication Protocols: MQTT, CoAP, BLE, LoRaWAN.<br>Overview of Edge AI: Concepts and Industry Trends-Introduction to TinyML and Embedded AI. | |
| **Module 2: Edge Hardware, Platforms, and AI Model Deployment** | | **12 Sessions** |
| | Edge AI Hardware Platforms: Raspberry Pi, NVIDIA Jetson, Google Coral, Arduino Nano 33 BLE-Model Optimization Techniques for Edge: Quantization, Pruning, Knowledge Distillation-AI Frameworks for Edge: TensorFlow Lite, ONNX, PyTorch Mobile, Edge Impulse-Deployment Workflows: From Training to On-Device Inference-Power, Memory, and Latency Constraints in Edge Devices | |
| **Module 3 IoT Data Analytics and Real-Time Processing** | | **12 Sessions** |
| | IoT Data Acquisition, Streaming, and Preprocessing -Time-Series Analysis for IoT Sensors -Lightweight ML Models for Edge: Decision Trees, k-NN, Naïve Bayes, SVMs -Anomaly Detection and Predictive Maintenance -Tools and Platforms: Azure IoT Hub, AWS Greengrass, Google IoT Core-Data Visualization for Edge Analytics (Grafana, ThingsBoard) | |

| Module 4 Applications, Security, and Project Implementation | | 10 Sessions |
|---|---|---|
| | Smart Home, Smart Agriculture, Industrial IoT (IIoT), Smart Cities-Case Studies: Edge AI in Surveillance, Energy Monitoring, Healthcare-Security in Edge AI and IoT (Device Authentication, Secure Boot, Data Privacy)-Edge-to-Cloud Integration | |
| | **Text Book**<br>1. Xiaofei Wang, Yi Pan "Edge AI: Machine Learning for Embedded Applications" Publisher: Springer- 1st Edition (2022)<br>2. Yunchuan Sun et al " Learning Edge AI: Algorithms and Applications". Publisher: Springer Edition: 1st Edition (2022)<br>3. Arshdeep Bahga, Vijay Madisetti "Internet of Things: A Hands-On Approach" Publisher: Universities Press Edition: 2nd Edition (2023)<br>4. William Lawless et al. "Artificial Intelligence for the Internet of Everything" Publisher: Academic Press (Elsevier) Edition: 1st Edition (2022) | |
| | **References**<br>1. Colin Dow "Hands-On Edge Analytics with Azure IoT: Stream Data Processing from Devices to Cloud" Publisher: Packt Publishing Edition: 1st Edition (2022).<br>**Web resources:**<br>1. NPTEL – Introduction to Internet of Things<br>https://nptel.ac.in/courses/106/105/106105166/<br>2. Google Developers – Edge AI Overview<br>https://developers.google.com/edge-tpu<br>3. Google Cloud IoT Core (Edge to Cloud Integration)<br>https://cloud.google.com/iot-core | |
| | **Topics relevant to "EMPLOYABILITY SKILLS":** Edge computing vs. cloud computing: trade-offs and applications- Use of analytics platforms (Grafana, AWS IoT, Azure IoT) **for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.** | |

| **Course Code:**<br>**CSD1715** | **Course Title:** Predictive Analytics Lab<br>**Type of Course:** | **L- P-C** | 0 | 0 | 1 |
|---|---|---|---|---|---|
| **Version No.** | 1 | | | | |
| **Course Pre-requisites** | NIL | | | | |
| **Anti-requisites** | NIL | | | | |
| **Course Description** | Predictive Analytics subject is conceptual in nature. The students will be benefited in this course to know about modern data analytic concepts and develop the skills for analyzing and synthesizing data sets for decision making in the firms. | | | | |
| Course Objective | The objective of the course is skill development of student by using Learning techniques | | | | |
| **Course Out Comes** | **On successful completion of the course the students shall be able to:**<br>• CO 1: **Define** the nature of analytics and its applications. (Remember) | | | | |

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| | • CO 2: **Summarize** the concepts of predictive analytics and data mining.( Understand)<br>• CO 3: **Construct** the analytical tools in business scenarios to achieve competitive advantage.(Apply)<br>• CO 4: **Build** the real-world insights in decision trees and time series analysis methods in dynamic business environment.(Apply) |
| **Course Content:** | |

**List of Laboratory Tasks:**

**1.Predicting buying behaviour**

- analytics to identify buying habits based on previous purchase history.
- predict customer purchase patterns.

**2.Fraud detection**

a. To identify anomalies in the system and detect unusual behavior to determine threats.
b. experts can feed historical data of cyberattacks and threats to the system. When the predictive analytics algorithm identifies something similar, it will send a notification to the respective personnel.

**3.Healthcare diagnosis**

- understanding the disease by providing an accurate diagnosis based on past data.
- predictive analytics help doctors reach the root cause of diseases.

**4.Card abandonment**

- predict how likely a customer is to abandon the cart.
- It will also provide companies with details about each customer about whether they will purchase or abandon the cart based on the previous visits to the store.

**5.Content recommendation**

- entertainment companies can predict what users want to watch based on their history.
- use analytics for predicting the user's behavior.

**6. Equipment maintenance**

the machinery would alert the personnel and the maintenance can be done to avoid unscheduled and accidental breakdowns.

**Targeted Application & Tools that can be used**

Statistical tools, documentary review, case analysis and Simulation help students to understand the data driven decisions for firms

**Project work/Assignment:**

Project:

By developing the questionnaire for specific objective of the brands, primary data collection and do the sales forecasting by using predictive analysis using SPSS software and develop report on data storytelling from the data analysis.

Assignment:

1. Review the article on Organisational capabilities in PA using PU link https://wwwemerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/MD-03-2018-0324/full/html
2. Develop a podcast of 5 mins of each group discussions on Darkside of data mining. Each group consist of 5 members in the team

**Text Book**

1.Jeffrey Strickland, Predictive analytics using R, Simulation educators, Colorado Springs, 2015

2.Max Kuhn and Kjell Johnson, Applied Predictive Modeling, 1st edition Springer, 2013.

**References**

**R1** Dinesh Kumar, U. (2021). Business Analytics: The Science of data-Driven Decision Making.

**R2** Business Analytics - Data Analysis & Decision Making", S. Christian Albright and Wayne L. Winston, Cengage Publication, 5th Edition, 2012

**E book link R1:** Raman, R., Bhattacharya, S., & Pramod, D. (2018). Predict employee attrition by using predictive analytics. Benchmarking: An International Journal. https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/BIJ-03-2018- 0083/full/html

2. **E book link R2:** Jing, Z., Luo, Y., Li, X., & Xu, X. (2022). A multi-dimensional city data embedding model for improving predictive analytics and urban operations. Industrial Management & Data Systems, (ahead-of-print). https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/IMDS-01-2022- 0020/full/html

3. **E book link R3:** Singh, R., Sharma, P., Foropon, C., & Belal, H. M. (2022). The role of big data and predictive analytics in the employee retention: a resource-based view. International Journal of Manpower. https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/IJM-03-2021- 0197/full/html

4. **E book link R4:** Mishra, D., Luo, Z., Hazen, B., Hassini, E., & Foropon, C. (2018). Organizational capabilities that enable big data and predictive analytics diffusion and organizational performance: A resource-based perspective. Management Decision. https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/MD-03-2018- 0324/full/html

**Web resources:**

W1.https://www.sas.com/en_in/insights/analytics/predictive-analytics.html

W2. https://www.techtarget.com/searchbusinessanalytics/definition/predictive-analytics

W3. https://www.cio.com/article/228901/what-is-predictive-analytics-transforming-data- intofuture-insights.html

W4. https://www.simplilearn.com/what-is-predictive-analytics-article

W5. https://www.northeastern.edu/graduate/blog/predictive-analytics/

W6.https://www.marketingevolution.com/knowledge-center/the-role-of-predictive-analyticsin-data-driven-marketing

Swayam & NPTEL Video Lecture Sessions on Predictive Analytics

1. https://onlinecourses.swayam2.ac.in/imb20_mg19/preview
2. https://onlinecourses.nptel.ac.in/noc19_mg42/preview

Case References

1. Predictive Analytics Industry Use cases.
2. https://www.rapidinsight.com/blog/11-examples-ofpredictive-analytics/
3. Srinivasan Maheswaran (2017). Predictive Analytics – Employee Attrition Case center.

**Topics relevant to development of "Skill Development":** ": Application of Business Analytics to enhances customer satisfaction and firms' success

**Topics relevant to development of "Environment and sustainability:** Focus on Predictive analytics to minimize the errors in decision making

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|---|---|---|---|---|---|---|
| **Course Code: CSD2002** | **Course Title: Applied Data Science Lab**<br>**Type of Course: Program Core** | **L-T-P-C** | 0 | 0 | 2 | 1 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | NIL | | | | | |
| **Anti-requisites** | NIL | | | | | |

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| **Course Description** | The aim of the course is to give complete overview of Python's data analytics tools and techniques. Learning python is a crucial skill for many data science roles, and this course helps to understand and develop feature engineering. With a blended learning approach, Python for data science along with concepts like data wrangling, mathematical computing, and more can be learnt. |
| **Course Objectives** | The objective of the course is to familiarize the learners with the concepts of **Applied Data Science** and attain **Skill Development** through E**xperiential Learning** techniques. |
| **Course Out Comes** | On successful completion of this course the students shall be able to:<br>5. Describe Numpy and Matrix Operations [Remember]<br>6. Summarize the need for data preprocessing and visualization techniques. [Understand]<br>7. Demonstrate the performance of different supervised learning algorithms [Apply]<br>8. Apply unsupervised learning algorithms for grouping the given data. [Apply] |
| **Course Content:** | **List of Laboratory Tasks:**<br>1. **Basic operations using Python**<br>2. **Reading and writing different types of datasets.**<br>3. **Descriptive statistics in python**<br>4. **Visualizations**<br>5. **Simple linear Regression**<br>6. **Simple logistic Regression**<br>7. **Decision trees classifier**<br>8. **Support vector machine classifier**<br>9. **Naive Bayes classifier**<br>10. **Clustering model**<br>**Targeted Application & Tools that can be used:**<br>• Anaconda- Jupyter Notebook<br>• Google-Colab<br>**Project work/Assignment:**<br>1. Design forest fire and wildfire prediction system.<br>1. Driver Drowsiness Detection System with OpenCV & Keras<br>1. Credit Card Fraud Detection using Python. |

**Textbook(s):**


2. Data Science Using Python and R- Chantal D.L & Daniel T.L John Wiley & Sons, Inc. -2019
3. Applied Data Science with Python and Jupyter-Alex Galea,Packt Publishing,October2018

Data Visualization in Python with Pandas and Matplotlib Paperback –DavidLandup, June 16, 2021

**References:**

1.Data Science with Python and Dask- Jesse Daniel,1st Edition,July30,2019

**Weblinks:**

- https://presiuniv.knimbus.com/user#/home
- Udemy: https://www.udemy.com/course/applied-data-science-with-python-specialization-mhm/
- NPTEL online course : https://nptel.ac.in/courses/106106179

**Topics relevant to "SKILLS Development":** Data Science, Decision Tree Algorithm for developing **Skills development** through **Experiential Learning techniques.**
**This is attained through assessment component mentioned in course handout.**

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|---|---|---|---|---|---|---|
| **Course Code: CSD1702** | **Course Title: Social Media Analytics**<br>**Type of Course: Discipline elective Lab Integrated** | **L-T-P-C** | 0 | 0 | 2 | 1 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | | | | | | |
| **Anti-requisites** | NIL | | | | | |
| **Course Description** | **This course provides a comprehensive overview of social media analytics, focusing on the techniques and tools used to analyze social media data. Students will learn how to collect, process, and analyze data from various social media platforms to extract valuable insights. The course covers topics such as big data collection, demographic analysis, web analytics, and the use of analytics tools to understand online customer behavior and make data-driven decisions.** | | | | | |
| **Course Objectives** | **The objective of the course is to familiarize the learners with the concepts Social Media Analytics and attain Skill Development through Experiential Learning techniques.** | | | | | |
| **Course Out Comes** | **On successful completion of the Social Media Analytics course, students can expect to achieve the following outcomes:**<br><br>**CO1: Understand the fundamental concepts and importance of social media analytics in modern business contexts. [Remember]**<br><br>**CO2: Effectively collect data from various social media platforms, ensuring they can gather relevant and accurate information. [Apply]**<br><br>**CO3: Develop the ability to process and analyze social media data, transforming raw data into meaningful insights. [Apply]**<br><br>**CO4: Acquire skills in visualizing data, enabling them to present findings in a clear and impactful manner. [Apply]** | | | | | |
| **Course Content:** | | **No. of Sessions: 15 (30 hours)** | | | | |
| **List of Programs**<br>**Experiment 1:** | | | | | | |

**LO1: Python Programs Dealing with structured Data**
**LO2: Python Programs Dealing with Unstructured Data**
**Experiment 2:**
**LO1: Python Programs for Data Integration**
**LO2: Python Programs for Outlier detection**
**Experiment 3:**
**LO1: Python Programs for Data transformation**
**LO2: Python Programs for Text cleaning**
**Experiment 4:**
**LO1: Python Programs Obtaining tokens**
**LO2: Programs for OAuth Authentication**
**Experiment 5:**
**LO1: Text classification using different**
**Classification Algorithms**
**LO2: Performance analysis of different classification algorithms**
**Experiment 5:**
**LO1: Text clustering using different Algorithms**
**LO2: Performance analysis of different clustering algorithms**
**Experiment 8:**
**LO1: Python program of individual behavior classification**
**LO2: Python program of individual Analysis**
**.Experiment 9:**
**LO1: Python program of collective behavior classification**
**LO2: Python program of collective behavior Analysis**
**Experiment 10:**
**LO1: Extracting my Facebook profile**
**LO2: Extracting friends' information from Facebook.**
**Experiment 11:**
**LO1: Perform a time frequency analysis of the posts extracted from Facebook page**
**LO2: Visualize the posts of Facebook page using word cloud**
**Experiment 12:**
**LO1: Python Programs for Extract Tweets from Home Timeline.**
**LO2: Retrieve tweets from a specific user timeline**

**Targeted Application & Tools that can be used:**

**Python Programming Language**

**Project work/Assignment: Mention the Type of Project /Assignment proposed for this course**

**Sentiment analysis of Facebook and Twitter data**

**Dataset resource link:**

**https://www.kaggle.com/datasets**

**REFERENCE MATERIALS:**

i. **Textbooks**

**T1. Mining the Social Web – Mathew A. Rusell, 3rd Edition, O'Reilly, 2019.**

**T2 : Python Social Media Analytics – Michal Krystyanczuk and Siddhartha Chatterjee, PacktPub, 2017.**

ii. **Reference Book(s)**

**R1. Charu C. Aggarwal, Social Network Data Analytics, Springer, 2011**

**R2:Mastering Social Media Mining with Python – Macro Bonzanini, PacktPub, 2016.**

**R3; Reza Zafarani Mohammad Ali Abbasi Huan Liu, Social Media Mining, Cambridge University Press, 2014**

**W1. NPTEL: https://onlinecourses.nptel.ac.in/noc21_cs28**

**W2. Coursera: https://www.coursera.org/learn/social-media-data-analytics**

**W3.Udemy:https://www.udemy.com/course/introduction-to-social-analytHYPERLINK "https://www.udemy.com/course/introduction-to-social-analytics/"ics/**

**W4. Others : https://research.facebook.com/publications/realtime-data-processing-at-facebook/**

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|---|---|---|---|---|---|---|
| **Course Code: CSE3016** | **Course Title:CSE3016 Neural Networks and Fuzzy Logic**<br>**Type of Course: Discipline Elective in AI & ML Basket**<br>**Theory Course** | | **L-T- P-C** | 3 | 0 | 0 | 3 |
| **Version No.** | 1.0 | | | | | | |
| **Course Pre-requisites** | NIL | | | | | | |
| **Anti-requisites** | NIL | | | | | | |
| **Course Description** | This course aims to introduce the basic concepts of Neural Networks and Fuzzy Logic. Neural networks reflect the behavior of the human brain, allowing computer programs to recognize patterns and solve common problems in the fields of AI, machine learning, and deep learning. Fuzzy Logic is a method of reasoning that resembles human reasoning. The approach of Fuzzy Logic imitates the way of decision-making in humans that involves all intermediate possibilities between digital values YES and NO. This course introduces fundamental concepts in Neural Networks and Fuzzy Logic Theory. | | | | | | |
| **Course Objective** | The objective of the course is to familiarize the learners with the concepts of **Neural Networks and Fuzzy Logic** and attain **Skill Development** through **Participative Learning** techniques. | | | | | | |
| **Course Outcomes** | **On successful completion of this course the students shall be able to:**<br>1. Define the concept of Neural Networks. [Knowledge]<br>2. Define the ideas behind most common learning algorithms in Neural Network.[Knowledge]<br>3. Discuss the concepts of Fuzzy Sets and Relations. [ Comprehension ]<br>4. Demonstrate the Fuzzy logic concepts and its applications.[ Application ] | | | | | | |
| **Course Content:** | | | | | | | |
| **Module 1** | **Introduction to Neural Network** | Quiz | Single Layer Perceptron | **9Classes** | | | |
| Topics:<br>Introduction to NN: History, Artificial and biological neural networks, Artificial intelligence and neural networks.<br>Neurons and Neural Networks: Biological neurons, Models of single neurons, Different neural network models. | | | | | | | |

Single Layer Perceptron: Least mean square algorithm, Learning curves, Learning rates, Perceptron.

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|---|---|---|---|---|
| **Module 2** | **Multilayer Perceptron** | Quiz | Multilayer Perceptron | **10 Classes** |

Topics:
Multilayer Perceptron: The XOR problem, Back-propagation algorithm, Heuristic for improving the back-propagation algorithm, Some examples.
Radial-Basis Function Networks: Interpolation, Regularization, Learning strategies.
Kohonen Self-Organising Maps: Self-organizing map, The SOM algorithm, Learning vector quantization.

| | | | | |
|---|---|---|---|---|
| **Module 3** | **Fuzzy Sets, Operations and Relations** | Quiz | Fuzzy Operations | **10Classes** |

Topics:
Fuzzy Sets: Crisp Sets - an Overview, Fuzzy Sets - Definition and Examples, α - Cuts and its Properties, Representations of Fuzzy Sets, Extension Principles of Fuzzy Sets.
Fuzzy Operations: Operations on Fuzzy Sets - Fuzzy Complements, Fuzzy Intersections, Fuzzy Unions, Combinations of Operations, Aggregation Operations.
Fuzzy Relations: Binary Fuzzy relations, Fuzzy Equivalence Relations, Fuzzy Compatibility Relations.

| | | | | |
|---|---|---|---|---|
| **Module 4** | **Fuzzy Logic and Fuzzy Logic Controller** | Assignment | Developing Fuzzy Logic Controller | **10Classes** |

Fuzzy Logic: Classical Logic, Multivalued Logic, Fuzzy Propositions, Fuzzy Quantifiers, Linguistic Hedges, Inference from Conditional Fuzzy Propositions, Conditional and Qualified Propositions and Quantified Propositions.
Fuzzy Controllers: An Overview, Fuzzification Module, Fuzzy Rule Base, Fuzzy Inference Engine, Defuzzification Module, An Example.

**Targeted Application & Tools that can be used:**

1. Python Libraries and Software (Eg.,Tensorflow, Scikit-Learn etc.)
2. Matlab (Neural Network Toolbox, Fuzzy Logic Toolbox)

**Project work/Assignment:**

Students will have to do group assignments for Modules 2 & 4. As a part of their assignments, they will have to implement the solution to particular problems.

**Textbook(s):**

1. Haykin, Simon. "*Neural networks and learning machines*", 3/E. Pearson Education India, 2011. https://www.pearson.com/en-us/subject-catalog/p/Haykin-Neural-Networks-and-Learning-Machines-3rd-Edition/P200000003278/9780133002553
2. George J. Klir and Bo Yuan, "*Fuzzy Sets and Fuzzy Logic- Theory and Applications*", Prentice Hall of India, 2015.
https://www.worldcat.org/title/fuzzy-sets-and-fuzzy-logic-theory-and-applications/oclc/505215200

**References:**

1. Shivanandam, Deepa S, "*Principles of Soft computing*", N Wiley India, 3rd Edition, 2018.https://www.wileyindia.com/principles-of-soft-computing-3ed.html
2. Timothy J. Ross, "*Fuzzy Logic with Engineering Applications*", Third Edition, Wiley, 2011. https://onlinelibrary.wiley.com/doi/book/10.1002/9781119994374
3. Kumar S., "*Neural Networks - A Classroom Approach*", Tata McGraw Hill, 2nd Edition 2017.https://www.worldcat.org/title/neural-networks-a-classroom-approach/oclc/56955342
4. Fakhreddine O. Karray, and Clarence W. De Silva. "*Soft computing and intelligent systems design: theory, tools, and applications*". Pearson Education, 2009.

**Weblinks**

https://www.pearson.com/en-gb/search.html?q=Karray%20Soft-Computing-and-Intelligent-Systems-Design-Theory-Tools-and-Applications

**Topics relevant to "Skill Development ":** Assignment implementations in software, batch wise presentations are used for Skill Development through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

| | | | | | | |
|---|---|---|---|---|---|---|
| **Course Code: CSE390** | **Course Title: Front-end Full Stack Development** | **L-T- P- C** | 0 | 0 | 4 | 2 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | **Nil** | | | | | |
| **Anti-requisites** | **NIL** | | | | | |
| **Course Description** | This intermediate course enables students to perform front-end full stack development, with emphasis on employability skills. The course covers key technologies and architectures that enables the student to design and implement front-end. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course. | | | | | |
| **Course Objectives** | The objective of the course is to familiarize the learners with the concepts Front end Full Stack Development and attain Employability through experiential Learning techniques. | | | | | |
| **Course Outcomes** | **On successful completion of the course the students shall be able to:**<br>**Describe the fundamentals of DevOps and Front-end full stack development. [Comprehension]**<br>**Illustrate a basic web design using HTML, CSS, Javascript. [Application]**<br>**Illustrate development of a responsive web. [Application]**<br>**Apply concepts of Angular.js to develop a web front-end. [Application]** | | | | | |
| **Course Content:** | | | | | | |
| **Module 1** | Fundamentals of DevOps | Project | Programming | | **04 Sessions** | |
| **Topics:**<br>Introduction to Agile Methodology; Scrum Fundamentals; Scrum Roles, Artifacts and Rituals; DevOps – Architecture, Lifecycle, Workflow & Principles; DevOps Tools Overview – Jenkins, Docker, Kubernetes. Review of GIT source control. | | | | | | |
| **Module 2** | Web Design & Development | Project | Programming | | **03 Sessions** | |
| **Topics:**<br>HTML5 – Syntax, Attributes, Events, Web Forms 2.0, Web Storage, Canvas, Web Sockets; CSS3 – Colors, Gradients, Text, Transform;<br>**Assignment:** Develop a website for managing HR policies of a department. | | | | | | |
| **Module 3** | Responsive web design | Project | Programming | | **08 Sessions** | |
| **Topics:**<br>BootStrap for Responsive Web Design; JavaScript – Core syntax, HTML DOM, objects, classes, Async; Ajax and jQuery Introduction<br>**Assignment:** Design and develop a website that can actively keep track of entry-exit information of a housing society.. | | | | | | |
| **Module 4** | Fundamentals of Angular.js | Project | Programming | | **15 Sessions** | |
| **Topics:** | | | | | | |

Setting up Development & Build Environment: Node.js and NPM; Introduction to TypeScript; Working with OOP concepts with TypeScript; Angular Fundamentals; Angular CLI; Introduction to TypeScript; Debugging Angular applications; Components & Databinding in Depth; Angular Directives; Using Services & Dependency Injection; Angular Routing; Observables; Handling Forms in Angular Apps; Output transformation using Pipes; Making Http Requests; Authentication & Route Protection; Dynamic Components; Angular Modules & Optimizing Angular Apps; Deploying an Angular App; Angular Animations; Adding Offline Capabilities with Service Workers; Unit Testing in Angular Apps (Jasmine, Karma). Overview of React.js

**Assignment:** Develop a software tool to do inventory management in a warehouse.

**Targeted Application & Tools that can be used:**

**Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers.**

**Professionally Used Software: GCC compiler.**

**Text Book:**

Fender, Young, "*Front-end Fundamentals",* Leanpub, 2015

Northwood, Chris, "*The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer",* APress, 2018

**References:**

R1. Flanagan D S, *"Javascript : The Definitive Guide"* 7th Edition. 7th ed. O'Reilly Media; 2020.

Alex Libby, Gaurav Gupta, and Asoj Talesra. *"Responsive Web Design with HTML5 and CSS3 Essentials",* Packt Publishing, 2016

3. Duckett J Ruppert G Moore J. *"Javascript & Jquery : Interactive Front-End Web Development.";* Wiley; 2014.

Web Reference: /www.youtube.com/watch?v=JGNTYXkVCVY&list=PLd3UqWTnYXOkTSBCBNyyhxo_jxlY_uTWA&index=2

Web Reference: https://www.freecodecamp.org/news/frontend-web-developer-bootcamp/

https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2233842&site=ehost-live

https://nptel.ac.in/courses/106102064

**Topics relevant to development of "Employability":** DevOps Tools Overview – Jenkins, Docker, Kubernetes for developing Employability Skills through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

| Course Code: CSD1705 | Course Title: Cloud Computing<br>Type of Course: Theory and Lab Integrated | L- T-P- C | 2 | 0 | 2 | 3 |
|---|---|---|---|---|---|---|
| Version No. | 2.0 | | | | | |
| Course Pre-requisites | [1] Data Communication and Computer Networks (CSE2011) | | | | | |
| Anti-requisites | NIL | | | | | |

| | |
|---|---|
| Course Description | This course provides a hands-on comprehensive study of Cloud concepts and capabilities across the various Cloud service models including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). It dives into all of the details that a student needs to know in order to plan for developing applications on the cloud and what to look for when using applications or services hosted on a cloud. |
| Course Objective | The course aims to impart knowledge to students that can provide easy, scalable access to computing resources and IT services.<br>This course is designed to improve the learner's EMPLOYABILITY SKILLS using EXPERIENTIAL LEARNING techniques. |
| Course Outcomes | Upon successful completion of the course, the students shall be able to:<br>1. Comprehend the significance of Cloud computing technologies<br>2. Describe appropriate Virtualization techniques to virtualize infrastructures<br>3. Apply Cloud mechanisms to optimize the QoS parameters<br>4. Interpret recent technologies on Cloud |

Course Content:

| | | | | |
|---|---|---|---|---|
| Module 1 | Introduction to Cloud Services | Assignment | Theory | **No. of Hours:10 ( Theory: 6, Lab:4)** |
| Topics: A Facility for Flexible Computing, The Start of Cloud: The Power Wall and Multiple Cores, From Multiple Cores to Multiple Machines, From Clusters to Web Sites and Load Balancing, Racks of Server Computers, The Economic Motivation for a Centralized Data Center, Cloud Computing Architecture, IaaS, PaaS, SaaS, Types of Clouds, and Cloud Computing Environments. | | | | |
| Module 2 | Virtualization Techniques | Lab-based Assignments | Theory | **No. of Hours:10 ( Theory: 6, Lab:4)** |
| Topics: Basics of Virtualization - Types of Virtualizations, Taxonomy of Virtualization Techniques, Implementation Levels of Virtualization. | | | | |
| Module 3 | QoS and Management | Application Development | Theory | **No. of Hours:10 ( Theory: 6, Lab:4)** |
| Topics: Quality of Service (QoS) in the Cloud, Cloud Infrastructure Mechanisms, Service Level Agreements (SLAs), Specialized Cloud Mechanisms, Cloud Management Mechanisms, Application development in the Cloud | | | | |
| Module 4 | Security and advancements | Case Study | Case Study | **No. of Hours:10 ( Theory: 6, Lab:4)** |
| Topics: The Zero Trust Security Model, Identity Management, Privileged Access Management, AI Technologies And Their Effect on Security, Protecting Remote Access, Privacy in a Cloud Environment, Application development in Cloud, Latest trends in Cloud Computing, Fog Computing, Dew Computing, Case Studies, and Recent Advancements | | | | |

Targeted Applications & Tools that can be used:

Targeted Applications:

Developing applications on Cloud Platforms via Virtual machines

Cloud Tools:

- VMWare
- Amazon EC2
- Google Compute Engine
- Microsoft Azure
- Cloudsim

Project work/Assignment:

1. Automation of performance analysis of students through the Cloud
2. Chatbots development using Cloud resources
3. Blog creation using Cloud computing

Analysis of Case Studies: When deciding to adopt cloud computing architecture, decide if the cloud is right for your requirements (for the application identified).

Suggested List of Hands-on Activities:

| Sl. No | Title |
|---|---|
| 1 | Install Virtualbox/VMware Workstation with different flavors of Linux or Windows OS on top of windows 11 |
| 2 | Install a C compiler in the virtual machine created using a virtual box and execute Simple Programs. |
| 3 | Install Google App Engine (GAE). Create a “hello world” application and other simple web applications using python/java |
| 4 | Use GAE launcher to launch the web applications. |
| 5 | Simulate a cloud scenario using CloudSim and run a scheduling algorithm |
| 6 | Find a procedure to transfer the files from one virtual machine to another virtual machine. |
| 7 | Find a procedure to launch a virtual machine using Openstack |
| 8 | Demonstrate Migration, Cloning, and Snapshots within and across VMs |
| 9 | Demonstrate on the Virtual Environment on hypervisor.<br>a) Communication between the VM’s.<br>b) The backup and restore mechanism. |
| 10 | Implement and Evaluate the performance of MapReduce program on word count for different file size. |

Text Book(s)

1. Douglas E. Comer, "The Cloud Computing Book: The Future of Computing Explained", Chapman and Hall/CRC; 1st edition, July 2021.

References

1. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, “Mastering Cloud Computing”, McGraw Hill Education, 2013 edition.
2. Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, “Cloud Computing Concepts, Technology & Architecture”, PHI publisher 2013 edition.
3. Anthony T Velte, Toby J Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, Tata McGraw-Hill, 2010 edition.
4. David E.Y. Sarna, “Implementing and Developing Cloud Applications”, CRC Press, 2018 edition.
5. Manvi, Sunilkumar, and Gopal K. Shyam. “Cloud Computing: Concepts and Technologies”. CRC Press, 2021.

Web Resources and Research Articles links:

**6.** IEEE Transactions on Cloud Computing- https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6245519

7. International Journal of Cloud Computing- https://www.inderscience.com/jhome.php?jcode=ijcc

**8.** CloudSim Resources- https://javadoc.io/doc/org.cloudsimplus/cloudsim-plus/latest/org/cloudbus/cloudsim/resources/class-use/Resource.html

**9.** Journal of Network and Computer Networking- https://www.journals.elsevier.com/journal-of-network-and-computer-applications

| Course Code: CSE3035 | Course Title: R Programming for Data Science<br><br>Type of Course: Program Core<br>Lab Integrated Course | L-T- P- C | 1 | 0 | 4 | 3 |
|---|---|---|---|---|---|---|
| Version No. | 1.0 | | | | | |
| Course Pre-requisites | Nil | | | | | |
| Anti-requisites | Nil | | | | | |
| Course Description | R Programming for Data Science is designed for inspecting, cleansing, transforming, and modeling data with the goal of discovering useful information, and supports in decision-making. The course begins by covering Data extraction, pre-processing, and transformation. It delivers the basic statistics and taught in an intuitive way to analysis the data. This course will help the students to apply the knowledge on Data Analytics to a wide range of applications. | | | | | |
| Course Objective | The objective of the course is to familiarize the learners with the concepts of R Programming for Data Science and attain **Employability** through **Problem Solving** Methodologies. | | | | | |
| Course Out Comes | On successful completion of the course the students shall be able to:<br>1) **Describe the R programming for Data Analytics.[Knowledge]**<br>**2) Generalize the appropriate visualization methods.[Comprehension]**<br>**3) Demonstrate the various statistical testing methods.[Application]**<br>**4) Apply the probability and complex distribution functions for the analysis of data.[Application]** | | | | | |
| Course Content: | | | | | | |

| Module 1 | Introduction to R Programming | Case studies | Programming | **8 Sessions** |
|---|---|---|---|---|
| R Studio: Base R-R Studio IDE-Introduction to R Projects and R Markdown. Basic R: R as a calculator-Scripts and Comments-R Variables. Data I/O: Working Directories-Importing Data-Exporting Data-More ways to save-Data I/O in Base R. Subsetting Data in R: Selecting specific elements-Renaming Columns-Subsetting Columns - Subsetting Rows – Adding/Removing Columns-Ordering Columns - Ordering Rows | | | | |
| **Module 2** | Data Analysis | Case studies | Programming | **10 Sessions** |
| Data Summarization: One Quantitative and Categorical Variable. Data Classes: One Dimensional Data Classes-Data Frames and Matrices-Lists. Data Cleaning: Dealing with Missing Data-Strings and Recoding Variables. Manipulating Data in R: Reshaping Data-Merging Datasets. Data Visualizations: Plotting with ggplot2- Plotting with Base R | | | | |
| **Module 3** | Statistical Analysis in R | Case studies | Programming | **8 Sessions** |
| Proportion tests-Chi squared test-Fisher exact test-Correlation-T test-Wilcoxon Rank sum tests-Wilcoxon signed rank test- One Way ANOVA- Kruskal Wallis Test-Linear Regression-Logistic Regression and Generalized Linear Models-Poisson Regression. | | | | |
| **Module 4** | Simulations | Case studies | Programming | **10 Sessions** |
| Functions: Writing your own function-Loops. Simulations: Standard Probability Distributions-Sampling from more Complex Distributions-The Accept and Reject Algorithm-The Metropolis Hasting Algorithm. R Markdown: Exploratory Analysis-Multiple Facets-Linear Models- Grabbing coefficients-Pander-Multiple Models-Data Extraction | | | | |

**Targeted Applications & Tools that can be used:**

**Tools**:

R Programming

**Lab:**

Exp 1.

Level 1:

a. create a new variable called `my.num` that contains 6 numbers
b. multiply `my.num` by 4
c. create a second variable called `my.char` that contains 5 character strings
d. combine the two variables `my.num` and `my.char` into a variable called `both`
e. what is the length of `both`?
f. what class is `both`?
g. divide `both` by 3, what happens?

Level 2:

a. create a vector with elements 1 2 3 4 5 6 and call it `x`
b. create another vector with elements 10 20 30 40 50 and call it `y`
c. what happens if you try to add `x` and `y` together? why?
d. append the value 60 onto the vector `y` (hint: you can use the `c()` function)
e. add `x` and `y` together
f. multiply `x` and `y` together. pay attention to how R performs operations on vectors of the same length.

Exp 2.

Level 1:

a. Read in the Youth Tobacco study, Youth_Tobacco_Survey_YTS_Data.csv and name it youth.
b. Install and invoke the readxl package. RStudio > Tools > Install Packages. Type readxl into the Package search and click install. Load the installed library with library(readxl).

Level 2:

a. Download an Excel version of the Monuments dataset, Monuments.xlsx, from CANVAS. Use the read_excel() function in the readxl package to read in the dataset and call the output mon.
b. Write out the mon R object as a CSV file using readr::write_csv and call the file "monuments.csv".
c. Write out the mon R object as an RDS file using readr::write_rds and call it "monuments.rds".

Exp 3:

Level 1:

a. Check to see if you have the mtcars dataset by entering the command mtcars.
b. What class is mtcars?
c. How many observations (rows) and variables (columns) are in the mtcars dataset?
d. Copy mtcars into an object called cars and rename mpg in cars to MPG. Use rename().
e. Convert the column names of cars to all upper case. Use rename_all, and the toupper command (or colnames).
f. Convert the rownames of cars to a column called car using rownames_to_column. Subset the columns from cars that end in "p" and call it pvars using ends_with().
g. Create a subset cars that only contains the columns: wt, qsec, and hp and assign this object to carsSub. What are the dimensions of carsSub? (Use select() and dim().)

Level 2:

a. Convert the column names of carsSub to all upper case. Use rename_all(), and toupper() (or colnames()).
b. Subset the rows of cars that get more than 20 miles per gallon (mpg) of fuel efficiency. How many are there? (Use filter().)
c. Subset the rows that get less than 16 miles per gallon (mpg) of fuel efficiency and have more than 100 horsepower (hp). How many are there? (Use filter().)
d. Create a subset of the cars data that only contains the columns: wt, qsec, and hp for cars with 8 cylinders (cyl) and reassign this object to carsSub. What are the dimensions of this dataset?
e. Re-order the rows of carsSub by weight (wt) in increasing order. (Use arrange().)
f. Create a new variable in carsSub called wt2, which is equal to wt^2, using mutate() and piping %>%.

Exp 4:
Level 1:

a. How many bike lanes are currently in Baltimore? You can assume that each observation/row is a different bike lane.
b. How many (a) feet and (b) miles of total bike lanes are currently in Baltimore? (The `length` variable provides the length in feet.)
c. How many types (`type`) bike lanes are there? Which type (a) occurs the most and (b) has the longest average bike lane length?

Level 2:

a. How many different projects (`project`) do the bike lanes fall into? Which `project` category has the longest average bike lane length?
b. What was the average bike lane length per year that they were installed? (Be sure to first set `dateInstalled` to `NA` if it is equal to zero.)
c. Numerically and graphically describe the distribution of bike lane lengths (`length`).
d. Describe the distribution of bike lane lengths numerically and graphically after stratifying them by (a) type and then by (b) number of lanes (`numLanes`).

Exp 5:

Level 1:

a. Get all the different types of bike lanes from the `type` column. Use `sort(unique())`. Assign this to an object `btypes`. Type `dput(btypes)`.
b. By rearranging vector `btypes` and using `dput`, recode `type` as a factor that has `SIDEPATH` as the first level. Print `head(bike$type)`. Note what you see. Run `table(bike$type)` afterwards and note the order.
c. Make a column called `type2`, which is a factor of the `type` column, with the levels: `c("SIDEPATH", "BIKE BOULEVARD", "BIKE LANE")`. Run `table(bike$type2)`, with the options `useNA = "always"`. Note, we do not have to make type a character again before doing this.

Level 2:

a. • Reassign `dateInstalled` into a character using `as.character`. Run `head(bike$dateInstalled)`.
b. Reassign `dateInstalled` as a factor, using the default levels. Run `head(bike$dateInstalled)`.
c. Do not reassign `dateInstalled`, but simply run `head(as.numeric(bike$dateInstalled))`. We are looking to see what happens when we try to go from factor to numeric.

d. Do not reassign `dateInstalled`, but simply run `head(as.numeric(as.character(bike$dateInstalled)))`. This is how you get a "numeric" value back if they were incorrectly converted to factors.

- Convert `type` back to a character vector. Make a column `type2` (replacing the old one), where if the type is one of these categories `c("CONTRAFLOW", "SHARED BUS BIKE", "SHARROW", "SIGNED ROUTE")` call it `"OTHER"`. Use `%in%` and `ifelse`. Make `type2` a factor with the levels `c("SIDEPATH", "BIKE BOULEVARD", "BIKE LANE", "OTHER")`.
- Parse the following dates using the correct `lubridate` functions:
  a. "2014/02-14"
  b. "04/22/14 03:20" assume `mdy`
  c. "4/5/2016 03:2:22" assume `mdy`

Exp 6:

Level 1:

a. Count the number of rows of the bike data and count the number of complete cases of the bike data. Use `sum` and `complete.cases`.

b. Create a data set called namat which is equal to `is.na(bike)`. What is the class of `namat`? Run `rowSums` and `colSums` on `namat`. These represent the number of missing values in the rows and columns of bike. Don't print `rowSums`, but do a table of the `rowSums`.

c. Filter rows of bike that are NOT missing the `route` variable, assign this to the object `have_route`. Do a table of the `subType` variable using table, including the missing `subType`s. Get the same frequency distribution using `group_by(subType)` and `tally()` or `count()`.

d. Filter rows of `bike` that have the type `SIDEPATH` or `BIKE LANE` using `%in%`. Call it `side_bike`. Confirm this gives you the same number of results using the `|` and ==.

e. Do a cross tabulation of the bike `type` and the number of lanes (`numLanes`). Call it `tab`. Do a `prop.table` on the rows and columns margins. Try `as.data.frame(tab)` or `broom::tidy(tab)`.

f. Read the Property Tax data into R and call it the variable `tax`.

g. How many addresses pay property `taxes`? (Assume each row is a different address.)

h. What is the total (a) city (`CityTax`) and (b) state (`SateTax`) tax paid? You need to remove the `$` from the `CityTax` variable, then you need to make it numeric. Try `str_replace`, but remember `$` is "special" and you need `fixed()` around it.

i. Using `table()` or `group_by` and `summarize(n())` or `tally()`.
   a. How many observations/properties are in each ward (`Ward`)?
   b. What is the mean state tax per ward? Use `group_by` and `summarize`.
   c. What is the maximum amount still due (`AmountDue`) in each ward? Use `group_by` and `summarize` with 'max`.
   d. What is the 75th percentile of city and state tax paid by Ward? (`quantile`)

j. Make boxplots showing `CityTax` (`y`-variable) by whether the property is a principal residence (`x = ResCode`) or not. You will need to trim some leading/trailing white space from `ResCode`.

Level 2:

a. Subset the data to only retain those houses that are principal residences. Which command subsets rows? Filter or select?
   a. How many such houses are there?
   b. Describe the distribution of property taxes on these residences. Use `hist`/`qplot` with certain breaks or `plot(density(variable))`.

b. Make an object called `health.sal` using the salaries data set, with only agencies (`JobTitle`) of those with "fire" (anywhere in the job title), if any, in the name remember `fixed("string_match", ignore_case = TRUE)` will ignore cases.

c. Make a data set called `trans` which contains only agencies that contain "TRANS".
d. What is/are the profession(s) of people who have "abra" in their name for Baltimore's Salaries? Case should be ignored.
e. What does the distribution of annual salaries look like? (use `hist`, 20 breaks) What is the IQR? Hint: first convert to numeric. Try `str_replace`, but remember `$` is "special" and you need `fixed()` around it.
f. Convert `HireDate` to the `Date` class - plot Annual Salary vs Hire Date. Use `AnnualSalary ~ HireDate` with a `data = sal` argument in plot or use `x`, `y` notation in `scatter.smooth`. Use the `lubridate` package. Is it `mdy(date)` or `dmy(date)` for this data - look at `HireDate`.
g. Create a smaller dataset that only includes the Police Department, Fire Department and Sheriff's Office. Use the `Agency` variable with string matching. Call this `emer`. How many employees are in this new dataset?
h. Create a variable called `dept` in the `emer` data set, `dept = str_extract(Agency, ".*(ment|ice)")`. E.g. we want to extract all characters up until ment or ice (we can group in regex using parentheses) and then discard the rest. Replot annual salary versus hire date and color by dept (not yet - using ggplot). Use the argument `col = factor(dept)` in `plot`.
i. (Bonus). Convert the 'LotSize' variable to a numeric square feet variable in the `tax` data set. Some tips: a) 1 acre = 43560 square feet b) The hyphens represent a decimals. (This will take a lot of searching to find all the string changes needed before you can convert to numeric.)

Exp 7:

Level 1:

a. Read in the Bike_Lanes_Wide.csv dataset and call is `wide`.
b. Reshape `wide` using `pivot_longer`. Call this data `long`. Make the key `lanetype`, and the value `the_length`. Make sure we gather all columns but `name`, using `-name`. Note the `NAs` here.
c. Read in the roads and crashes .csv files and call them `road` and `crash`.
d. Replace (using `str_replace`) any hyphens (`-`) with a space in `crash$Road`. Call this data `crash2`. Table the `Road` variable.
e. How many observations are in each dataset?
f. Separate the `Road` column (using `separate`) into (`type` and `number`) in `crash2`. Reassign this to `crash2`. Table `crash2$type`. Then create a new variable calling it `road_hyphen` using the `unite` function. Unite the `type` and `number` columns using a hyphen (`-`) and then table `road_hyphen`.
g. Which and how many years were data collected in the `crash` dataset?
h. Read in the dataset Bike_Lanes.csv and call it `bike`.

Level 2:

a. Keep rows where the record is not missing `type` and not missing `name` and re-assign the output to `bike`.
b. Summarize and group the data by grouping `name` and `type` (i.e for each type within each name) and take the `sum` of the `length` (reassign the sum of the lengths to the `length` variable). Call this data set `sub`.

c. Reshape `sub` using `pivot_wider`. Spread the data where the key is `type` and we want the value in the new columns to be `length` - the bike lane length. Call this `wide2`. Look at the column names of `wide2` - what are they? (they also have spaces).

d. Join data in the crash and road datasets to retain only complete data, (using an inner join) e.g. those observations with road lengths and districts. Merge without using `by` argument, then merge using `by = "Road"`. call the output merged. How many observations are there?

e. Join data using a `full_join`. Call the output `full`. How many observations are there?

f. Do a left join of the `road` and `crash`. ORDER matters here! How many observations are there?

g. Repeat above with a `right_join` with the same order of the arguments. How many observations are there?

Exp 8

Level 1:

a. Plot average ridership (`avg` data set) by `date` using a scatterplot.
    a. Color the points by route (`orange`, `purple`, `green`, `banner`)
    b. Add black smoothed curves for each route
    c. Color the points by day of the week

b. Replot 1a where the colors of the points are the name of the `route` (with `banner` –> `blue`)

```
pal = c("blue", "darkgreen","orange","purple")
```

c. Plot average ridership by date with one panel per `route`

Level 2:

a. Plot average ridership by date with separate panels by `day` of the week, colored by `route`

b. Plot average ridership (`avg`) by date, colored by `route` (same as 1a). (do not take an average, use the average column for each route). Make the x-label `"Year"`. Make the y-label `"Number of People"`. Use the black and white theme `theme_bw()`. Change the `text_size` to (`text = element_text(size = 20)`) in `theme`.

c. Plot average ridership on the `orange` route versus date as a solid line, and add `dashed` "error" lines based on the `boardings` and `alightings`. The line colors should be `orange`. (hint `linetype` is an aesthetic for lines - see also `scale_linetype` and `scale_linetype_manual`. Use `Alightings = "dashed", Boardings = "dashed", Average = "solid"`)

Exp 9

Level 1:

a. Compute the correlation between the `1980`, `1990`, `2000`, and `2010` mortality data. No need to save this in an object. Just display the result to the screen. Note any `NA`s. Then compute using `use = "complete.obs"`.

b.
    a. Compute the correlation between the `Myanmar`, `China`, and `United States` mortality data. Store this correlation matrix in an object called `country_cor`
    b. Extract the Myanmar-US correlation from the correlation matrix.

c. Is there a difference between mortality information from `1990` and `2000`? Run a paired t-test and a Wilcoxon signed rank test to assess this. Hint: to extract the column of information for `1990`, use `mort$"1990"`

Level 2:

a. Using the cars dataset, fit a linear regression model with vehicle cost (`VehBCost`) as the outcome and vehicle age (`VehicleAge`) and whether it's an online sale (`IsOnlineSale`) as predictors as well as their interaction. Save the model fit in an object called `lmfit_cars` and display the summary table.
b. Create a variable called `expensive` in the `cars` data that indicates if the vehicle cost is over `$10,000`. Use a chi-squared test to assess if there is a relationship between a car being expensive and it being labeled as a "bad buy" (`IsBadBuy`).
c. Fit a logistic regression model where the outcome is "bad buy" status and predictors are the `expensive` status and vehicle age (`VehicleAge`). Save the model fit in an object called `logfit_cars` and display the summary table. Use summary or
`tidy(logfit_cars, conf.int = TRUE, exponentiate = TRUE)` or
`tidy(logfit_cars, conf.int = TRUE, exponentiate = FALSE)` for log odds ratios

Exp 10

Level 1:

- Write a function, sqdif, that does the following:
  a. takes two numbers x and y with default values of 2 and 3.
  b. takes the difference
  c. squares this difference
  d. then returns the final value
  e. checks that x and y are numeric and stops with an error message otherwise

Level 2:

- Try to write a function called top() that takes a matrix or data.frame and a number n, and returns the first n rows and columns, with the default value of n=5.
- Write a function that will calculate a 95% one sample t interval. The results will be stored in a list to be returned containing sample mean and the confidence interval. The input to the functions is the numeric vector containing our data. For review, the formula for a 95% one sample t interval is $\bar{x} \pm 1.96 * s/\sqrt{n}$.

Exp 11

Level 1:

Simulate a random sample of size n=100

- from
  a. a normal distribution with mean 0 and variance 1. (see `rnorm`)
  b. a normal distribution with mean 1 and variance 1. (see `rnorm`)
  c. a uniform distribution over the interval [-2, 2]. (see `runif`)
- Run a simulation experiment to see how the type I error rate behaves for a two sided one sample t-test when the true population follows a Uniform distribution over [-10,10]. Modify the function `t.test.sim` that we wrote to run this simulation by
  - changing our random samples of size `n` to come from a uniform distribution over [-10,10] (see `runif`).
  - performing a two sided t-test instead of a one sided t-test.
  - performing the test at the 0.01 significance level.

- choosing an appropriate value for the null value in the t-test. Note that the true mean in this case is 0 for a Uniform(-10,10) population. Try this experiment for `n=10,30,50,100,500`. What happens the estimated type I error rate as `n` changes? Is the type I error rate maintained for any of these sample sizes?

Level 2:

- From introductory statistics, we know that the sampling distribution of a sample mean will be approximately normal with mean $\mu$ and standard error $\sigma/\sqrt{n}$ if we have a random sample from a population with mean $\mu$ and standard deviation $\sigma$ and the sample size is "large" (usually at least 30). In this problem, we will build a simulation that will show when the sample size is large enough.
  a. Generate `N=500` samples of size `n=50` from a Uniform[-5,5] distribution.
  b. For each of the `N=500` samples, calculate the sample mean, so that you now have a vector of 500 sample means.
  c. Plot a histogram of these 500 sample means. Does it look normally distributed and centered at 0?
  d. Turn this simulation into a function that takes arguments `N` the number of simulated samples to make and `n` the sample size of each simulated sample. Run this function for `n=10,15,30,50`. What do you notice about the histogram of the sample means (the sampling distribution of the sample mean) as the sample size increases.

**Text Book**

1. Introduction to R- Robert Parker, John Mushcelli and Andrew Jaffe, Johns Hopkins University, 2020

**References**

1. Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining Paperback, Glenn J. Myatt and Wayne P. Johnson, Import, 22 July 2014.
2. The R Software-Fundamentals of Programming and Statistical Analysis -Pierre Lafaye de Micheaux, Remy Drouilhet, Benoit Liquet, Springer 2013.

**Topics relevant to Development skills**
**Topics relevant to development of "Employability": Real time application development using R Programming Tools.**
**Topics relevant to "Human Values & Professional Ethics"**

| Course Code:<br><br>CSE3087 | Course Title: Applied Machine Learning<br><br>Type of Course: 1] Program Core<br>2] Laboratory integrated | L-T- P-C | 2 | 0 | 2 | 3 |
|---|---|---|---|---|---|---|
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | **CSE3001 Artificial Intelligence and Machine Learning** | | | | | |
| **Anti-requisites** | **NIL** | | | | | |
| **Course Description** | Machine Learning algorithms are the key to develop intelligent systems such as Apple's Siri, Google's self-driving cars etc. This course introduces the concepts of the core machine learning techniques such as Regression learning, Bayesian learning, Ensemble learning, Perceptron learning, Unsupervised learning, Competitive learning, learning from Gaussian mixture models and learning to detect outliers. Course lectures covers both the theoretical foundations as well as the essential algorithms for the various learning methods. Lab sessions complement the lectures and enable the students in developing intelligent systems for real life problems. | | | | | |
| **Course Objectives** | This course is designed to improve the learners 'EMPLOYABILITY SKILLS' by using EXPERIENTIAL LEARNING techniques. The supervised hands-on laboratory exercises, assessments and the group projects facilitate this learning process. | | | | | |
| **Course Out Comes** | On successful completion of the course the students shall be able to:<br>1] Apply advanced supervised machine learning methods for predictive modeling. [Application]<br>2] Produce machine learning models with better predictive performance using meta learning algorithms [Application]<br>3] Create predictive models using Perceptron learning algorithms[Application]<br>4] Employ advanced unsupervised learning algorithms for clustering, competitive learning and outlier detection[Application]<br>5] Implement machine learning based intelligent models using Python libraries. [Application] | | | | | |
| **Course Content:** | | | | | | |

| **Module 1** | Supervised Learning | Assignment | Programming using Keras/Sklearn | **No. of Classes L – 7 P – 12** |
|---|---|---|---|---|

**Topics:** An overview of Machine Learning(ML); ML workflow; types of ML; Types of features, Feature Engineering -Data Imputation Methods; Regression – introduction; simple linear regression, loss functions; Polynomial Regression; Logistic Regression; Softmax Regression with cross entropy as cost function**; Bayesian Learning –** Bayes Theorem, estimating conditional probabilities for categorical and continuous features, Naïve Bayes for supervised learning; Bayesian Belief networks; Support Vector Machines – soft margin and kernel tricks.

| **Module 2** | Ensemble Learning | Assignment | Programming using Keras/Sklearn | **No. of Classes L-3 P-4** |
|---|---|---|---|---|

Topics: **Ensemble Learning –** using subset of instances – Bagging, Pasting, using subset of features –random patches and random subspaces method; Voting Classifier, Random Forest; Boosting – AdaBoost, Gradient Boosting, Extremely Randomized Trees, Stacking.

| | | | | |
|---|---|---|---|---|
| **Module 3** | Perceptron Learning | Assignment /Quiz | Programming using Keras/Sklearn | **No. of Classes L-7 P -2** |

Topics: **Perceptron Learning –** from biological to artificial neurons, Perceptrons, Linear Threshold Units, logical computations with Perceptrons, common activation functions – sigmoid, tanh, relu and softmax, common loss functions, multi-layer Perceptrons and the Backpropagation algorithm using Gradient Descent.

| | | | | |
|---|---|---|---|---|
| **Module 4** | Unsupervised Learning | Assignment | Programming using Keras/Sklearn | **No. of Classes L-6 P -6** |

Topics: **Unsupervised Learning –** simple k Means clustering- simple and mini-batch**;** updating centroids incrementally; finding the optimal number of clusters using Elbow method ; Silhoutte coefficient, drawbacks of kMeans, kMeans++ **;** Divisive hierarchical clustering – bisecting k-means, clustering using Minimum Spanning Tree (MST) **Competitive Learning** - Clustering using Kohenen's Self Organising Maps (SOM), **Density Based Spatial Clustering – DBSCAN**; clustering using Gaussian Mixture Models (GMM) with EM algorithm ; Outlier Detection methods – **Isolation Forest, Local Outlier Factor(LOF)**

**List of Laboratory Tasks:**

**Experiment N0 1: Methods for handling missing values**
**Level 1:** Given a data set from UCI repository, implement the different ways of handling missing values in it using Scikit-learn library of Python
**Level 2:** Implement one of these methods using a custom defined function in Python.

**Experiment No. 2: Data Visualization**
**Level 1** Perform Exploratory Data Analysis for a given data set by creating Scatter Plot, Pair Plot, Count Plot using Matplotlib and Seaborn
**Level 2** Create Heat Maps, WordCloud

**Experiment No. 3: Regression learning**
**Level 1** Given a data set from UCI repository, implement the simple linear regression algorithm and estimate the models parameters and the performance metrics. Plot the learning curves.
**Level 2** Implement the polynomial regression algorithm. Compare the learning curves of Polynomial and Linear Regression.

**Experiment No.4: Logistic regression**
**Level 1** Write custom code for generating the logistic/sigmoid plot for a given input
**Level 2** Given a data set from UCI repository, implement the Logistic regression algorithm. Estimate the class probabilities for a given test data set. Plot and analyze the decision boundaries.

**Experiment No.5: Bayesian Learning**
**Level 1** Given a data set from UCI repository, implement a classification model using the Bayesian algorithm

**Experiment No.6: Support Vector Machine(SVM)**
**Level 1** Given data sets from UCI repository, implement a linear SVM and a non-linear SVM based classification model.

**Experiment No. 7: Ensemble Learning**
**Level 1** : Implement Ensemble Learning algorithms such as Bagging, Pasting and Out-of Bag Evaluation
**Level 2** : Random Patches and Random Subspace Method

**Experiment No. 8: Ensemble Learning**
**Level 1** : AdaBoost and Gradient Boosting, Stacking

**Experiment No. 9: Perceptron Learning**
**Level 1** : Implement the Perceptron Classifier
**Level 2** : – An Image Classifier Using the Sequential API of Keras

**Experiment No. 10: Unsupervised Learning**
**Level 1** : K-means – simple and mini-batch. Finding the optimal number of clusters using Elbow method and Silhoutte Coefficient . Compare the inertia of both as k increases. Tuning the hyperparameter 'k' using GridSearchCV.
**Level 2** : – Using clustering for Image segmentation and Preprocessing. Kmeans++
**Experiment No. 11: Density Based Clustering**
**Level 1** Implement DBSCAN – clustering using the local density estimation. Perform hard and soft clustering for new instances.
**Experiment No. 12: Outlier Detection**
**Level 1** Outlier Detection using Isolation Forest and Local Outlier Factor

**Targeted Application & Tools that can be used :**

1. Execution of the ML algorithms will be done using the Google's cloud service namely "Colab", available at https://colab.research.google.com/ or Jupyter Notebook.
2. The data sets will be from the bench marking repositories such as UCI machine learning repository available at : https://archive.ics.uci.edu/ml/index.php
3. Laboratory tasks will be implemented using the libraries available in Python such as Scikit learn, matplotlib, seaborn, perceptron and the deep learning framework namely Keras.

**Project work/Assignment: Mention the Type of Project /Assignment proposed for this course**

Students can be assigned a mini project to develop a machine learning application for real-life problems in various domains such as health care, business intelligence, environmental modeling, etc.

**Text Book**

There are a number of useful textbooks for the course, but each cover only a part of the course syllabus. Following is an indicative list of textbooks.

1. Aurélien Géron, "Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow", Oreilly, Second Edition, 2019.
2. Andreas C Muller, Sarah Guido, "Introduction to Machine Learning with Python :A Guide for Data Scientists", Oreilly, First Edition, 2018
3. Giuseppe Bonaccorso, "Machine Learning Algorithms: A reference guide to popular algorithms from data science and machine learning", Packt Publishing, 2017.

**References In references apart from the books and web links, mention a few standards &Hand books relevant to the Laboratory tasks used by the professionals.**

| | |
|---|---|
| 1. Tan P. N., Steinbach M & Kumar V. "***Introduction to Data Mining*", ** Pearson Education, 2016.<br>2. **https://towardsdatascience.com/machine-learning/home**<br>3. MITopencourseware:https://ocw.mit.edu/courses/6-0002-introduction-to-computational-thinking-and-data-science-fall-2016/resources/lecture-11-introduction-to-machine-learning/<br>4. https://onlinecourses.nptel.ac.in/noc21_cs85/preview | |
| **Catalogue prepared by** | Dr J Alamelu Mangai |
| **Recommended by the Board of Studies on** | BOS NO: SOCSE 2nd BOS held on 10/07/23 |
| **Date of Approval by the Academic Council** | Academic Council Meeting No 21, Dated 06/09/2023 |

| Course Code: UG COURSE: CSE3107 | Course Title: Robotic Vision<br><br>Type of Course: Program Core Theory with embedded lab | L-T-P- C | 2 | 0 | 2 | 3 |
|---|---|---|---|---|---|---|
| Version No. | 1.0 | | | | | |
| Course Pre-requisites | MAT1001- Calculus and Linear Algebra, MAT1002 - Transform Techniques, Partial Differential Equations and their Applications | | | | | |
| Anti-requisites | NIL | | | | | |
| Course Description | This Course is an introduction to Robotic vision and image analysis techniques and concepts. Robotic vision has found much wider applications not only in the space program, but also in the areas such as medicine, biology, industrial automation, astronomy, law enforcement, defense, intelligence. With the progress made AI Robotics these days, Robotic vision has become an indispensable part of our digital age. This course includes Fundamentals, Applications, Human Visual Perception, Image Formation, Sampling and Quantization, Binary Image, Three-Dimensional Imaging, Image file formats. Color and Color Imagery: Perception of Colors, Image Transformation: Fourier Transforms, Image Enhancement and Restoration, Image Reconstruction, Image Segmentation, Visual based Servoing, Object detection. | | | | | |
| Course Objective | The objective of the course is to familiarize the learners with the concepts of Robotic Vision **Employability** through **Problem Solving** Methodologies. | | | | | |
| Course Out Comes | **On successful completion of the course the students shall be able to:**<br>1. Explain the fundamentals of Robotic vision and its processing. **[Understanding]**<br>2. Utilize image enhancement techniques in spatial and frequency domain. **[Application]**<br>3. Apply the mathematical modeling of image degradation and restoration.**[Application]**<br>4. Apply the concept of image segmentation. **[Application]** | | | | | |
| Course Content: | | | | | | |
| Module 1 | Introduction to Robotic Vision | Assignment | Practical | No. of Classes:8 | | |
| Overview of computer vision and its applications in robotics, Introduction to robotic perception and the role of vision sensors ,Challenges and limitations of robotic vision systems<br>Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Classification of images, Some Basic Relationships between Pixels, Linear and Nonlinear Operations. | | | | | | |
| Module 2 | Image Transformation: | Assignment | Practical | No. of Classes:8 | | |
| **Image enhancement in spatial domain:** Some basic gray level transformations, Histogram processing, Smoothing and Sharpening spatial filters.<br>**Image enhancement in frequency domain:** 1D FFT, 2D FFT, Smoothing and Sharpening frequency domain filters, Homomorphic filtering. | | | | | | |
| Module 3 | Image Restoration | Assignment | Practical | No. of Classes:8 | | |
| A model of the image restoration and degradation process, Noise models – spatial and frequency properties of noise, some important probability density functions: Gaussian noise, Rayleigh noise, Gamma noise, exponential, uniform, impulse noise, Periodic noise Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering. | | | | | | |
| Module 4 | Image Segmentation and Ethics | Assignment | Practical | No. of Classes:6 | | |
| Point, Line, and Edge Detection, Thresholding, Region-Based Segmentation, | | | | | | |

**Color image processing:** Color Fundamentals, Color Models, Pseudo color Image Processing.
**Morphological Image Processing:** Preliminaries, Erosion and Dilation, Opening and Closing, Some Basic Morphological Algorithms.
**Ethical and Social Implications:** Ethical considerations in robotic vision applications, Privacy concerns and data protection, Social impact and implications of robotic vision technologies

## Lab Experiments are to be conducted on the following topics:-

## Lab Sheet 1:

1. Simulation and Display of an Image, Negative of an Image (Binary & Gray Scale._____**(One Lab Session)**
   a) Red Blue and Green and Gray Components _____**(Level 1)**
   b) Display color Image, find its complement and convert to gray scale _____**(Level 1)**
   c) Simulation of an Image (Arithmetic & Logic Operation)._____**(Level 2)**
2. Implementation of Relationships between Pixels._____**(One Lab Session)**
   a. find Neighbour of a given Pixel _____**(Level 1)**
   b. 4 Point Neighbour _____**(Level 1)**
   c. 8 Point Neighbour _____**(Level 2)**
   d. Diagonal Neighbour _____**(Level 2)**

## Lab Sheet 2:

3. Implementation of Transformations of an Image._____**(One Lab Session)**
   a. Scaling & Rotation _____**(Level 1)**
   b. Gray level transformations, power law, logarithmic, negative._____**(Level 2)**
4. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization. **(One Lab Session) (Level 2)**
5. Display of bit planes of an Image. _____**(One Lab Session) (Level 2)**
6. Implementation of Image Intensity slicing technique for image enhancement._**(One Lab Session) (Level 2)**

## Lab Sheet 3:

7. Display of FFT (1-D & 2-D) of an image. _____**(One Lab Session) (Level 2)**
8. Computation of mean, Standard Deviation, Correlation coefficient of the given Image. **( One Lab Session) (Level 2)**
9. Implementation of Image Smoothening Filters(Mean, Median and MinMax filtering of an Image) **( One Lab Session) (Level 2)**
10. Implementation of image sharpening filters and Edge Detection using Gradient Filters. **( One Lab Session) (Level 2)**

## Lab Sheet 4:

11. Canny edge detection Algorithm._____**( One Lab Session) (Level 2)**
12. Image morphological operations opening closing erosion dilation._____**( Two Lab Sessions) (Level 2)**

13. Image segmentation by region growing split and merge algorithm._____**( Two Lab Sessions) (Level 2)**

**Tools/Software Required:**

1. OpenCV 4
2. Python 3.7
3. MATLAB

**Text Books**

1. Rafael C. Gonzalez and Richard E. Woods' "Digital Image Processing", Fourth Edition, Global Edition 2018.

**References**

1. Perter Corke, "Robotics, Vision and Control: Fundamental Algorithms in MATLAB", 2nd Edition, Springer, 2017
2. Ravishankar Chityala, Sridevi Pudipeddi, "Image Processing and Acquisition Using Python", Taylor & Francis, 2020.
3. Jason M. Kinser, "Image Operators: Image Processing in Python", CRC Press, 2018.
4. TinkuAcharya and Ajoy K. Ray, "Image Processing Principles and Applications", John Wiley and Sons publishers.

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|---|---|
| Catalogue prepared by | 1. Mr. Yamanappa |
| Recommended by the Board of Studies on | BOS NO: SOCSE 2nd BOS held on 10/07/23 |
| Date of Approval by the Academic Council | Academic Council Meeting No 21, Dated 06/09/2023 |

| Course Code: CSE3155 | Course Title: Data Communications and Computer Networks<br><br>Type of Course: Program Core Theory–Laboratory integrated | L-T-P-C | 3 | 0 | 2 | 4 |
|---|---|---|---|---|---|---|
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | Digital Design | | | | | |
| **Anti-requisites** | NIL | | | | | |
| **Course Description** | The objective of this course is to provide knowledge in data communications and computer networks, its organization and its implementation, and gain practical experience in the installation, monitoring, and troubleshooting of LAN systems. .<br>The associated laboratory is designed to implement and simulate various networks using Cisco packet tracer, NS2. All the lab exercises will focus on the fundamentals of creating multiple networks, topologies and analyzing the network traffics. | | | | | |
| **Course Objective** | The objective of the course is to familiarize the learners with the concepts of Data Communications and Computer Networks and attain **Employability** through **Problem Solving** Methodologies. | | | | | |
| **Course Out Comes** | On successful completion of the course, the students shall be able to:<br>1] I<br>llustrate the Basic Concepts Of Data Communication and Computer Networks.<br>2] Analyze the functionalities of the Data Link Layer.<br>3] Apply the Knowledge of IP Addressing and Routing Mechanisms in Computer Networks.<br>4] Demonstrate the working principles of the Transport layer and Application Layer. | | | | | |
| **Course Content:** | | | | | | |

| **Module 1** | Introduction and Physical Layer-CO1 | Assignment | Problem Solving | 07 Classes |
|---|---|---|---|---|

Introduction to Computer Networks and Data communications, Network Components – Topologies, Transmission Media –Reference Models -OSI Model – TCP/IP Suite.
Physical Layer -Analog and Digital Signals – Digital and Analog Signals – Transmission - Multiplexing and Spread Spectrum.

| Module 2 | Reference Models and Data Link Layer – CO2 | Assignment | Problem Solving | **7 Classes** |
|---|---|---|---|---|

Data Link Layer - Error Detection and Correction – Parity, LRC, CRC, Hamming Code, Flow Control and Error Control, Stop and Wait, ARQ, Sliding Window, Multiple Access Protocols, CSMA/CD,CSMA/CA, IEEE 802.3, IEEE 802.11 Ethernet.

| | | | | |
|---|---|---|---|---|
| Module 3 | Network Layer – CO 3 | Assignment | Problem Solving | **10 Classes** |
| Network Layer Services - Network Layer Services, Switching Techniques, IP Addressing methods- IPv4 IPV6 – Subnetting. Routing, - Distance Vector Routing – RIP-BGP-Link State Routing –OSPF-Multi cast Routing-MOSPF- DVMRP – Broad Cast Routing. EVPN-VXLAN, VPLS, ELAN. | | | | |
| Module 4 | Transport and Application Layer -CO3 | Assignment | Problem Solving | **10 Classes** |
| Transport Layers - Connection management – Flow control – Retransmission, UDP, TCP, congestion control, – Congestion avoidance (DECbit, RED)<br>The Application Layer: Domain Name System (DNS), Domain Name Space, SSH, FTP, Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – – SNMP, Web Services, Virtual Networking. | | | | |
| List of Laboratory Tasks:<br><br>Lab sheet -1, M-1, 3 [2 Hours]<br>Experiment No 1:<br>Level 1: Study of basic network commands and network configuration commands.<br><br>Lab sheet -2, M-1[2 Hours]<br>Experiment No 1:<br>Level 1: Identify and explore Network devices, models and cables. Introduction to Cisco packet tracer.<br>Experiment No. 2:<br>Level 2 – Create various network topologies using a cisco packet tracer.<br><br>Lab sheet -3, M-2,3 [2 Hours]<br>Experiment No. 1:<br>Level 2 - Basic Configuration of switch/router using Cisco packet tracer.<br>Experiment No. 2:<br>Level 2 -Configure the privilege level password and user authentication in the switch/router.<br><br>Lab sheet – 4, M-3 [2 Hours]<br>Experiment No. 1:<br>Level 2 - Configure the DHCP server and wireless router and check the connectivity<br><br>Lab sheet – 5, M-3 [2 Hours]<br>Experiment No. 1:<br>Level 2 - Configure the static routing in the Cisco packet tracer.<br>Experiment No. 2:<br>Level 2 - Configure the dynamic routing protocol in the Cisco packet tracer.<br><br>Lab sheet – 6, M-4 [2 Hours]<br>Experiment No. 1: Configuration of DNS Server with Recursive & Integrative approach in Cisco packet tracer.<br><br>Lab sheet – 7, M-4 [2 Hours]<br>Experiment No. 1:<br>Configure the telnet protocol in the router using the Cisco packet tracer.<br>Lab sheet – 8, M-4[2 Hours] | | | | |

Experiment No. 1:
Level1- Introduction to NS2 and basic TCL program.
Lab sheet – 9, M-4 [2 Hours]
Experiment No. 1:
Level 1: Simulate three node Point to point network using UDP in NS2.
Experiment No. 2:
Simulate transmission of Ping message using NS2.
Lab sheet – 10, M-4[2 Hours]
Experiment No. 1:
Simulate Ethernet LAN using N-node in NS2.
Experiment No. 2:
Simulate Ethernet LAN using N-node using multiple traffic in NS2
Lab sheet –11, M-3,4 [2 Hours]
Experiment No. 1:
Level 1- Introduction to Wire Shark.
Experiment No. 2:
Level 2- Demonstration of packet analysis using wire shark.

Lab sheet –12, M-1,2,3 [2 Hours]
Experiment No. 1:
Level 2- Demonstration of switch and router configuration using real devices

**Targeted Application & Tools that can be used:** Cisco Packet Tracer, Wireshark, and NS2.

**Case Study/Assignment: Choose and analyze a network from any organization/Assignment proposed for this course in CO1-CO4**

1. **Problem Solving: Choose and appropriate devices and implement various network concepts.**
2. **Programming: Simulation of any network using NS2.**

**Text Book**

1. **Behrouz A. Forouzan, "Data Communications and Networking 5E", 5th Edition, Tata McGraw-Hill, 2017.**
2. **Andrew S Tanenbaum, Nick Feamster & David J Wetherall, "Computer Networks" Sixth Edition, Pearson Publication, 2022**

**References**


1. **"Computer Networking: A Top-Down Approach", Eighth Edition, James F. Kurose, Keith W. Ross, Pearson publication, 2021.**
2. **William Stallings, Data and Computer Communication, 8th Edition, Pearson Education, 2007.**
3. **Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2007.**


**E-Resources:**

**1.https://archive.nptel.ac.in/courses/106/105/106105183/**
**2. http://www.nptelvideos.com/course.php?id=393**
**3.https://www.youtube.com/watch?v=3DZLItfbqtQ**
**4.https://www.youtube.com/watch?v=_fIdQ4yfsfM**
**5. https://www.digimat.in/keyword/106.html**
**https://puniversity.informaticsglobal.com/login**

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|---|---|
| **Catalogue prepared by** | Prof. Dr.A.VIJAYAKUMAR |
| **Recommended by the Board of Studies on** | BOS NO: SOCSE 2nd BOS held on 10/07/23 |
| **Date of Approval by the Academic Council** | Academic Council Meeting No 21, Dated 06/09/2023 |

| Course Code:<br><br>CSE 5020 | Course Title: Medical Image Processing<br><br>Type of Course: Discipline Elective<br>Theory and Lab Integrated | L- T-P-C | 2 | 0 | 2 | 3 |
|---|---|---|---|---|---|---|

| | |
|---|---|
| Version No. | 2.0 |
| Course Pre-requisites | • Python programming language<br>• OpenCV library<br>• Basics of digital image processing |
| Anti-requisites | NIL |
| Course Description | The course introduces the basics to advance the implementation of biomedical images such as MRI, CT, X-ray, etc. Here we will be studying about complete basics of theical image processing and then moving forward we will be learning about the various filters and feature extraction techniques. This course also teaches the segmentation and restoration techniques in depth along with the practical implementation. |
| Course Objective | The objective of the course is SKILL DEVELOPMENT of student by using PARTICIPATIVE LEARNING techniques. |
| Course Outcomes | On successful completion of the course, the students shall be able to:<br>**CO 1:** understand digital image processing using OpenCV and Python programming language.<br>**CO 2:** Demonstrate image enhancements for Filter and feature extraction of statistical measurement.<br>**CO 3:** Implement deep learning techniques for image restoration and segmentation.<br>**CO 4:** Experiment with soft computing techniques for content-based medical image retrieval |
| Course Content: | |

| | | | | |
|---|---|---|---|---|
| Module 1 | Digital image processing | Assignment | Image processing | **10 Sessions** |
| **Introduction:** What is an image, Digital image, Image resolution, and aspect ratio, components of digital image processing, sampling, and quantization, applications areas, vision fundamentals, CAD systems, research areas of digital image processing. **Biomedical image processing:** various modalities of medical imaging: breast cancer imaging, mammographic imaging, ultrasound imaging, magnetic resonance imaging(MRI), and breast thermography imaging. Problems with medical images, image enhancement, and other modalities of medical imaging. | | | | |
| Module 2 | **Filters and feature extraction** | Use case study | Feature extraction | **10 Sessions** |
| **Noise reduction filters for medical imaging:** sources of noise and filters used for noise reduction, spatial domain filters, frequency domain filters, practical results. **Feature extraction and statistical measurement:** selection of features, shape-related features, Fourier descriptors, text analysis. | | | | |
| Module 3 | **Image restoration and segmentation** | Assignment | Segmentation | **8 Sessions** |

| | | | | |
|---|---|---|---|---|
| **Medical Image restoration:** Image resolution, degradation model, estimation of degradation function, blur model, medical image restoration, blur identification, super-resolution method. **Biomedical image segmentation:** Broad classification and applications, point detection, line detection, edge detection methods, histogram-based image segmentation, segmentation using split and merge method, region growing method, watershed method, k-means clustering method, self-similar fractal method, topological derivative-based segmentation, comparison of segmentation methods. | | | | |
| **Module 4** | **Soft computing techniques and content-based image retrieval** | use case study | Content based imge retrieval | **10 Sessions** |
| **Soft computing techniques:** Fuzzy-based techniques, Neural network-based techniques ,genetic algorithm-based techniques. **Content-based image retrieval:** Content-based image retrieval (CBIR): Visual connect descriptors, shape similarity measure, relevance feedback, distance measureand s, challenges,**Content-based medical image retrieval (CBMIR):** Challenges in implementation of CBMIR, Practical approaches of CBMIR. | | | | |
| **Targeted Application & Tools that can be used:**<br>• Google Collab Pro<br>• Jupyter Notebook with GPU | | | | |
| **Project work/Assignment:** | | | | |
| **Mini project on feature extraction using deep learning algorithm such as CNN.** | | | | |
| **Text Book**<br>T1. G.R Sinha, Bhagwati Charan Patel," Medical Image Processing Concepts and Applications", Eastern Economy Edition.2020 | | | | |
| **References**<br>R1. Geoff Dougherty California State University, Channel Islands" Digital Image Processing for Medical Applications", Cambridge University Press.2019<br>**Weblinks**<br>W1. https://onlinecourses.nptel.ac.in/noc22_bt34/preview<br>W2. https://www.slideshare.net/AboulEllaHassanien/medical-image-analysis-27297012 | | | | |
| **Topics relevant to development of "SKILL DEVELOPMENT":Design and development of feature extraction and segmentation algorithm using python programming language.**<br>**Topic relevant to HUMAN VALUES & PROFESSIONAL ETHICS":** Naming and coding convention for Project Development. | | | | |
| **Catalogue prepared by** | Dr.Senthilkumar S | | | |
| **Recommended by the Board of Studies on** | BOS NO: SOCSE 2nd BOS held on 10/07/23 | | | |
| **Date of Approval by the Academic Council** | Academic Council Meeting No 21, Dated 06/09/2023 | | | |

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|---|---|---|---|---|---|---|
| **Course Code:**<br>**CSE3068** | **Course Title:Advanced DBMS**<br>**Type of Course: Core**<br>**Theory &Integrated Laboratory** | **L-T- P- C** | 2 | 0 | 2 | 3 |
| **Version No.** | **1.0** | | | | | |

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| **Course Pre-requisites** | **[1] Database Management System (CSE2074)**<br>**Basics of DBMS, like, File System and its drawbacks, Database Approach, 3-Schema Architecture and its concepts, Relational Algebra, Normalization, Transactions and its concepts, Backup and Recovery. In laboratory MySQL database skills are learnt.** |
| **Anti-requisites** | **NIL** |
| **Course Description** | **The purpose of this course is to make the students revisit RDBMS transactions first. Then introduce them with Distributed, Parallel, and NoSQL database concepts. They include the main characteristics, advantages, and disadvantages of each one of them. Importance and differences among them are noted. Need to transit from RBMS to NoSQL is discussed. The striking features of distributed, parallel and NoSQL are considered and studied.**<br>**The associated laboratory provides a chance to have hands-on concepts learned during this course.** |
| **Course Objective** | **This course is designed to improve the learners' EMPLOYABILITY SKILLS by learning the working on Database using MySQL.** |
| **Course Outcomes** | **On successful completion of this course the students shall be able to:**<br>1. Recall the transactions in RDMS<br>**(2)** Explain advanced features of distributed, parallel, and NoSQL databases.<br>**(3)** Illustrate the features in Distributed database<br>**(4)** Employ Parallel database concepts in real life applications. |
| **Course Content:** | |

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| **Module 1** | **Transactions in RDBMS** | Quiz | Comprehension based Quizzes and assignments. | **06Classes** |

Topics:
RDBMS -Transaction control state diagram, ACID properties of transaction, Schedules in transactions - Serial, Non-Serial and Serializable, Serializability-Conflict and View, Conflict Serializability check by Precedency Graph, Concurrency Control – Lock Based and Time Stamp Based.

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| **Module 2** | **NoSQL Databases** | Programming and Mini Project | Laboratory experiments and Mini Projects on NoSQL Topics using MongoDB/ Casandra. | **06Classes** |

Topics:
NoSQL Introduction – Scale Out, Commodity Hardware, Brief History, Features – Non-Relational, Schema Free, Simple API, and Distributed. NoSQL Architectures/Data Models - Document, Columnar, Key-Value, and Graph. Transaction in NoSQL- BASE for reliable database transactions, Achieving Horizontal Scalability with Database Sharding, CAP theorem.
Case Study: MongoDB/Casandra/ AWS/ HBase

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| **Module 3** | **Distributed Databases** | Assignment | Assignment on main topics of Distributed Databases | **06Classes** |

Topics:
Loosely Coupled, Characteristics of Distributed Databases, Local and Global view of applications, Distributed Processing, Types – Homogeneous and Heterogeneous, Distributed Data Storage – Replication and Fragmentation, Fragmentation – Horizontal and Vertical Type, Difference between Centralized and Distributed Databases.

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| Module 4 | Parallel Databases | Assignment | Assignment on main topics of Parallel Databases | **06 Classes** |

Topics:
Tightly Coupled, Features of parallel databases, Shared Memory, Shared Disk, Shared Nothing Systems. Advantages of each of these schemes, Advantages and Disadvantages of Parallel Databases, Differences between Parallel and Distributed Databases.

**Install MONGODB**
**https://www.javatpoint.com/mongodb-create-database**
**Create any one of the following databases.**
**Employee, Student, University, Banking, or Online Shopping**

**Drop database**
**Create Collection: In MongoDB db.createCollection(name,option) is used to create collection.**
**Drop Collection**

**List of Laboratory Tasks:(7 X 2= 14 Sessions)**

**Level 1: Perform CRUD operations (Insert, Update, Delete and Query Documents) on 'Student' Database.**
**Level 2: Do MongoDB text search on 'Employee' Database.**

**Experiment No. 2: Try experiments on MongoDB Operators**
**Level 1: Perform queries involving MongoDB Query and Projection Operators using 'Student' Database.**
**Level 2: Do queries involving MongoDB update operator on 'Employee' Database.**

**Experiment No. 3:Explore different query modifiers.**
**Level 1: Perform different query modifiers on 'Student' Database.**
**Level 2: Try various query modifiers on 'Employee' Database.**

**Experiment No. 4:Explore Aggregation commands.**
**Level 1: Implement different aggregation commands on 'Student' Database.**
**Level2: Perform various aggregation commands on 'Employee' Database.**

**Experiment No. 5:Explore Authentication commands.**
**Level 1: Try authentication commands on 'Student' Database.**
**Level 2: NA**

**Experiment No. 6:Explore Replication Commands**
**Level 1: Try all replication commands on 'Student' Database.**
**Level2: Implement replication commands on 'Employee' Database.**

**Experiment No.7:Try Sharding Commands.**
**Level1: Explore Sharding Commands on 'Student' Database.**
**Level 2: Implement Sharding Commands on 'Employee' Database.**

**Targeted Application & Tools that can be used:**
**MongoDB is to be installed and used.**

**Project work/Assignment:**

**Each batch of students (self-selected batch mates) will identify projects, such as, Library, Banking, and Reservation etc.,and do it. Concepts of NoSQL, like, CRUD operations, supporting ad hoc queries, indexing flexibility, assisting replication, creating capped collections, and Retrieving data from multiple documents.**
**Sample Mini Projects:**
**1. Content Management System**
**Clubbing the content assets like text and HTML into a single database helps provide a better user experience. MongoDB has an excellent toolset not only for storing and indexing but also for controlling the structure of a content management system. You can easily design a web-based CMS by using the model proposed by "Metadata and Asset Management" in MongoDB. Additionally, you can use "Storing Comments" to model user comments on blog posts.**
**2. Gaming Project**
**Data is an essential part of making video games work. Some typical examples of gaming data include player profiles, matchmaking, telemetry, and leaderboards.**
**The common thread between all games is that they all have a specific goal. And you have to achieve multiple objectives or pay your way out to reach the end goal. This may involve steps like watering your plants, growing vegetables, serving food in a restaurant, and so on.**

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| **Textbook(s):**<br>1. **Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, 1st Edition, 2019(Wiley Publications).**<br>2. **Stefano Ceri, Giuseppe Pelagatti , Distributed Databases: Principles and Systems,, 2017(McGraw Hill Education).** |
| **References**<br>1. **Elmasri R and Navathe S B, "Fundamentals of Database System",7th Edition, 2017(Pearson Publication).**<br>2. **Pivert. *NoSQL Data Models: Trends and Challenges*, 1st edition(Wiley).** |
| Topics related to development of "FOUNDATION":Transaction, CRUD Operations, Replication, and Sharding<br>Topics related to development of "EMPLOYABILITY": Project implementations in software, batch wise presentations<br>Topics related to development of "HUMAN VALUES AND PROFESSIONAL ETHICS": Team Dynamics during Mini Project Development. |

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| **Catalogue prepared by** | **Dr. Naga Raju Mysore** |
| **Recommended by the Board of Studies on** | BOS NO: SOCSE 2nd BOS held on 10/07/23 |
| **Date of Approval by the Academic Council** | Academic Council Meeting No 21, Dated 06/09/2023 |

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|---|---|---|---|---|---|---|
| **Course Code:** CSE3070 | **Course Title:** Advanced Computer Networks | **L-T- P-C** | 3 | 0 | 0 | 3 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | CSE-2011-Data communication and Computer Networks- TCP/IP Protocol Suite, IEEE 802.x, VLAN, Ipv4 Addresses, IpV6 address | | | | | |
| **Anti-requisites** | **NIL** | | | | | |
| **Course Description** | This course emphasizes the advanced concepts of computer networks and their design aspects. This course will explore the design aspects of physical and network layers, switching basics, logical design and management aspects, network traffic and scheduling, performance of WIFI AND WIMAX network along with current internet technology like 5G and Software Defined Network. | | | | | |
| **Course Objective** | This course goal is to provide an advanced background on relevant and recent computer networking topics and to have a comprehensive and deep knowledge in computer networks. | | | | | |
| **Course Outcomes** | Upon successful completion of the course the students shall be able to:<br>1. Understand the physical network technology and design of WAN.<br>2. Understand switching networks, routing in packet switching networks with different routing algorithms.<br>3. Demonstrate the Modeling of network traffic and networking protocols.<br>4. Understand the principles of new generation of computer networks, alternative Infrastructures and SDN. | | | | | |

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**Course Content:**

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| **Module 1** | **PHYSICAL NETWORK DESIGN** | Assignment | Theory | **No. of Classes:10** |

Topics: Remote Access Technologies and Devices – Modems and DSLs – SLIP and PPP - WAN Design and Enterprise Networks – Core networks, distribution networks and access networks

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| **Module 2** | **SWITCHING BASICS** | Assignment | Theory | **No. of Classes:12** |

Topics: Circuit switching, Message switching and Packet switching – Datagrams and Virtual circuits – Cell switching – Label switching – L2 switching Vs L3 switching – VLANs – Switching and Bridging – Loop resolution, Spanning tree algorithms – Cut through and Store and forward switches – Head of line blocking – Back pressure – Switch design goals

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| **Module 3** | **LOGICAL DESIGN AND MANAGEMENT** | Assignment | Theory | **No. of Classes:10** |

Topics: VLSM, OSPF and BGP – VPN –RMON and SNMP, Modeling 802.11 protocol – Basic DCF modeling, RTS/CTS modeling, Modeling 802.11e, Performance, 802.11e HCCA Performance. Modeling 802.16 protocol – system and user performance.

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| **Module 4** | **NETWORK TRAFFIC, SCHEDULING and Alternative Infrastructures** | Assignment | Case Study | **No. of Classes:12** |

Topics: Modeling network traffic – Flow traffic models – Continuous time modeling, Discrete time modeling, Pareto traffic distribution, Destination traffic. Scheduling algorithms – Analysis Alternative Infrastructures (Active networks, Software defined network. Network Security and wireless and Mobile networks, 5G cloudification.

**Targeted Application & Tools that can be used:**

1. **CISCO Packet Tracer,**
2. **Whireshark**

**Project work/Assignment:**

1. Design LAN WAN and assign IP Address.
2. Configure the WAN topology using routing protocols
3. Design Wireless network in college campus.

**Suggested List of Hands-on Activities:**

1. **Perform a case study on VLSM**
2. **Using CISCO Packet Tracer design a LAN with 50 PCV and configure it with suitable IP addressing and routing protocols**
3. **DO a case study on an SDN for an Enterprise.**
4. **Perform a case study on 5G Cloudification.**

**Text Book**

1. Larry L. Peterson & Bruce S. Davie, “Computer Network: A System Approach”, Morgan Kaufmann, 5/e, 2012.
2. Jochen Schiller, “Mobile Communications”, Pearson Addison-Wesley, 2/e, 2010.

**References**


1. Behrouz A. Forouzan , “TCP/IP Protocol Suite”, McGraw- Hill, 4/e, 2015.
2. James F. Kurose, Keith W. Ross, “Computer Networking”, Pearson, 2016.
3. Charles M. Kozierok, “The TCP/IP Guide”, No starch press, 2018.
4. Computer Networking: A Top-Down Approach, James F. Kuros and Keith W. Ross,Pearson, 6th Edition,2012
5. A Practical Guide to Advanced Networking , Jeffrey S. Beasley and PiyasatNilkaew,Pearson, 3rd Edition,2012
6. Computer Networks , Andrew S. Tanenbaum, David J. Wetherall,Prentice, 5th Edition,201


**Web Resources and Research Articles links:**

1. **Journal of Network and Computer Networking-**
https://www.journals.elsevier.com/journal-of-network-and-computer-applications

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|---|---|
| **Catalogue prepared by** | Dr. Ashish Kumar Srivastava<br>Dr. Shanmugarathinam<br>Ms. B Prema Sindhuri,<br>Ms. Bhavana A<br>Ms. Kaipa Sandhya |
| **Recommended by the Board of Studies on** | BOS NO: SOCSE 2nd BOS held on 10/07/23 |
| **Date of Approval by the Academic Council** | Academic Council Meeting No 21, Dated 06/09/2023 |

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|---|---|---|---|---|---|---|
| **Course Code:** **CSE 3071** | **Course Title:** Computer Vision **Type of Course: Program Core** **Theory and Lab Integrated Course** | **L-T- P-C** | 2 | 0 | 2 | 3 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | Linear algebra, vector calculus, and probability, Data structures | | | | | |
| **Anti-requisites** | **NIL** | | | | | |
| **Course Description** | This course introduces computer vision, including fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, image classification, scene understanding, and deep learning with neural networks. We will develop basic methods for applications that include finding known models in images, depth recovery from stereo, camera calibration, image stabilization, automated alignment, tracking, boundary detection, and recognition. We will develop the intuitions and mathematics of the methods in class, and then learn about the difference between theory and practice in HomeWorks. | | | | | |
| **Course Objective** | The objective of the course is SKILL DEVELOPMENT of student by using PARTICIPATIVE LEARNING TECHNIQUES. | | | | | |
| **Course Outcomes** | On successful completion of the course the students shall be able to:<br><br>CO1: Apply mathematical modeling methods for low-, intermediate- and high-level image processing tasks.<br><br>CO2: Perform software experiments on computer vision problems and compare their performance with the state of the art.<br>CO3: Describe the geometric relationships between 2D images and the 3D world. | | | | | |
| **Course Content:** | | | | | | |
| **Module 1** | Digital Image Processing | Programming Assignment | Data Collection and Analysis | **12 sessions** | | |
| Image Formation, Image Filtering, Edge Detection, Principal Component Analysis, Corner Detection SIFT, Applications: Large Scale Image Search. | | | | | | |
| **Module 2** | Geometric Techniques in Computer Vision | Programming Assignment | Data Collection and Analysis | **12 sessions** | | |
| Image Transformations, Camera Projections, Camera Calibration, Depth from Stereo, Two View Structure from Motion, Object Tracking. | | | | | | |
| **Module 3** | Machine Learning for Computer Vision | Programming Assignment | Data analysis | **14 sessions** | | |
| Introduction to Machine Learning, Image Classification, Object Detection, Semantic Segmentation. | | | | | | |
| **List of Laboratory Tasks:**<br>1. Simulation and Display of an Image, Negative of an Image (Binary & Gray Scale)[Text Wrapping Break]2. Implementation of Relationships between Pixels[Text Wrapping Break]3. Implementation of Transformations of an Image[Text Wrapping Break]4. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization[Text Wrapping Break]5. Display of bit planes of an Image[Text Wrapping Break]6. Display of FFT (1-D & 2-D) of an image[Text Wrapping Break]7. Computation of Mean, Standard Deviation, Correlation coefficient of the given Image[Text Wrapping Break]8. Implementation of Image Smoothening Filters (Mean and Median filtering of an Image)[Text Wrapping Break]9. Implementation of image sharpening filters and Edge Detection using Gradient Filters[Text Wrapping Break]10. Image Compression by DCT, DPCM, HUFFMAN coding[Text Wrapping Break]11. Implementation of image restoring | | | | | | |

techniques[Text Wrapping Break]12. Implementation of Image Intensity slicing technique for image enhancement

**Targeted Application & Tools that can be used: Matlab**

**Project work/Assignment:**

**Text Book**

**T1** Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.

**T2** Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, 2ndEdition, Cambridge University Press, March 2004.

**References**

R1. R. Bishop; Pattern Recognition and Machine Learning, Springer,2006

R2. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.

R3. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.

Web references:

https://onlinecourses.swayam2.ac.in/cec20_cs08/preview

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Library reference: https://presiuniv.knimbus.com/user#/home

Topics relevant to development of "Employability":

Topics relevant to "HUMAN VALUES &PROFESSIONAL ETHICS"":

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| **Catalogue prepared by** | Dr.PravinthRaja. |
| **Recommended by the Board of Studies on** | BOS NO: SOCSE 2nd BOS held on 10/07/23 |
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|---|---|---|---|---|---|---|
| **Course Code:**<br><br>**CSD3423** | **Course Title: Applied Artificial Intelligence**<br><br>**Type of Course: Program Core & Theory Only** | **L-T- P- C** | 2 | 0 | 2 | 3 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | NIL | | | | | |
| **Anti-requisites** | Nil | | | | | |
| **Course Description** | Applied Artificial Intelligence is an advanced-level course designed to build upon the foundational knowledge of artificial intelligence (AI) and its applications in engineering. This course aims to provide engineering students with an in-depth understanding of AI techniques, algorithms, and emerging trends that are shaping the future of AI-driven engineering systems. Through theoretical concepts, practical examples, and case studies, students will explore cutting-edge AI methodologies and their application in solving complex engineering problems. | | | | | |
| **Course Objectives** | This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies. | | | | | |
| **Course Out Comes** | On successful completion of the course the students shall be able to:<br>1. Explain AI techniques and algorithms in engineering domains. [Understand]<br>2. Solve problems in AI using search methods and constraint satisfaction. [Apply]<br>3. Apply logic methods for problem-solving using Resolution. [Apply]<br>4. Describe solutions for problems involving uncertainty in AI. [Apply] | | | | | |
| **Course Content:** | | | | | | |
| **Module 1** | **Search** | Quiz Tests | Programming Assignment | | | **L : 12** |
| **Introduction:** Solving Problems by Searching. Problem-solving agents. Formulating problems.<br>**Uninformed Search Algorithms:** Breadth-first search. Depth-first search. Uniform cost search. Applications in pathfinding in games.<br>**Heuristic Search Algorithms:** Heuristics. Greedy best-first search. A* search. Difference between Uniform cost search and A* search.<br>**Adversarial Search Algorithms:** Game tree. Minimax algorithm. Alpha-beta pruning. Ideal ordering and worst ordering. Extensions of Minimax algorithm for multiplayer games (MaxN) and stochastic games (Expectimax) | | | | | | |
| **Module 2** | **Knowledge-Based Logic Representation** | Quiz Tests | | | | **L: 12** |
| Representation, Reasoning, and Logic. Prepositional Logic. First-Order Logic. Syntax and Semantics. Inference Rules. Propositional and First-Order Resolution. Applications for solving story problems using Resolution. | | | | | | |
| **Module 3** | **Constraint Satisfaction Problems** | Quiz Tests | Programming Assignment | | | **L:7** |
| Constraints. Definition of a CSP. Examples of Constraint Satisfaction Problems. Arc consistency. Problem structure and problem decomposition. Backtracking. Backtracking heuristics. Local search. Timetable scheduling as a real-world example. | | | | | | |
| **Module 4** | **Uncertainty in AI** | Quiz Tests | Programming Assignments | | | **L: 7** |
| Uncertainty in AI. Revision of Probability Basics and Bayes Theorem. Bayesian Networks. Hidden Markov Models. Sub-problems in HMM and their solutions – Forward probability and Viterbi Algorithm. Case study of sequence labeling using HMM for part-of-speech tagging and named entity recognition. | | | | | | |

**Targeted Application & Tools that can be used :**

**Applications:**

Game playing, knowledge representation, solving story problems, timetable scheduling, sequence labeling in NLP.

**Tools:**

1. Google Colab
2. IDEs (in case they are solving them using C/C++ or Java) like Visual Studio, Netbeans, Eclipse, etc.

**Project work/Assignment: Mention the Type of Project /Assignment proposed for this course**

1. Students will be given programming assignments to implement AI algorithms
2. Students may work with real or simulated datasets and be asked to explore and analyze the data, extract meaningful insights, and visualize the results using appropriate tools.
3. Students are also recommended to watch NPTEL videos, register for corresponding NPTEL courses, etc.

**Text Book**

1. Stuart J. Russell and Peter Norvig, "Artificial intelligence: A Modern Approach", 4th edition, 2022. Pearson Education.
2. Lavika Goel, "Artificial Intelligence: Concepts and Applications", 1st Edition. 2021.Wiley.

**References**

1. Deepak Khemani, "A First Course in Artificial Intelligence", First Edition Sixth Reprint (2018). Tata McGraw Hill.

**NPTEL Courses (and other video links):**

1. Mausam (IIT Delhi), "An Introduction to Artificial Intelligence". – Link: https://nptel.ac.in/courses/106102220. Useful for the full course.
2. Deepak Khemani (IIT Madras), "Artificial Intelligence: Search Methods for Problem-Solving". – Link: https://nptel.ac.in/courses/106106226. Useful for Module 1.
3. Deepak Khemani (IIT Madras), "Artificial Intelligence: Knowledge Representation and Reasoning". – Link: https://nptel.ac.in/courses/106106140. Useful for Module 2.
4. Deepak Khemani (IIT Madras), "AI: Constraint Satisfaction" – Link: https://nptel.ac.in/courses/106106158. Useful for Module 3.
5. IJCAI 2020 Talk by Eugene Freuder. Link: https://ijcai20.org/excellence-research-award-session/. This will serve as a motivation for the Module 3.

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| **Catalogue prepared by** | Dr. Jai Singh W<br>Dr. Sandeep Albert Mathias |
| **Recommended by the Board of Studies on** | BOS NO: SOCSE 2nd BOS held on 10/07/23 |
| **Date of Approval by the Academic Council** | Academic Council Meeting No 21, Dated 06/09/2023 |

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|---|---|---|---|---|---|---|
| **Course Code: CSE3009** | **Course Title: Optimization Techniques for Machine Learning**<br><br>**Type of Course: Program Core& Theory Only** | **L-T- P-C** | 3 | 0 | 0 | 3 |
| **Version No.** | 1.1 | | | | | |
| **Course Pre-requisites** | Fluency with reasoning and analysis using linear algebra and probability is required. Familiarity with Python is preferrable. | | | | | |
| **Anti-requisites** | **NIL** | | | | | |

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| **Course Description** | The course aims to equip students with advanced techniques and methods in optimization that are tailored to large-scale statistics and machine learning problems. A number of prominent developments in first-order optimization methods in the convex, nonconvex, stochastic, and distributed settings are explored in this course. Upon completing the course, students are expected to be able to better formulate an optimization problem by exploiting desired structural properties (for example, convexity, smoothness, and sparsity), and to select an efficient optimization method under problem constraints (for example, online, distributed, and memory cost).<br>The course aims to equip students with advanced techniques and methods in optimization that are tailored to large-scale statistics and machine learning problems. A number of prominent developments in first-order optimization methods in the convex, nonconvex, stochastic, and distributed settings are explored in this course. Upon completing the course, students are expected to be able to better formulate an optimization problem by exploiting desired structural properties (for example, convexity, smoothness, and sparsity), and to select an efficient optimization method under problem constraints (for example, online, distributed, and memory cost). |
| **Course Objective** | This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies. |
| **Course Out Comes** | On successful completion of the course the students shall be able to:<br><br>1] Understand standard supervised and unsupervised machine learning tasks as optimization problems [Understand]<br>2] Understand key definitions relating to convex functions, convex sets, and convex optimization [Understand]<br>3] Implement first-order and stochastic first-order solvers for convex optimization problems. [Application]<br>4] Apply machine learning techniques to real world problems. [Application] |
| **Course Content:** | |

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|---|---|---|---|---|
| **Module 1** | Fundamentals of Convex Analysis | Assignment | Programming Task | **8 Sessions** |

**Topics:**
Review of basic linear algebra and probability, convex sets and functions – Strong and weak duality, constraint qualifications, Optimality conditions for machine learning problems (regressions, SVM, etc.)

**Assignment: Quiz on optimality conditions for machine learning problems.**

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|---|---|---|---|---|
| **Module 2** | First order and Higher Order Methods | Assignment | Data Collection/Excel | **14 Sessions** |

**Topics:**

First Order Methods : Gradient descent convergence analysis – Convergence analysis for momentum-based acceleration methods: Heavy-ball, multistep, Nesterov, FISTA, etc. – Convergence speedup with conjugacy – Convergence analysis for sub-gradient methods – Stochastic (sub) gradient descent (convergences in probability and distribution, almost sure convergence, parallelism, applications in deep learning, etc.)

Higher-Order Methods – Newton's method: convergence analysis (exact/inexact step-sizes, self-concordance), applications in regressions – Quasi-Newton Theory (Secant methods), convergence proofs for BFGS/DFP, L-BFGS in machine learning

**Assignment:** Different first order methods and their types with examples.

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| **Module 3** | Regularized Optimization & Proximal and Operator Splitting | Assignment | Programming/Data analysis Task | **10 Sessions** |

**Topics:**

$l_1$ -regularized sparse optimization for machine/statistical learning: compressed sensing, LASSO, logistic regression, etc. – Structured sparsity optimization for machine/statistical learning: low-rank matrix completion, nuclear norm regularization, inverse covariance inference, atomic norm regularization, etc.

Dual decomposition and decentralization – Method of multipliers and ADMM methods: convergence analysis and proofs – Proximal operators and proximal methods – Design and analysis of distributed algorithms

**Assignment:** Design of distributed algorithms with examples.

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| **Module 4** | Nonconvex Optimization in Machine Learning | Assignment | Programming/Data analysis Task | **8 Sessions** |

**Topics:**

Coordinate descent methods and convergence analysis – Special structured nonconvex optimization – Optimization landscape – Saddle point escape

**Assignment:** Design of nonconvex optimization algorithms and their usage.

**Targeted Application & Tools that can be used:**

Google Colab

**Project work/Assignment:**

Creating a classification system using Machine Learning methods (Stochastic Gradient Descent, Naïve bayes Classifier, etc. ) using standard datasets like Iris Recognition Dataset etc.

**Text Book**

T1. A. Beck, First-Order Methods in Optimization, MOS-SIAM Series on Optimization, 2017.

T2. S. Bubeck, Convex Optimization: Algorithms and Complexity, Foundations and Trends in Optimization, 2015.

T3. F. Bach, "Learning with Submodular Functions: A Convex Optimization Perspective", Foundations and Trends in Machine Learning, Now Publishers Inc., 2013.

**References**

R1. S. Boyd, N. Parikh, and E. Chu," Distributed optimization and statistical learning via the alternating direction method of multipliers", Foundations and Trends in Machine Learning, Now Publishers Inc.
R2. Y. Nesterov, "Introductory Lectures on Convex Optimization: A Basic Course," Springer, 2004.
R3. M. Bazarra, H.D. Sherali, and C.M. Shetty, "Nonlinear Programming: Theory and Algorithms," John Wiley & Sons, 2006.

http://192.168.1.10/cgi-bin/koha/opac-detail.pl?biblionumber=11708&query_desc=ti%2Cwrdl%3A%20MACHINE%20LEARNING

**Topics relevant to development of "SKILL":**
Gradient descent convergence analysis, Quasi-Newton Theory (Secant methods), LASSO, Logistic Regression,
Coordinate descent methods and convergence analysis
**Topics relevant to development of "ENVIRONMENT AND SUSTAINABILITY SKILLS":** NIL

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|---|---|
| **Catalogue prepared by** | **Ms. Tulika Dutta** |
| **Recommended by the Board of Studies on** | BOS NO: SOCSE 2nd BOS held on 10/07/23 |
| **Date of Approval by the Academic Council** | Academic Council Meeting No 21, Dated 06/09/2023 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Course Code:** **CSE3011** | **Course Title: Reinforcement Learning** **Type of Course: 1] Program Core 2] Laboratory integrated** | **L-T- P-C** | 2 | 0 | 2 | 3 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | CSE3001: Artificial Intelligence and Machine Learning | | | | | |
| **Anti-requisites** | **NIL** | | | | | |
| **Course Description** | For both engineers and researchers in the field of Computer science, it is common to develop models of real-life situations and develop solutions based on those models. It is of utmost importance to come up with innovative solutions for scenarios that are highly stochastic. The objective of this course, is to introduce different reinforcement learning techniques which is a promising paradigm for stochastic decision making in the forthcoming era. Starting from the basics of stochastic processes, this course introduces several RL techniques that are as per the industry standard.<br>With a good knowledge in RL, the students will be able to develop efficient solutions for complex and challenging real-life problems that are highly stochastic in nature. | | | | | |
| **Course Objectives** | This course is designed to improve the learners 'EMPLOYABILITY SKILLS' by using EXPERIENTIAL LEARNING techniques. | | | | | |
| **Course Out Comes** | On successful completion of the course the students shall be able to:<br>1. Apply dynamic programming concepts to find an optimal policy in a gaming environment [Applying]<br>2. Implement on-policy and off-policy Monte Carlo methods for finding an optimal policy in a | | | | | |

| | | | | |
|---|---|---|---|---|
| | reinforcement learning environment. [Applying]<br><br>3. Utilize Temporal Difference learning techniques in the Frozen Lake RL environment [Applying]<br>4. Solve the Multi-Armed Bandit (MAB) problem using various exploration-exploitation strategies [Applying] | | | |
| **Course Content:** | | | | |
| **Module 1** | Introduction to Reinforcement Learning | Assignment | Programming using the OpenAI Gym environment | **No. of Classes L – 5 P – 6** |
| Topics : Elements of RL, Agent, environment Interface, Goals and rewards, RL platforms, Applications of RL, Markov decision process (MDP), RL environment as a MDP, Maths essentials of RL, Policy and its types, episodic and continuous tasks, return and discount factor, fundamental functions of RL – value and Q functions, model-based and model-free learning, types of RL environments, Solving MDP using Bellman Equation, Algorithms for optimal policy using Dynamic Programming -Value iteration and policy iteration, Example : Frozen Lake problem, Limitations and Scope | | | | |
| **Module 2** | Monte-Carlo(MC) methods | Assignment | Programming using the OpenAI Gym environment | **No. of Classes L-5 P-6** |
| Topics: Monte Carlo methods, prediction and control tasks, Monte Carlo prediction : algorithm, types of MC prediction, examples , incremental mean updates, Monte Carlo Control : algorithm, on-policy MC control, MC with epsilon-greedy policy, off-policy MC control. Limitations of MC method. | | | | |
| **Module 3** | Temporal Difference(TD) Learning | Assignment /Quiz | Programming using the OpenAI Gym environment | **No. of Classes L-7 P -6** |
| Topics: Temporal difference learning: TD Prediction, TD Control : On-policy TD control – SARSA, computing the optimal policy using SARSA, Off-policy TD control – Q learning, computing optimal policy using Q learning, Examples, Difference between SARSA and Q-learning, Comparison of DP, MC and TD methods. | | | | |
| **Module 4** | Multi-Armed Bandit (MAB) problem | Assignment | Programming using the OpenAI Gym environment | **No. of Classes L-6 P -4** |
| Topics: Understanding the MAB problem, Various exploration strategies – epsilon-greedy, softmax exploration, upper confidence bound and Thompson sampling, Applications of MAB - finding the best advertisement banner for a web site, Contextual bandits, introduction to Deep Reinforcement Learning(DRL) Algorithm – Deep Q Network (DQN) | | | | |
| **List of Laboratory Tasks:**<br><br>1 .**Software Setup : installalling Anaconda, OpenAI Gym and Universe.**<br>Basic simulations of some gaming environments in Gym<br>2. **Working with Gym environments to create agents with random policy**<br>2.1 Create the Frozen Lake GYM environment and explore the states, action, transition probability, reward functions and generating episodes.<br>2.2 Create an agent for the Cart-Pole environment using a random policy and record the game<br>3. **Finding the optimal policy for the agent using Dynamic Programming**<br>3.1 Compute the optimal policy for the Frozen Lake Environment using value iteration method<br>3.2 Compute the optimal policy for the Frozen Lake Environment using policy iteration method | | | | |

4. **Implementing Monte Carlo prediction method using blackjack game**
    4.1 Every-visit MC prediction
    4.2 First-visit MC prediction
5. **Implementing on-policy MC control method using the epsilon-greedy policy for the blackjack game**
6. **Implementing Temporal Difference prediction for the Frozen lake environment for a random policy**
7. **Computing the optimal policy using on-policy TD control – SARSA**
8. **Computing the optimal policy using off-policy TD control – Q-learning**
9. **Multi-Armed Bandit problem**
    9.1 Creating a MAB in Gym
    9.2 Compute the best arm using various exploration strategies such as epsilon-greedy and softmax exploration method.
10. **Application of MAB – Finding the best advertisement banner for a web site using MAB**

**Targeted Application & Tools that can be used :**

1. Execution of the RL algorithms will be done using the environments provided by OpenAI's Gym and Gymnasium of Farama Foundation in "Colab", available at https://colab.research.google.com/ or Jupyter Notebook.
2. Laboratory tasks will be implemented using the necessary libraries available in Python

**Project work/Assignment: Mention the Type of Project /Assignment proposed for this course**

Students can be given group assignments to develop different gaming environments and implement the RL algorithms

**Text Book**

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", MIT press, Second Edition, 2018.
2. Sudharshan Ravichandiran, "Deep Reinforcement Learning with Python", Packt Publishers, Second Edition, 2020

**References**

1. Laurra Graesser and Wan Loon Keng, "Foundations of Deep Reinforcement Learning", Pearson, 2022

2. https://www.udemy.com/course/artificial-intelligence-reinforcement-learning-in-python/

| | |
|---|---|
| **Catalogue prepared by** | Dr J Alamelu Mangai, Dr Jai Singh and Dr Swati Sharma |
| **Recommended by the Board of Studies on** | BOS NO: SOCSE 2nd BOS held on 10/07/23 |
| **Date of Approval by the Academic Council** | Academic Council Meeting No 21, Dated 06/09/2023 |

| Course Code: CSE 3012 | Course Title: Time Series Analysis<br>Type of Course: Laboratory Integrated | L-T- P-C | 2 | 0 | 2 | 3 |
|---|---|---|---|---|---|---|
| Version No. | 1 | | | | | |
| Course Pre-requisites | CSE 3001 Artificial Intelligence and Machine Learning | | | | | |
| Anti-requisites | -- | | | | | |
| Course Description | The course will provide a basic introduction to modern time series analysis. This course teaches time-series analysis and the methods used to predict, process, and recognize sequential data. The objective of the course is to give students a better understanding of the concepts and the tools in time series analysis. The course develops a comprehensive set of tools and techniques for analyzing various forms of time series and for understanding the current literature in applied time series econometrics.<br>This course covers time series regression and exploratory data analysis, ARMA/ARIMA models, model identification/estimation/linear operators, Fourier analysis, spectral estimation, and state space models. | | | | | |
| Course Objective | This course is designed to improve the learners "EMPLOYIBILITY SKILLS" by using EXPERIENTIAL LEARNING techniques. Lecturers on the Time Series Analysis facilitates the Peer Learning and group projects on real time applications. | | | | | |
| Course Out Comes | **On successful completion of the course the students shall be able to:**<br>• Understand basic concepts in time series analysis and forecasting. [Understand]<br>• Understand the use of time series models for forecasting and the limitations of the methods. [Understand]<br>• Develop time series regression models. [Application]<br>• Compare with multivariate times series and other applications. [Comprehension] | | | | | |
| Course Content: | | | | | | |

| Module 1 | INTRODUCTION OF TIMESERIES ANALYSIS | Assignment | Data Collection/Interpretation | **L[6] +P[2] Sessions** |
|---|---|---|---|---|

**Topics:**

Introduction to Time Series and Forecasting -Different types of data-Internal structures of time series-Models for time series analysis-Autocorrelation and Partial autocorrelation. Examples of Time series Nature and uses of forecasting-Forecasting Process-Data for forecasting – Resources for forecasting.

Graphical Displays -Time Series Plots - Plotting Smoothed Data - Numerical Description of Time Series Data - Use of Data Transformations and Adjustments- General Approach to Time Series Modeling and Forecasting- Evaluating and Monitoring Forecasting Model Performance.

| Module 2 | TIME SERIES REGRESSION MODEL | Assignment/Quiz | Case studies | **L[6] +P[3] Sessions** |
|---|---|---|---|---|

**Topics:**

Introduction - Least Squares Estimation in Linear Regression Models - Statistical Inference in Linear Regression- Prediction of New Observations - Model Adequacy Checking -Variable Selection Methods in Regression - Generalized and Weighted Least Squares- Regression Models for General Time Series Data- Exponential Smoothing-First order and Second order.

| Module 3 | AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) MODELS | Quiz | Case studies | **L[10] +P[2] Sessions** |
|---|---|---|---|---|

**Topics:**

Autoregressive Moving Average (ARMA) Models - Stationarity and Invertibility of ARMA Models - Checking for Stationarity using Variogram- Detecting Nonstationarity - Autoregressive Integrated Moving Average (ARIMA) Models - Forecasting using ARIMA - Seasonal Data - Seasonal ARIMA Models- Forecasting using Seasonal ARIMA Models Introduction - Finding the "BEST" Model - Example: Internet Users Data- Model Selection Criteria - Impulse Response Function to Study the Differences in Models - Comparing Impulse Response Functions for Competing Models .

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|---|---|---|---|---|
| **Module 4** | MULTIVARIATE TIME SERIES MODELS AND FORECASTING | Assignment | Case studies | **L[8] +P[1] Sessions** |

**Topics:**

Multivariate Time Series Models and Forecasting - Multivariate Stationary Process- Vector ARIMA Models - Vector AR (VAR) Models - Neural Networks and Forecasting -Spectral Analysis - Bayesian Methods in Forecasting.

**List of Laboratory Tasks:**

1. Loading, Preprocessing and Handling Time series data.
2. Fitting and plotting by Modified Exponential Curve.
3. Estimating and eliminating trend using Aggregation, Smoothing and Polynomial Fitting.
4. Eliminating Trend and Seasonality via Differencing and Decomposition.
5. Fitting of Trend using Moving Average Method.
6. Forecasting by Exponential Smoothing, ARIMA.
7. Forecasting by Seasonal autoregressive integrated moving average model (SARIMA).
8. Develop Time series model using Multivariate Analysis models via Canonical Correlation
9. Develop Time series model using Multivariate Analysis models via Structural Equation Modeling.
10. Develop Time series model using Inter Dependence Techniques via Factor Analysis.
11. Develop Time series model using Inter Dependence Techniques via Cluster Analysis.

**Targeted Application & Tools that can be used**

**Target Applications:**

- HealthCare Industries.
- Manufacturing Industries.
- Cyber Security.
- Smart Intelligent systems.

**Tools:**

- Python
- R
- MATLAB
- XLSTAT
- Tableau
- Qlik Sense

**Project work/Assignment:**

**Assignment:**

- Predicting changes in the thickness of Ozone layer based on its time-series data from 1926 – 2016.
- Examine the South African GDP on a period from 1960 to 2016. Our data contains 226 observations and has been obtained from OECD Statistics.
- Developing an ARIMA model to forecast the monthly Australian gas production level for the next 12 months.

**Text Book**


**T1** Douglas C. Montgomery, Cheryl L. Jen , Introduction To Time Series Analysis And Forecasting, 4th Edition, Wiley Series In Probability And Statistics, 2019. https://b-ok.cc/book/2542456/2fa941

**T2** Dr. Avishek Pal , Dr. Pks Prakash , Master Time Series Data Processing, Visualization, And Modeling Using Python, 2019. https://b-ok.cc/book/3413340/2eb247

**T3** John Wiley & Sons , Time Series Analysis And Forecasting By Example ,Technical University Of

Denmark, 2021.
https://b-ok.cc/book/1183901/9be7ed

**References**


**R1** Peter J. Brockwell Richard A. Davis Introduction To Time Series And Forecasting Third Edition.(2016).

**R2** Multivariate Time Series Analysis and Applications William W.S. Wei Department of Statistical Science Temple University, Philadelphia, PA, SA This edition first published 2019 John Wiley & Sons Ltd.

**R3** Time Series Analysis by James D Hamilton Copyright © 2020 by prince town university press.


**E book link R1:** https://b-ok.cc/book/2802612/149485

**E book link R2:** https://b-ok.cc/book/3704316/872fbf

**E book link R3:** https://b-ok.cc/book/3685042/275c71

**Web resources:**

1. https://www.coursera.org/learn/practical-time-series-analysis
2. https://ocw.mit.edu/courses/economics/14-384-time-series-analysis-fall-2013/download-course-materials/
3. https://swayam.gov.in/nd1_noc19_mg46/preview

**Topics relevant to development of "Skill Development":**

1. Systematic variation in time series data
2. Autoregressive Models
3. Exponential smoothing models or esms
4. Generating forecasts on time series

**Topics relevant to development of "Employability Skills"**

1. Time series analysis to Monitor and access water resources.
2. Remote Sensing time series analysis for Crop Monitoring.
3. Satellite Image Time series Analysis.
4. Waste Monitoring and Analysis.

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| **Catalogue prepared by** | Mrs. Poornima S |
| **Recommended by the Board of Studies on** | BOS NO: SOCSE 2nd BOS held on 10/07/23 |
| **Date of Approval by the Academic Council** | Academic Council Meeting No 21, Dated 06/09/2023 |

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|---|---|---|---|---|---|---|
| **Course Code: CSE3017** | **Course Title: Autonomous Navigation and Vehicles**<br>**Type of Course : Theory** | **L-T- P-C** | 3 | 0 | 0 | 3 |
| **Version No.** | 1.1 | | | | | |
| **Course Pre-requisites** | • Real-time embedded programming<br>• Optimal estimation and control<br>• Linear algebra | | | | | |
| **Anti-requisites** | NIL | | | | | |

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| **Course Description** | Overview of technologies vehicles including sensors, sensing algorithms, machine learning, localization, mapping, object detection, tracking, communication and security. Hands-on implementation of robotic sensing and navigation algorithms on both simulated and physical mobile platforms. This course covers the mathematical foundations and state-of-the-art implementations of algorithms for vision-based navigation of autonomous vehicles (e.g., mobile robots, self-driving cars, drones). It culminates in a critical review of recent advances in the field and a team project aimed at advancing the state-of-the-art.<br><br>**Topics include:** Autonomous driving technologies overview, Object Recognition and Tracking, Localization with GNSS, Visual Odometry, Perceptions In Autonomous driving, Deep learning in Autonomous Driving Perception, Prediction and Routing, Decision planning and control |
| **Course Objective** | This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies. |
| **Course Out Comes** | **On successful completion of the course the students shall be able to:**<br>1. Understand the Autonomous system's and its requirements. Explain algorithm, sensing, object recognition and tracking of an Autonomous system. [ Understand]<br>2. Do the error analysis of Localization systems and use the tools and techniques,[Analyze]<br>3. Explain, plan and control the traffic behavior, and shall be able to do lane level routing and create simple algorithms. [Application]<br>4. Explain Plan and control motion, choose proper client systems for automotive vehicles and understand the cloud platform.[Application] |
| **Course Content:** | |

| **Module 1** | **12 Sessions** |
|---|---|
| **Introduction to autonomous driving:** Autonomous driving technologies overview, autonomous driving algorithms: Sensing, Perception. Object Recognition and Tracking: Autonomous driving client system, driving cloud platform, Robot Operating System, HD Map Production, Deep learning Model Training, Localization with GNSS: GNSS overview, GNSS error analysis, satellite based augmentation systems, real time kinematic and differential GPS, precise point positioning, Visual Odometry: Stereo Visual Odometry, Monocular Visual Odometry, Visual Inertial Odometry, Dead Reckoning and Wheel Odometry. | |
| **Module 2** | **8 Sessions** |
| **Perceptions In Autonomous driving:** Introduction, Datasets, Detection, Segmentation, Sterio, Optical flow and Scene flow. **Deep learning in Autonomous Driving Perception:** Convolutional Neural Networks, Detection, Semantic segmentation, Stereo and optical flow. | |
| **Module 3** | **10 Sessions** |
| **Prediction and Routing:** Planning and control overview, Traffic prediction: Behaviour prediction as classification, Vehicle trajectory generation, Lane level routing: Constructing a weighted directed graph for routing, typical routing algorithms, routing graph cost. | |
| **Module 4** | **08 Sessions** |
| **Decision planning and control:** Behavioral decisions, Motion planning, Feedback control Reinforcement Learning Based Planning and Control, Client systems for Autonomous Driving: Operating systems and computing platform Cloud platform for Autonomous driving: Introduction, infrastructure, simulation. | |

**Targeted Application & Tools that can be used:**

**Applications:** Obstacle Avoidance, Path Planning, Autonomous Vehicles.

**Tools: MIDGUARD** A Simulation platform for Autonomous Vehicle navigation.

**Project Work/Assignment:**

1. Develop a system that avoids obstacles in the path.
2. To develop a cloud based autonomous navigation, what are the parameters should be considered, draw a framework for the navigation system.

**Text Book**

**T1:** Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc, Creating Autonomous Vehicle Systems Morgan & Claypool Publishers 2nd Edition, 2019

**T2:** Ronald K. Jurgen Autonomous Vehicles for Safer Driving SAE International Edition , 2019

**References**

R1. Hod Lipson, Melba Kurman Driverless: Intelligent Cars and the Road ahead MIT Press. 1st Edition, 2016

R2. Markus Maurer, J. Christian Gerdes, Barbara Lenz Autonomous Driving: Technical, Legal and Social Aspects 1st Edition, 2016

R3. Hannah YeeFen Lim, Autonomous Vehicles and the Law: Technology, Algorithms and Ethics ,Edward Elgar Publishing. 1st Edition, 2018

**Web Resources:** http://pu.informatics.global

**Topics relevant to development of "Employability":**

Deep Learning Models, Convolutional Neural Networks, Vehicle trajectory generation, Decision planning, Reinforcement learning.

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|---|---|
| **Catalogue prepared by** | **Dr. RAGAVENTHIRAN** |
| **Recommended by the Board of Studies on** | BOS NO: SOCSE 2nd BOS held on 10/07/23 |
| **Date of Approval by the Academic Council** | Academic Council Meeting No 21, Dated 06/09/2023 |

<table>
<tr><td>Course Code:<br><br>CSE3018</td><td colspan="3">Course Title: Digital Health and Imaging<br><br>Type of Course: Program Core& Theory Only</td><td>L-T- P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="8">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">CSE3008: Machine Learning Techniques</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">-</td></tr>
<tr><td>Course Description</td><td colspan="8">This course will give an overview of digital health and its impact on healthcare, Image enhancement techniques, filtering, and restoration. Medical Imaging, health informatics, Health data analytics and predictive modeling.</td></tr>
<tr><td>Course Objectives</td><td colspan="8">This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.</td></tr>
<tr><td>Course Out Comes</td><td colspan="8">On successful completion of the course the students shall be able to:<br>1.Understand the role of digital health’s impact in ethical and legal considerations. [Understand]<br>2. Apply Machine learning techniques for medical image analysis. [Application]<br>3. Apply Computer-aided detection and diagnosis in medical imaging. [Application]<br>4. Apply Health data analytics and predictive modeling. [Application]</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td colspan="2">Introduction to Digital Health and Digital Image</td><td>Assignment</td><td colspan="2">Theory</td><td colspan="2">L : 8</td></tr>
<tr><td colspan="9">Introduction to Digital Health<br>Overview of digital health and its impact on healthcare, Introduction to telemedicine, wearables, and health monitoring devices, Ethical and legal considerations in digital health.<br>Digital Image Processing Fundamentals:<br>Digital image representation and properties, Image enhancement techniques, Image filtering and restoration, Image segmentation and feature extraction</td></tr>
<tr><td>Module 2</td><td colspan="2">Medical Imaging Modalities</td><td>Assignment</td><td colspan="2">Case studies can be assigned to students, where they analyze real-world scenarios and propose AI-based solutions</td><td colspan="2">L: 10</td></tr>
<tr><td colspan="9">Medical Imaging Modalities: Principles and applications of various medical imaging modalities. X-ray imaging, computed tomography (CT), and magnetic resonance imaging (MRI) , Ultrasound imaging and nuclear medicine imaging, Imaging modalities for specific healthcare domains (e.g., radiology, cardiology)</td></tr>
<tr><td>Module 3</td><td colspan="2">Image Analysis in Healthcare</td><td>Assignment /Quiz</td><td colspan="2">Researching and reviewing academic papers or industry publications on specific AI applications</td><td colspan="2">L:12</td></tr>
<tr><td colspan="9">Image registration and fusion techniques, Quantitative image analysis for disease diagnosis and treatment planning, Computer-aided detection and diagnosis in medical imaging, Machine learning in medical image analysis.</td></tr>
</table>

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| Health Informatics and Electronic Health Records, Introduction to health informatics and electronic health records (EHR), EHR systems and interoperability, Data privacy, security, and regulatory considerations in health informatics. | | | | |
| **Module 4** | **Digital Health Applications and Innovations** | Assignment | Students may work with real or simulated datasets and be asked to explore and analyze the data, extract meaningful insights, and visualize the results using appropriate tools. | **L: 10** |
| Mobile health (mHealth) applications and remote patient monitoring, Health data analytics and predictive modeling. Artificial intelligence and machine learning in digital health. Emerging technologies and trends in digital health. | | | | |
| **Targeted Application & Tools that can be used:**<br>**Applications:** Quantitative image analysis for disease diagnosis, Mobile health (mHealth<br>**Tools:** TensorFlow, PyTorch, Computer-aided detection | | | | |
| **Project work/Assignment: Mention the Type of Project /Assignment proposed for this course** | | | | |
| Assignments can involve researching and reviewing academic papers or industry publications on specific AI applications in engineering / Students may be given programming assignments to implement AI algorithms / Case studies can be assigned to students, where they analyze real-world scenarios and propose AI-based solutions / Students may work with real or simulated datasets and be asked to explore and analyze the data, extract meaningful insights, and visualize the results using appropriate tools. | | | | |
| **Text Book**<br>1. "Digital Health: Scaling Healthcare to the World" by Paul Sonnier-2020<br>2. Digital Image Processing" by Rafael C. Gonzalez and Richard E. Woods<br>3. "Biomedical Signal and Image Processing" by Kayvan Najarian and Robert Splinter | | | | |
| **References**<br>1. Lavika Goel, Artificial Intelligence: Concepts and Applications, Wiley , 2021..<br>2. "Introduction to Health Informatics" by Mark S. Braunstein<br>3. https://talentsprint.com/course/ai-digital-health<br>4. https://www.udemy.com/topic/medical-imaging/ | | | | |
| **Catalogue prepared by** | Mr. Yamanaapa | | | |
| **Recommended by the Board of Studies on** | BOS NO: SOCSE 2nd BOS held on 10/07/23 | | | |
| **Date of Approval by the Academic Council** | Academic Council Meeting No 21, Dated 06/09/2023 | | | |

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|---|---|---|---|---|---|---|
| **Course Code:**<br>**CSE3019** | **Course Title:** Stochastic Decision Making<br>**Type of Course: Program Core& Theory Only** | **L-T- P-C** | 3 | 0 | 0 | 3 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | MAT1003: Applied Statistics | | | | | |

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| **Anti-requisites** | - | | | |
| **Course Description** | Stochastic Decision Making is an advanced-level course designed to build upon the foundational knowledge of artificial intelligence (AI) and its applications in engineering. This course aims to provide engineering students with an in-depth understanding of Stochastic techniques, algorithms, and emerging trends that are shaping the future of Agent-driven engineering systems. Through theoretical concepts, live examples, and case studies, students will explore cutting-edge building intelligent agents methodologies and their application in solving complex partially observable environment. | | | |
| **Course Objectives** | This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies. | | | |
| **Course Out Comes** | On successful completion of the course the students shall be able to:<br>1. Understand the role of knowledge-based agents and Apply logic in problem-solving [**Understanding**]<br>2. Apply dynamic System concepts to find an optimal policy in partially observable environment. [**Application**]<br>3. Implementation of various detection techniques and hypothesis for taking the decision in the real time environment [**Application**]<br>4. Apply various Project Scheduling strategies to solve the decision problem. [**Application**] | | | |
| **Course Content:** | | | | |
| **Module 1** | Intelligent Agents and Searching Techniques | Assignment | Theory | **L : 10** |
| **Introduction** - Structure of Intelligent Agents - Agent programs - Simple reflex agents - Goal-based agents - Utility-based agents - Agents and Environments - Properties of task environments - fully observable vs. partially observable - Deterministic vs. stochastic. Static vs, dynamic, Discrete vs. continuous, Single agent vs. multiagent<br>**Searching Techniques**: Solving Problems by Searching - Problem-Solving Agents - Formulating Problems - Real-world problems - Searching for Solutions - Search Strategies - Breadth-first search - Uniform cost search - Depth-first search - Depth-limited search - | | | | |
| **Module 2** | **Dynamic Systems** | Assignment | Case studies can be assigned to students, where they analyze real-world scenarios and propose AI-based solutions | **L: 10** |
| **Dynamic Programming** - Decision Trees - Deterministic Decision Trees , Stochastic Decision Trees scenario tree , Stochastic Dynamic Programming, Markowitz' model Comparing the Deterministic and Stochastic Objective values.<br><br>**Recourse Problems** - Outline of Structure - Knowledge Engineering - The Electronic Circuits Domain - General Ontology - The Grocery Shopping World.<br>**Problem Reduction:** Finding a Frame, Removing Unnecessary Columns, Removing Unnecessary Rows, Reducing the Complexity of Feasibility Tests | | | | |
| **Module 3** | **Detection and decisions** | Assignment /Quiz | Researching and reviewing academic papers or industry | **L:10** |

| | | | | |
|---|---|---|---|---|
| | | | publications on specific AI applications | |

**Detection and decisions :** Decision criteria and the maximum a posteriori probability criterion, Binary MAP detection, Binary detection with a minimum-cost criterion, The error curve and the Neyman–Pearson rule, The min–max detection rule

**Hypothesis testing** : Sufficient statistics with M ≥ 2 hypotheses, More general minimum-cost tests, Binary hypotheses with IID observations,

**Feasibility in Networks:** The un-capacitated case, Generating Relatively Complete Recourse, An Investment Example

| | | | | |
|---|---|---|---|---|
| **Module 4** | **Project Estimation and Scheduling** | Assignment | Students may work with real or simulated datasets and be asked to explore and analyze the data, extract meaningful insights, and visualize the results using appropriate tools. | **L: 10** |

**Project Estimation :** Introduction **-** The squared-cost function, Other cost functions. MMSE estimation for Gaussian random vectors- Scalar iterative estimation, The vector space of random variables; orthogonality MAP estimation and sufficient statistics

**Project Scheduling** : PERT as a Decision Problem , Introduction of Randomness, Bounds on the Expected Project Duration, Series reductions, Parallel reductions, Disregarding path dependences, Arc duplications ,Using Jensen's inequality,

**Targeted Application & Tools that can be used:**

**Applications:** Object detection, image classification, Sentiment analysis, language translation, Speech recognition, speaker identification, emotion recognition, Personalized product recommendations etc.

**Tools:** OpenCV, TensorFlow, PyTorch, NLTK (Natural Language Toolkit), OpenAI Gym

**Project work/Assignment: Mention the Type of Project /Assignment proposed for this course**

Assignments can involve researching and reviewing academic papers or industry publications on specific AI applications in engineering / Students may be given programming assignments to implement AI algorithms / Case studies can be assigned to students, where they analyze real-world scenarios and propose AI-based solutions / Students may work with real or simulated datasets and be asked to explore and analyze the data, extract meaningful insights, and visualize the results using appropriate tools.

**Text Book**


1. Peter Kall, Stein W. Wallace, "Stochastic Programming," Springer 2020
2. Robert G. Gallager, "Stochastic Processes Theory for Applications", Cambridge University Press 2019


**References**


1. Lavika Goel, Artificial Intelligence: Concepts and Applications, Wiley , 2021..
2. Laurra Graesser and Wan Loon Keng, "Foundations of Deep Reinforcement Learning", Pearson, 2022
3. https://www.udemy.com/course/artificial-intelligence-reinforcement-learning-in-python/


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| **Catalogue prepared by** | Dr Jai Singh W |
| **Recommended by the Board of Studies on** | BOS NO: SOCSE 2nd BOS held on 10/07/23 |

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| **Date of Approval by the Academic Council** | Academic Council Meeting No 21, Dated 06/09/2023 |

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|---|---|---|---|---|---|---|---|
| **Course Code: CSE3088** | **Course Title: Business Intelligence and Analytics**<br>**Type of Course:1] Theory** | **L-T- P-C** | **3** | **0** | **0** | **3** |
| **Version No.** | 1.0 | | | | | | |
| **Course Pre-requisites** | NIL | | | | | | |
| **Anti-requisites** | **NIL** | | | | | | |
| **Course Description** | The purpose of the course is to instill a strong foundation of scientific process orientation that is the cornerstone of effective. Business Intelligence (BI) is a set of architectures, theories, methodologies and technologies that transform structured, semi-structured and unstructured data into meaningful and useful information. Students will analyze enterprise data requirements to develop queries, reports and build OLAP cubes that use business analytics to answer complex business questions. | | | | | | |
| **Course Objective** | This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies. | | | | | | |
| **Course Out Comes** | **On successful completion of this course the students shall be able to:**<br>1. Discuss the impact of Business Intelligence (BI) theories, architectures, and methodologies on the organizational decision making process.[Comprehension]<br>2. Analyse the differences between the structured, semi-structured and unstructured data types to leverage the best technologies.[Application]<br>3. Develop Ad hoc queries, reports, spread sheets, dashboards and mobile BI applications.[ Application]<br>4. Using business analytics to answer complex business questions using data from a variety of sources, such as data files and relational/NoSQL databases.[ Knowledge] | | | | | | |
| **Course Content:** | | | | | | | |
| **Module 1** | An Overview of Business Intelligence, Analytics (Comprehension) | Assignment | | | **10 Hours** | | |
| Topics:<br>A Framework for Business Intelligence (BI). Intelligence Creation Use and BI Governance. Transaction Processing Versus Analytic Processing. Successful BI Implementation. Analytics Overview. Brief introduction to Big Data Analytics. | | | | | | | |
| **Module 2** | Business Reporting, Visual Analytics and Business Performance (Knowledge) | Assignment | | | **10 Hours** | | |
| Topics:<br>Management Business Reporting Definitions and Concepts. Data and Information Visualization. Different Types of Charts and Graphs. The Emergence of Data Visualization and Visual Analytics. Performance Dashboards. Business Performance Management. Performance Measurement. Balanced Scorecards. Six Sigma as a Performance Measurement System. | | | | | | | |

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| **Module 3** | Big Data and Analytics (Application) | Assignment | | **10 Hours** |
| Topics:<br>Definition of Big Data. Fundamentals of Big Data Analytics. Big Data Technologies. Data Scientist. Big Data and Data Warehousing. Big Data Vendors. Big Data and Stream Analytics. Applications of Stream Analytics. | | | | |
| **Module 4** | Emerging Trends and Future Impacts (Application) | Assignment | | **10 Hours** |
| Topics:<br>Location-Based Analytics for Organizations. Analytics for Consumers. Recommendation Engines. The Web 2.0 Revolution and Online Social Networking. Cloud Computing and BI. Impacts of Analytics in Organizations: An Overview. Issues of Legality, Privacy, and Ethics. The Analytics Ecosystem. | | | | |
| | | | | |
| **Targeted Application & Tools that can be used:** Anaconda/Google Colab, Google Data Studio, Deep Note | | | | |
| **Project work/Assignment: Mention the Type of Project /Assignment proposed for this course** | | | | |
| 1. Gain an immersive understanding of the practices and processes used by a junior or associate data analyst in their day-to-day job<br>2. Learn key analytical skills (data cleaning, analysis, & visualization) and tools (spread sheets, SQL, R programming, Tableau) | | | | |
| **Text Book**<br>1. C. Albright and W. L. Winston " Business Analytics: Data Analysis & Decision Making ", Cengage Learning India Pvt. Ltd ; Sixth Edition , September 2019<br>2. S. Christian, and L.Wayne, "Business Analytics: Data Analysis and Decision Making with MindTap". Second Edition , September 2022 | | | | |
| **References**<br>**R1.** Ramesh Sharda, Dursun Delen, Efraim Turban " Analytics, Data Science, & Artificial Intelligence (10th ed.). Upper Saddle River, NJ: Pearson. ISBN- 9781292341552, Second Edition 6 March 2020<br>**R2.** Jose, J. and Lal, S.P. :Introduction to Computing & problem solving with Python, Khanna Book Publishing First edition 2019<br>**R3.** B. Mt Wan " Data Analytics using Python ", 9th Edition, published by Pearson Education 2020.<br>**R4.** Ramesh Sharda "Business Intelligence Analytics And Data Science A Managerial Perspective" 4Th Edition , Pearson India, April 2019.<br><br>**Web links**<br>**R1.** http://owl.english.purdue.edu/owl/resource/560/01/<br>**R2.** http://myregisapp.regis.edu/Citrix/StoreWeb/<br>**R3.** https://in.coursera.org/courses?query=business%20intelligence<br>R4. https://www.coursera.org/learn/business-intelligence-data-analytics<br>R5. https://www.udemy.com/course/business-intelligence-and-data-analytics/ | | | | |
| **Topics relevant to development of "Employability":** Business Intelligence, Big Data Analytics, Data Scientist. | | | | |
| **Catalogue prepared by** | Dr. Harish Kumar K S | | | |

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| **Recommended by the Board of Studies on** | BOS NO: SOCSE 2nd BOS held on 10/07/23 |
| **Date of Approval by the Academic Council** | Academic Council Meeting No 21, Dated 06/09/2023 |

| Course Code: CSE3103 | Course Title: Cognitive Science & Analytics Type of Course : Theory | L-T- P- C | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|---|
| Version No. | 1.1 | | | | | |
| Course Pre-requisites | CSE3008: Machine Learning Techniques | | | | | |
| Anti-requisites | NIL | | | | | |
| Course Description | Overview of biological structure and artificial network, sensing algorithms, machine learning, localization. Hands-on implementation of cognitive recognition algorithms on both simulated and physical platforms. This course covers the mathematical foundations and state-of-the-art implementations of algorithms for cognitive analysis. It culminates in a critical review of recent advances in the field and a team project aimed at advancing the Reasoning. | | | | | |
| Course Objective | This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies. | | | | | |
| Course Out Comes | **On successful completion of the course the students shall be able to:**<br>1. Understand the different neural network models. **[Understand]**<br>2. Understand cognition systems and its requirements. **[Understand]**<br>3. Apply dynamic System concepts in Cognitive Science and Neuroeconomics. [**Application**]<br>4. Apply Cognitive Science in Learning and Reasoning. [**Application**] | | | | | |
| Course Content: | | | | | | |

| Module 1 | 8 Sessions |
|---|---|
| **Introduction to Biological Neuron:** Structure of Neuron, Action Potential, Process of Action Potential, Process of Synaptic Transmission, Stimulate the synaptic vesicle, *Depolarization of the neuron,*<br>**Memory (Biological Basis):** Theories of Memory Formation, System Consolidation Theory, Multiple-Trace Theory, Reconsolidation Theory,<br>**Artificial Neural Network:** Models of single neurons, Different neural network models. Single Layer Perceptron: Least mean square algorithm, Learning curves, Learning rates, Perceptron**.**<br>Bayesian Network, Degree of Belief, Conditional Probability, Bayes's Rule | |
| **Module 2** | **12 Sessions** |
| **Cognitive Architecture:** Fundamental Concepts, Cognitive View, Computers in Cognitive Science, Applied Cognitive Science, Interdisciplinary Nature of Cognitive Science, Nature of Cognitive Psychology, Notion of Cognitive Architecture, Global View of the Cognitive Architecture, Cognitive Processes, Working Memory, and Attention. Neuroscience: Brain and Cognition, Introduction to the Study of the Nervous System, Organization of the Central Nervous System, Neural Representation, Neuropsychology, Computational Neuroscience, | |
| **Module 3** | **10 Sessions** |
| **MO D E L S AN D TOO LS :** The Physical Symbol System Hypothesis :Intelligent Action and the Physical Symbol System, Neural based Models of Information Processing. Cognitive Science and Dynamical Systems, Applying Dynamical Systems. Neuroeconomics: Perception as a Bayesian Problem, Neuroeconomics: Bayes in the Brain<br>Strategies for Brain Mapping, Studying Cognitive Functioning: Techniques from Neuroscience | |
| **Module 4** | **08 Sessions** |
| **Application:** Models of Language Learning- Language Learning in Neural Networks, Bayesian Language Learning, Language Acquisition, Natural Language Processing, Semantics. Neural Network Models of Children's Physical Reasoning, Cognitive Science and the Law, Autonomous Vehicles: Combining Deep Learning and Intuitive Knowledge, | |

**Targeted Application & Tools that can be used:**

**Applications:** Behavior-Based Robotics

**Tools:** SHAKEY's Software, Logic Programming in STRIPS and PLANEX

**Project Work/Assignment:**

1. Develop a Model for Cognition and Knowledge Representation
2. Develop a Model for Biorobotics- Insects and Morphological Computation

**Text Book**

**T2:** José Luis Bermúdez, COGNITIVE SCIENCE l Publishers 3rd Edition, Cambridge University Press,2020

**T2:** Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc, COGNITIVE SCIENCE Publishers 3rd Edition, Cambridge University Press,2020

**References**

R1. Hod Lipson, Melba Kurman Driverless: Intelligent Cars and the Road ahead MIT Press. 2nd Edition, 2019

R2. Markus Maurer, J. Christian Gerdes, Barbara Lenz Autonomous Driving: Technical, Legal and Social Aspects 12n Edition, 2020

R3. Hannah YeeFen Lim, Autonomous Vehicles and the Law: Technology, Algorithms and Ethics ,Edward Elgar Publishing. 2nd Edition, 2019

**Web Resources:** https://www.cambridge.org/highereducation/books/cognitive-science/

**Topics relevant to development of "Employability":**

Deep Learning Models, Convolutional Neural Networks, Vehicle trajectory generation, Decision planning, Reinforcement learning.

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| **Catalogue prepared by** | **Dr. Jayakumar** |
| **Recommended by the Board of Studies on** | BOS NO: SOCSE 2nd BOS held on 10/07/23 |
| **Date of Approval by the Academic Council** | Academic Council Meeting No 21, Dated 06/09/2023 |

| Course Code: CSE3108 | Course Title: Expert Systems<br><br>Type of Course: Program Core& Theory Only | L-T- P- C | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|---|
| Version No. | 1.1 | | | | | |
| Course Pre-requisites | CSE3008: Machine Learning Techniques | | | | | |
| Anti-requisites | NIL | | | | | |
| Course Description | This course is an introduction to expert systems, which is an integral part of the computer science curriculum. In this course, we learn how theory and applications complement each other. Both theory and application are presented. Students are provided with the various tools language which they can use to develop systems of their own. By integrating theory with a fully functional means of applying that theory to real-world situations, students will gain an appreciation for the role played by expert systems in today's world. | | | | | |
| Course Objective | This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies. | | | | | |
| Course Out Comes | On successful completion of the course the students shall be able to:<br><br>[1] Understand the various AI programming knowledges.<br>[2] Apply the expert system techniques for specific task completion.<br>[3 ]Design and Develop expert systems using appropriate knowledge-based tools. | | | | | |
| Course Content: | | | | | | |

| Module 1 | Introduction to AI programming knowledges | Case study | Programming Task | 12 Sessions |
|---|---|---|---|---|
| Introduction to AI programming languages, Blind search strategies, Breadth-first – Depth-first – Heuristic search techniques Hill Climbing – Best first – A Algorithms AO* algorithm – game tress, Min-max algorithms, game playing – Alpha-beta pruning. Knowledge representation issues predicate logic – logic programming Semantic nets- frames and inheritance, constraint propagation; Representing Knowledge using rules, Rules-based deduction systems. | | | | |
| Module 2 | Expert System tools | Assignment | Tools | 14 Sessions |
| Introduction to Expert Systems, Architecture of expert system, Representation and organization of knowledge, Basics characteristics, and types of problems handled by expert systems.<br><br>Expert System Tools: Techniques of knowledge representations in expert systems, knowledge engineering, system-building aids, support facilities, stages in the development of expert systems. | | | | |
| Module 3 | Building an expert systems | Assignment | Programming | 16 Sessions |

**Building an Expert System: Expert system development, Selection of the tool, Acquiring Knowledge, Building process.**
**Problems with Expert Systems: Difficulties, common pitfalls in planning, dealing with domain experts, difficulties during development.**

**Targeted Application & Tools that can be used:**
AI related tools and knowledge based tools for expert system.

**Project work/Assignment:**
Assignment 1:Task on FuzzyCLIPS.
Assignment 2: Back-propagation algorithm for training Neural Networks (NN)

**Text Book**
T1.Elain Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw-Hill, New Delhi.
T2. Introduction to Expert Systems, Jackson P. , 3rd edition, Addison Wesley, ISBN 0-201-87686-8
T2.Waterman D.A., "A Guide to Expert Systems", Addison Wesley Longman

**References**
R1. Stuart Russel and other Peter Norvig, "Artificial Intelligence – A Modern Approach", Prentice-Hall,
R2.Patrick Henry Winston, "Artificial Intelligence", Addison Wesley,
R3.Patterson, Artificial Intelligence & Expert System, Prentice Hall India,1999.
R4.Hayes-Roth, Lenat, and Waterman: Building Expert Systems, Addison Wesley,
R5.Weiss S.M. and Kulikowski C.A., "A Practical Guide to Designing Expert Systems", Rowman &Allanheld, New Jersey

**Weblinks:**
https://onlinelibrary.wiley.com/journal/14680394
https://www.youtube.com/watch?v=11nzrNkn9D8

https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=1223875&site=ehost-live&ebv=EB&ppid=pp_xiii
https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2706929&site=ehost-live

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| **Catalogue prepared by** | **Ms.Akshatha Y** |
| **Recommended by the Board of Studies on** | BOS NO: SOCSE 2nd BOS held on 10/07/23 |
| **Date of Approval by the Academic Council** | Academic Council Meeting No 21, Dated 06/09/2023 |

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|---|---|---|---|---|---|---|
| **Course Code: CSE3072** | **Course Title: Wireless Sensor Networks** | **L-T- P-C** | 3 | 0 | 0 | 3 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | **CSE-236** Principles of Data Communications and Computer Networks | | | | | |
| **Anti-requisites** | **NIL** | | | | | |

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| **Course Description** | This course examines wireless cellular, ad hoc and sensor networks, covering topics such as wireless communication fundamentals, medium access control, network and transport protocols, uni cast and multicast routing algorithms, mobility and its impact on routing protocols, application performance, quality of service guarantees, and security. Energy efficiency and the role of hardware and software architectures may also be presented for sensor networks. |
| **Course Objective** | The objective of the course is SKILL DEVELOPMENT of student by using PARTICIPATIVE LEARNING TECHNIQUES |
| **Course Out Comes** | **On successful completion of the course the students shall be able to:**<br>• Explain the basics of the Wireless systems.<br>• Describe different protocols being used by wireless networks including ABR and MANETS.<br>• Illustrate the Fundamental Concepts and applications of ad hoc and wireless sensor networks.<br>• Interpret the WSN routing issues by considering related QoS measurements. |

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| **Course Content:** | | | | |
| **Module 1** | **Overview of Wireless Sensor and Adhoc Networks** | Assignment | Data Interpretation | **08 Sessions** |

**Topics:**
Introduction, Sensor Network Technology background, Elements of basic Sensor Network Architecture, Survey of Sensor Networks, Network Characteristics and Challenges, Applications of Wireless Sensor Networks, Range of Applications, Category 2 WSN Applications – Home Control, Industrial Automation, Medical Applications, Category 1 WSN Applications – Sensor and Robots, Reconfigurable Sensor Networks, Highway Monitoring, Military Applications, Civil and Environmental Engineering Applications, Wildfire Instrumentation, Habitat Monitoring, Nanoscopic Sensor Applications, Introduction to Cellular and Adhoc Networks, Issues in Adhoc Networks – Routing, Multicasting, QoS, Security, Scalability.

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| **Module 2** | **Wireless Transmission Technology and MAC Protocols for Adhoc** | Assignment | Basics and Interpretation | **13 Sessions** |

**Topics:**
Introduction, Radio Technology Primer – Propagation and Modulation, Propagation and Modulation impairments, Available Wireless Technologies, Campus Applications, MAN/WAN Applications, Medium Access Control Protocols – Fundamentals, Performance Requirements, MAC Protocols for WSNs - Schedule based Protocols and Random Access based Protocols, Sensor MAC case study, Issues in Designing MAC Protocol for Adhoc Networks - Bandwidth efficiency, QoS support, Synchronization, error-prone broadcast channel, Mobility of nodes.

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| **Module 3** | **Routing Protocols for Adhoc and WSN** | Quiz | Questions Set | **9Sessions** |

**Topics:**
Background, Data Dissemination and gathering, Routing challenges, Network Scale and Time-Varying Characteristics, Routing Strategies, characteristics of an ideal Routing Protocol for Adhoc Networks, WSN Routing Techniques, Classifications of Routing Protocols, Table-driven and on-demand Routing Protocols, Routing Protocols with efficient flooding mechanism.

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| **Module 4** | **Demonstration of WSN Adhoc Network using Simulators** | Quiz | Questions Set | **8 Sessions** |

**Topics:**
GloMoSim Simulator, TOSSIM, OMNeT++ and other recent available simulation tools (MATLAB wireless module, NS2, etc).

**Targeted Application & Tools that can be used:**

This course helps the students to understand the concepts related to Wireless Sensor and Adhoc and networks.by using simulation tools in several educational associations and research hubs. For this reason, the study of existing experimental tools for analyzing the behavior of WSNs has become essential, with wireless sensor networks that include NS-2, OMNeT++, Prowler, OPNET, and TOSSIM.

**Project work/Assignment:**

**Project Assignment:**

1. Resource Allocation Robust to Traffic and Channel Variations in Multihop Wireless Networks.
2. Evaluation Models for the Nearest Closer Routing Protocol in Wireless Sensor Networks

Assignment:

1]Define Wireless Sensor Networks? Explain in brief about the Applications of Wireless SensorNetworks

2] Discuss the advantages and applications of sensor networks?

3] Discuss the design considerations of physical layer and transceiver?

**Text Book**

**T1: Kazem Soharby, Daniel Minoli and Taieb Znati, Wireless Sensor Networks: Technology, Protocols and Applications, Wiley Publication, 2016, ISBN : 978-81-265-2730-4**

**T2: C. Siva Ram Murthy and B. S. Manoj, Adhoc Wireless Networks – Architecture and Protocols, Pearson Publication, 2013. ISBN: 978-81-317-0688-6**

**References**

**1: Jagannathan Sarangapani, Wireless Adhoc and Sensor Networks – Protocols, Performance and Control, CRC Press 2017, e-book ISBN: 9781315221441**

**2: Chai K. Toh, Ad Hoc Mobile Wireless Networks: Protocols and Systems, Prentice Hall Publisher 2007, ISBN : 0-13-007617-4**

**3: https://networksimulationtools.com/glomosim-simulator-projects/**

**R4 : http://vlabs.iitkgp.ac.in/ant/8/**

**Case study**

**link:**https://www.academia.edu/33109763/A_Case_Study_on_Mobile_Adhoc_Network_Security_for_Hostile_Environment

**E book link :** http://www.tfb.edu.mk/amarkoski/WSN/Kniga-w03.pdf

**E book link :** https://referenceglobe.com/CollegeLibrary/library_books/20180301073312adhoc2-ilovepdf-compressed.pdf

**Web resources:** https://archive.nptel.ac.in/courses/106/105/106105160/- **IIT KGP,** Prof. SUDIP MISHRA

**Web resources:** https://www.digimat.in/nptel/courses/video/106105160/L22.html - **IIT KGP,** Prof. SUDIP MISHRA

**Topics relevant to development of "Skill Development":**Sustainable development tools, Integrity Availability Concepts Policies, procedures,Guidelines, infrastructure-less wireless network that is deployed in a large number of wireless sensors.

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| **Catalogue prepared by** | Dr.Ashsih |
| **Recommended by the Board of Studies on** | BOS NO: SOCSE 2nd BOS held on 10/07/23 |
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|---|---|---|---|---|---|---|
| **Course Code: CSE3073** | **Course Title: Game design and Development**<br><br>**Type of Course: Program Core** | **L-T- P-C** | 2 | 0 | 2 | 3 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | **Nil** | | | | | |
| **Anti-requisites** | NIL | | | | | |

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| **Course Description** | The Game Design and development course is a hands-on learning experience that focuses on teaching students how to design, develop, and test game prototypes. Students will learn game design concepts such as player engagement, game mechanics, and game balance, and the basics of game art, sound, and programming. Throughout the course, students will work in teams to develop and refine their game prototypes, receiving feedback and guidance from the instructor and their peers. Topics covered include prototyping tools, sample game engines, and the creation of simple 2D and 3D game prototypes. The course will culminate in a final project where students will present and demonstrate their completed game prototypes to the class. |
| **CourseObjective** | This course is designed to develop ENTREPRENEURIAL SKILLS by USING EXPERIENTIAL LEARNING Techniques. |
| **Course OutComes** | At the end of the course the student should be able to:<br><br>CO1 Recall the elements of Game Mechanics.<br>CO2Distinguish between several types of prototypes.<br>CO3 Employ the concepts to create prototypes of games. |
| **CourseContent:** | Game mechanics, emergence and progression, resource mechanics, feedback structures.Uses and importance of prototyping, distinct types of prototypes, stages of prototyping, identifying key features, create functioning prototypes. |
| **Version No.** | 1.0 |

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| **Module 1** | **Game Mechanics** | **Assignment** | Evolution of prototyping | **No.of Classes:12** |

Topics:
Introduction to Game Mechanics, distinct types of game mechanics and applications, concepts of emergence and progression, Resource mechanics and economies, level design and progression in levels, feedback structures and semiotics.

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| **Module 2** | **Designing** | **Case Study** | Importance of prototyping | **No.of Classes:13** |

Topics:
Introduction to prototyping, uses and importance of prototyping. Distinct types of prototypes such as paper, physical, playable, art and sound prototypes, interface, low fidelity and high-fidelity code, core game and complete game prototypes.

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| **Module 3** | **Creating and Testing Prototypes** | **Assignment** | Prepare physical prototype of a popular game | **No. ofClasses:20** |

Topics:
Documentation, identifying key features, stages of prototyping, testing and feedback, application of different prototyping techniques such as paper, physical, playable, art and sound prototypes, interface, code, low fidelity and high-fidelity prototyping techniques to create functioning prototypes.

**Targeted Application & Tools that can be used:**
Algodoo

**Project work/Assignment:**

1. 2D Platformer Design
2. Game Development
3. UI/UX Design

**Textbook(s):**

1. Jeremy G. Bond, "Introduction to Game Design, Prototyping, and Development", 2nd Edition, Addison-Wesley Professional, 2017.

**References**

1. Ennio De Nucci, Adam Kramarzewski, "Practical Game Design : Learn the Art of Game Design Through Applicable Skills and Cutting-edge Insights", Packt Publishing, 2018.
2. Ernest Adams, "Fundamentals of Game Design", Pearson Education, 2012.

**Weblinks:**

https://learn.unity.com/
https://starloopstudios.com/rapid-game-prototyping-why-is-it-important-in-game-development/[Text Wrapping Break]

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| **Catalogue prepared by** | Dr. Pradeep Bhaskar |
| **Recommended by the Board of Studies on** | BOS NO: SOCSE 2nd BOS held on 10/07/23 |
| **Date of Approval by the Academic Council** | Academic Council Meeting No 21, Dated 06/09/2023 |

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|---|---|---|---|---|---|---|
| **Course Code: CSE3083** | **Course Title: Advanced Computer Architecture**<br>**Type of Course: Discipline Elective** | **L-T- P- C** | 3 | 0 | 0 | 3 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | CSE 2009 Computer Organization and Architecture | | | | | |
| **Anti-requisites** | **NIL** | | | | | |
| **Course Description** | This course introduces the principles and classes of parallelism in computation and architectures of different levels of parallel processing from intermediate to advanced level. This theory-based course emphasizes understanding advanced memory optimization techniques. It equips the students with the intuition behind Instruction level parallelism with pipelining and reducing the cost & hazards using dynamic scheduling. It helps the students to appreciate multiprocessing & thread level parallelism using shared, distributed and directory-based memory models for synchronization and consistency. The course also explores SIMD processors like Graphics Processing Units and Vector processors. | | | | | |
| **Course Outcomes** | On successful completion of the course the students shall be able to:<br>1] Discuss the concept of parallelism, virtualization, and memory optimization.<br>2] Interpret the practices to explore Instruction level parallelism with pipe lining and reducing the cost & hazards using dynamic scheduling.<br>3] Explain the intuition behind multiprocessing & thread level parallelism using shared, distributed and directory-based memory models for synchronization and consistency.<br>4] Discuss internal architecture of SIMD systems like Vector processors and GPUs. | | | | | |
| **Course Content:** | | | | | | |

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| **Module 1** | Flynn's classification and Memory Hierarchy | Assignment | Data Analysis task | **10 Classes** |

**Topics:**
Defining Computer Architecture, Flynn's Classification of Computers, Metrics for Performance Measurement, Amdahl's Law, Advanced Optimizations of Cache Performance, Memory Technology and Optimizations, Virtual Memory and Virtual Machines, The Design of Memory Hierarchy.

Case Study: Memory Hierarchies in Intel Core i7 and ARM Cortex-A8.

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| **Module 2** | Instruction Level Parallelism | Assignment | Analysis, Data Collection | **9 Classes** |

**Topics:**
Concepts and Challenges, Superscalar architecture, Hazard Resolution and Timing Constraints, Out of Order Execution and Register Renaming, Reducing Branch Costs with Advanced Branch Prediction, Dynamic Scheduling, Advanced Techniques for Instruction Delivery and Speculation, Limitations of ILP.
Case Study: Dynamic Scheduling in Intel Core i7 and ARM Cortex-A8.

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| **Module 3** | Thread Level Parallelism | Case Study | Data analysis task | **9 Classes** |

**Topics:**
Introduction, Shared-Memory Multicore Systems, Performance Metrics for Shared-Memory Multicore Systems, Prefetching, Cache Coherence Protocols, Synchronization, Memory Consistency.
Case Study: Intel Skylake and IBM Power8.

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| **Module 4** | Data Level Parallelism | Assignment | Analysis, Data Collection | **9 Classes** |

**Topics:**
Introduction, Vector Architecture, SIMD Instruction Set Extensions for Multimedia, Graphics Processing Units, GPU Memory Hierarchy, Detecting and Enhancing Loop- Level Parallelism
Case Study: Nvidia Maxwell.

**Targeted Application & Tools that can be used:**

Targeted employment sector is processor manufacturing and memory chip fabrication vendors like Intel, AMD, Motorola, NVidia, Samsung, Micron Technology, western Digital etc. Targeted job profiles include Memory circuit design and verification engineers, Physical system design engineer, System programmer, Fabrication engineer etc.

**Tools:**

- Virtual Lab, IIT KGP
- Tejas – Java Based Architectural Simulator, IIT Delhi

**Project work/Assignment:**

**Case Study:**

- Memory Hierarchies in Intel Core i7 and ARM Cortex-A8
- Dynamic Scheduling in Intel Core i7 and ARM Cortex-A8

**Term Assignments:**

- **Comparative analysis of instruction set architecture (ISA) of CISC and RISC processors**

  Carry out a thorough analysis of the internal organization and Instruction set Architecture of state-of the art CISC processors like VAX, PDP-11, Motorola 68k, Intel's x86 and the best in the market RISC architectures including DEC Alpha, ARC, AMD 29k, Atmel AVR, Intel i860, Blackfin, i960, Motorola 88000, MIPS, PA-RISC, Power, SPARC, SuperH, and ARM too.

- **A short survey of the recent trends in advanced Cache memory optimization**

  Study and analyze few important present day cache memory optimization techniques the levels used, the mapping technique employed, read and write policies, coherency and consistency scenarios etc.

**Text Book**

1. J.L. Hennessy and D.A. Patterson, "Computer Architecture: A Quantitative Approach", 6th Edition, Morgan Kauffmann Publishers, November 2021.

**References**

1. J.P. Shen and M.H. Lipasti, "Modern Processor Design: Fundamentals of Superscalar Processors", 2nd Edition paperback imprint, McGraw-Hill Higher Education, 2013.
2. D.B. Kirk and W.W. Hwu, "Programming Massively Parallel Processors", 3rd Edition, Morgan Kauffmann Publishers, November 2016.

Topics relevant to development of "FOUNDATION SKILLS": Pipelining, CISC and RISC processors, Static and Dynamic scheduling

Topics relevant to "HUMAN VALUES &PROFESSIONAL ETHICS": Collaboration and Data collection for Term assignments and Case Studies.

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|---|---|
| **Catalogue prepared by** | Prof. Archana Sasi<br>Dr. Tapas Guha<br>Prof. Preethi |
| **Recommended by the Board of Studies on** | BOS NO: |
| **Date of Approval by the Academic Council** | Academic Council Meeting No. |

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|---|---|---|---|---|---|---|
| **Course Code:** **CSE3085** | **Course Title:** **Real Time Operating Systems**<br>**Type of Course:** **Theory** | **L-T- P-C** | 3 | 0 | 0 | 3 |
| **Version No.** | 1 | | | | | |
| **Course Pre-requisites** | **NIL** | | | | | |
| **Anti-requisites** | **NIL** | | | | | |

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| **Course Description** | The Real-time Operating Systems program is an educational and methodological document included in the master's educational program, provides for the acquisition of skills and competencies related to the study of the features of embedded operating systems, as well as real-time systems. Real-time Operating Systems is aimed at the formation of competencies aimed at obtaining theoretical knowledge about embedded operating systems, and the acquisition of practical skills and competencies in installing, configuring and debugging operating systems. |
| Course Objective | This course is designed to develop ENTREPRENEURIAL SKILLS by using EXPERIENTIAL LEARNING Techniques. |
| **Course Out Comes** | **On successful completion of the course the students shall be able to:**<br>• Explain the fundamentals of Real time systems and their classifications.<br>• Understand the concepts of System control and the suitable computer hardware requirements for real-time applications.<br>• Describe the operating system concepts and techniques applicable for real time systems.<br>• Apply deadlock detection and prevention algorithms to solve the given problem |
| **Course Content:** | |

| **Module 1** | **8 Sessions** |
|---|---|

**Introduction Real Time Operating System**

Introduction to Operating System: Computer Hardware Organization, BIOS and Boot Process, Multi-threading concepts, Processes, Threads, Scheduling

| **Module 2** | **8 Sessions** |
|---|---|

**BASICS OF REAL-TIME CONCEPTS**

Terminology: RTOS concepts and definitions, real-time design issues, examples, Hardware Considerations: logic states, CPU, memory, I/O, Architectures, RTOS building blocks, Real-Time Kernel

| **Module 3** | **8 Sessions** |
|---|---|

**PROCESS MANAGEMENT**

Concepts, scheduling, IPC, RPC, CPU Scheduling, scheduling criteria, scheduling algorithms Threads: Multi-threading models, threading issues, thread libraries, synchronization Mutex: creating, deleting, prioritizing mutex, mutex internals

| **Module 4** | **8 Sessions** |
|---|---|

**INTER-PROCESS COMMUNICATION**: Messages, Buffers, mailboxes, queues, semaphores, deadlock, priority inversion,

**PIPES MEMORY MANAGEMENT**: - Process stack management, run-time buffer size, swapping, overlays, block/page management, replacement algorithms, real-time garbage collection

**Text Book**


1. J. J Labrosse, “MicroC/OS-II: The Real –Time Kernel”, Newnes, 2002.
2. Jane W. S. Liu, “Real-time systems”, Prentice Hall, 2000.


**References**


1. W. Richard Stevens, “Advanced Programming in the UNIX® Environment”, 2nd Edition, Pearson Education India, 2011.
2. Philips A. Laplante, “Real-Time System Design and Analysis”, 3rd Edition, John Wley& Sons, 2004
3. Doug Abbott, “Linux for Embedded and Real-Time Applications”, Newnes, 2nd Edition, 2011.


**Web resources:**http://pu.informatics.global

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|---|---|
| **Topics relevant to development of "Skill Development":** Threads: Multi-threading models, threading issues, thread libraries, synchronization | |
| **Catalogue prepared by** | Dr.Madhushudhan |
| **Recommended by the Board of Studies on** | BOS NO: SOCSE 2nd BOS held on 10/07/23 |
| **Date of Approval by the Academic Council** | Academic Council Meeting No 21, Dated 06/09/2023 |

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|---|---|---|---|---|---|---|
| **Course Code:** CSE3089 | **Course Title: Software Architecture**<br><br>**Type of Course: Theory Only** | **L-T-P- C** | 3 | 0 | 0 | 3 |
| **Version No.** | 2.0 | | | | | |
| **Course Pre-requisites** | Software Engineering and Object-oriented Analysis and design | | | | | |
| **Anti-requisites** | NIL | | | | | |
| **Course Description** | This course deals with basic concepts and principles regarding software architecture and software design. It starts with discussion on importance of Architectures, design issues, followed by coverage on design patterns. It then gives an overview of architectural structures and styles. Practical approaches and methods for creating and analysing software architecture is presented. The emphasis is on the interaction between quality attributes and software architecture. Students will also gain experience with examples in design pattern application and case studies in software architecture. | | | | | |
| **Course Objective** | **This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PARTICIPATIVE LEARNING techniques** | | | | | |
| **Course Out Comes** | **COURSE OUTCOMES: On successful completion of the course the students shall be able to:**<br>CO1. Describe the importance of software architecture in large-scale software systems.<br>CO2.Understand the major software architectural-styles, design-patterns, and frameworks.<br>CO3.Distinguish the quality attributes of a System Architecture.<br>CO4.Identify the appropriate architectural pattern(s) for a given scenario | | | | | |
| **Course Content:** | | | | | | |
| **Module 1** | Introduction | Quiz | Introduction on S/W A | **08 Sessions** | | |
| Topics: The Architecture Business Cycle: Software processes and the architecture business cycle; What makes a "good" architecture. Influence of software architecture on organization-both business and technical, Architectural patterns, reference models and reference architectures; Architectural structures and views. | | | | | | |
| **Module 2** | Architectural Styles and Case Studies | Quiz | Design | **07 Sessions** | | |
| Topics: Architectural styles; Four Architectural Designs for the KWIC System; Pipes and filters; Data abstraction and object-oriented organization; Event-based, implicit invocation; Layered systems; Service oriented architecture, Hypertext style, Repositories; Interpreters; Heterogeneous architectures. Case Studies: Keyword in Context, Mobile Robot system. | | | | | | |
| **Module 3** | Quality: Functionality and architecture | Quiz | Quality Attributes | **09 Sessions** | | |
| Topics: Architecture and quality attributes; System quality attributes; Quality attribute scenarios in practice; Business qualities; Introducing tactics; Availability tactics; Modifiability tactics; Performance tactics, Security tactics. Quality Model, Application of The Customized Quality Model to a Case Study | | | | | | |
| **Module 4** | Architectural patterns and styles | Seminar | Architectural styles | **17 Sessions** | | |
| Topics: Architectural Patterns: Introduction; From Mud to Structure: Layers, Pipes and Filters, Blackboard, Distributed Systems: Broker. Design Patterns: Structural decomposition: Whole – Part; Organization of work: Master – Slave;<br>Model View Controller and Reflection patterns. Introduction to Service Oriented Architecture,Three Types of Service-Oriented Architecture | | | | | | |
| **Targeted Application & Tools that can be used:**<br>Multiple integrations with other major architecture software (ArchX, Archisoft, Build software, Astena, Bouwsoft, Teamleader, Total Synergy, etc.) and export opportunities with google drive, dropbox, and CSV formats allow this tool to be widely and comfortably used in the industry.<br>**Professionally used software–**Slack**,** Google calendar**,** outlook email**, and others.** | | | | | | |
| **Quiz and Seminar** | | | | | | |

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| Quiz on topics from the module 1,2 and 3. Seminar topics will be given to students to present in the class |
| **Text Book**<br>1. T1.Software Architecture in Practice–LenBass,PaulClements,RickKazman,2ndEdition,Pearson Education, 2019.<br>T2.Pattern-OrientedSoftwareArchitecture,ASystemofPatterns-Volume1–FrankBuschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michael Stal, John Wiley and Sons, 2019.<br>T3.MaryShawandDavidGarlan:SoftwareArchitecture-PerspectivesonanEmergingDiscipline, Prentice-Hall of India, 2007. |
| **References**<br>R1.DesignPatterns-ElementsofReusableObject-OrientedSoftware–E.Gamma,R.Helm,R.Johnson,J. Vlissides:, Addison- Wesley, 1995.<br>**E-Resources**<br>W1. WebsiteforPatterns:http://www.hillside.net/patterns/ |
| **Topics relevant to the development of SKILLS:**<br>CasestudyonArchitecturalstyles<br>ModelViewPresenter(MVP) Architecture |

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| **Catalogue prepared by** | Dr. Preethi |
| **Recommended by the Board of Studies on** | BOS NO: 11th BOS, held on 7/8/2020 |
| **Date of Approval by the Academic Council** | Academic Council Meeting No. 15th, Dated 23/10/2020 |

| Course Code: CSE 2028 | Course Title: Statistical Foundation of Data Science Type of Course: Integrated | L-T- P-C | 2 | 0 | 2 | 3 |
|---|---|---|---|---|---|---|
| Version No. | 1 | | | | | |
| Course Pre-requisites | Basic knowledge about mathematical operations and statistics, Machine learning. | | | | | |
| Anti-requisites | | | | | | |
| Course Description | This course is intended for those developers who are interested in entering the field of data science and are looking for concise information on the topic of statistics with the help of insightful content based exercises, examples and simple explanation. This course gives in depth introduction to statistics and machine learning theory, methods, and algorithms for data science. It covers multiple regression, kernel learning, sparse regression, sure screening, generalized linear models and quasi-likelihood, covariance learning and factor models, principal component analysis and other related topics. | | | | | |
| Course Objective | This course is designed to improve the learner's **EMPLOYABILITY SKILLS** by using real-world **PROBLEM-SOLVING** methodologies. | | | | | |
| Course Out Comes | **On successful completion of the course the students shall be able to:**<br>1. Identify the statistical concepts in the field of data science. (Knowledge)<br>2. Apply logical thinking, solve the problem in context of High Dimensional Inference. (Application)<br>3. Classify the relevant topics in statistics and supervised learning & unsupervised learning (Comprehension)<br>4. Demonstrate different types of data classification real -world problems of data science applications. (Application) | | | | | |
| Course Content: | | | | | | |

| Module 1 | Multiple and Nonparametric Regression | Assignment | Data Collection/Interpretation | 10Sessions |
|---|---|---|---|---|
| **Topics:** Introduction, Multiple Linear Regression - The Gauss-Markov Theorem, Statistical Tests Weighted Least-Squares, Box-Cox Transformation, Model Building and Basis Expansions - Polynomial Regression, Spline Regression, Multiple Covariates, Ridge Regression - Bias-Variance Tradeoff , Penalized Least Squares, Bayesian Interpretation, Ridge Regression Solution Path, Kernel Ridge Regression, | | | | |
| **Module 2** | High Dimensional Inference | Case studies | Case studies / Case let | **10 Sessions** |
| **Topics:** Inference in linear regression - Debias of regularized regression estimators, Inference in generalized linear models, Test of linear hypotheses, Numerical comparison - Asymptotic efficiency, Statistical efficiency and Fisher information, Linear regression with random design, Partial linear regression, Gaussian graphical models - Inference via penalized least squares, Sample size in regression and graphical models, General solutions. | | | | |

| Module 3 | Mathematics of machine learning | Quiz | Case studies | 10 Sessions |
|---|---|---|---|---|
| **Topics:** Bayesian modelling and Gaussian processes, randomized methods, Bayesian neural networks: approximate inference, variational autoencoders, generative models, applications. Recurrent neural networks, backpropagation through time, Long short term memory networks, neural Turing machines, machine translation, Restricted Boltzmann Machin | | | | |
| **Module 4** | Advanced Neural Networks | Quiz | Case studies | 10 Sessions |

Convolutional neural network, Prediction of data using Convolutional Neural Networks, Generative adversarial networks-Deep learning in Sequential Data, RNN(Recurrent Neural Networks) & LSTM(Long Short Term Memory), GRU(Gated Recurrent Unit), Sentiment Analysis, Recommender systems.

**List of Laboratory Tasks:**

**Experiment No 1:** Working with Numpy arrays

**Level 1:** Basic Statistics, Copying, & Subsetting, Indexing, Flattening,

**Level 2:** Dealing with Missing Values, and filling with missing values

**Experiment No. 2:** Working with Pandas data frames

**Level 1:** Descriptive Statistics, Basic statistical functions

**Level 2:** Statistical functions, Aggregations

**Experiment No. 3:** Develop python program for Basic plots using Matplotlib

**Level 1:** Plot, Line, Scatter Plot, Pie Charts, Bars, Histogram, Box Plots

**Level 2:** Time Series, Categorical Data, and Text Data

**Experiment No. 4:** Develop python program for Frequency distributions

**Level 1:** student dataset , pollution dataset

**Level 2:** stack market dataset

**Experiment No. 5:** Develop python program for Variability

**Level 1:** Statistical values

**Level 2:** Probability Distributions and Pipes

**Experiment No. 6:** Develop python program for Normal Curves

**Experiment No. 7:** Develop python program for Correlation and scatter plots

**Experiment No. 8:** Develop python program for Correlation coefficient

**Experiment No. 9 :** Develop python program for Simple Linear Regression

**Experiment No. 10 :** Apply and explore various plotting functions on UCI data sets, Normal curves, Density and contour plots, Correlation and scatter plots

**Targeted Applications & Tools that can be used:**

- Data Analysis
- Data classification
- Data Exploration
- Data Clustering

**Tools**:

Python with statistical packages

**Project work/Assignment: Mention the Type of Project /Assignment proposed for this course**

- After completion of each module a programming-based Assignment/Assessment will be conducted.
- A scenario will be given to the students to be developed as a series of Program/ Application.
- On completion of Module 2 and Module 4, students will be asked to develop a Mini Project using python.

**Text Book**

**T1** Fan, Jianqing, Runze Li, Cun-Hui Zhang, and Hui Zou. *Statistical foundations of data science*. CRC press, 2020.

**T2** Alan Agresti, Maria Kateri "Foundations of Statistics for Data Scientists With R and Python" 2021

**References**

**Books**

**R1.** James, G., Witten, D., Hastie, T.J., Tibshirani, R. and Friedman, J. (2013). *An Introduction to Statistical Learning with Applications in R* . Springer, New York.

**R2**. Hastie, T.J., Tibshirani, R. and Friedman, J. (2009). *The elements of Statistical Learning: Data Mining, Inference, and Prediction* (2nd ed). Springer, New York.

**R3.** Buehlmann, P. and van de Geer, S. (2011). *Statistics for High-Dimensional Data: Methods, Theory and Applications*. Springer, New York.

**E book link**

**1.**W. N. Venables, D. M. Smith and the R Core Team,
**https://www.ebooksdirectory.com/details.php?ebook=1791**

**Web link:**

1. **https://www.udemy.com/course/statistics-for-data-science-and-business-analysis(Udemy)**
2. **https://www.coursera.org/learn/foundations-of-data-science(Coursera)**

**Topics relevant to the development of "Foundation Skills":**

- Data Exploration using Python and R Programming.

**Topics relevant to the development of "Employability Skills":**

Statistical Data Analysis and exploration using Python and R Programming.

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| **Catalogue prepared by** | **Dr. HarishKumar K S** |
| **Recommended by the Board of Studies on** | BOS NO: SOCSE 2nd BOS held on 10/07/23 |
| **Date of Approval by the Academic Council** | Academic Council Meeting No 21, Dated 06/09/2023 |

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|---|---|---|---|---|---|---|
| Course Code: UG COURSE: **CSE3013** | Course Title: Machine Vision<br><br>Type of Course: Discipline elective Theory with embedded lab | L-T-P- C | 2 | 0 | 2 | 3 |
| Version No. | 1.0 | | | | | |
| Course Pre-requisites | MAT1003 Applied Statistics<br>CSE2048 Robotic Vision | | | | | |
| Anti-requisites | NIL | | | | | |
| Course Description | Machine Vision is a field of study that focuses on the design, development, and implementation of computer vision systems and technologies for visual perception and analysis. This course provides an in-depth understanding of the fundamental principles, algorithms, and applications of machine vision.<br>The Machine Vision course covers a wide range of topics related to computer vision, image processing, and pattern recognition. It combines theoretical concepts with hands-on practical exercises to provide students with a comprehensive understanding of machine vision techniques. Introduction to Machine Vision, Image Acquisition and Preprocessing, Image Segmentation and Feature Extraction, Object Detection and Recognition, Machine Vision Systems and Applications. | | | | | |
| Course Object | The objective of the course is to familiarize the learners with the concepts of Machine Vision and attain **Employability** through **Problem Solving** Methodologies. | | | | | |
| Course Out Comes | **On successful completion of the course the students shall be able to:**<br>1. Gain a solid understanding of the fundamental principles and concepts underlying machine vision systems, including image processing, computer vision algorithms, and pattern recognition techniques. **[Knowledge]**<br>2. Acquire knowledge of various machine vision algorithms and techniques used for tasks such as image acquisition, preprocessing, segmentation, feature extraction, object detection, tracking. **[Application]**<br>3. Ability to Implement Machine Vision Systems Develop the skills to design, implement, and evaluate machine vision systems using programming languages and libraries commonly used in the field, such as MATLAB, OpenCV, Python, TensorFlow, or PyTorch. **[Application]**<br>4. Gain hands-on experience through lab exercises, projects, and assignments that involve implementing and experimenting with machine vision algorithms and systems. **[Application]**<br>5. Develop teamwork and communication skills by working on group projects and effectively presenting findings and results related to machine vision tasks. **[Application]** | | | | | |
| Course Content: | | | | | | |
| Module 1 | **Introduction to Machine Vision** | Assignment | Practical | **No. of Classes:8** | | |
| Overview of machine vision and its applications, Basic components of a machine vision system, Challenges and limitations in machine vision | | | | | | |

| Module 2 | Image Acquisition and Preprocessing | Assignment | Practical | No. of Classes:14 |
|---|---|---|---|---|

Image formation and acquisition methods, Image enhancement techniques, Noise reduction and image denoising.

**Image Segmentation and Feature Extraction:** Thresholding techniques

- Edge detection algorithms
- Region-based segmentation
- Feature extraction methods

| Module 3 | Object Detection and Recognition | Assignment | Practical | No. of Classes:8 |
|---|---|---|---|---|

Object detection algorithms (e.g., template matching, Haar cascades),Feature-based object recognition, Machine learning-based object detection and recognition

| Module 4 | Machine Vision Systems and Application | Assignment | Practical | No. of Classes:8 |
|---|---|---|---|---|

- Industrial machine vision systems
- Robotics and autonomous systems
- Medical imaging and healthcare applications
- Surveillance and security systems
- Augmented reality and virtual reality applications

## Lab Experiments are to be conducted on the following topics:-

## Lab Sheet 1:

1. Image Loading and Display:
   - Load an image from a file using the `imread` function.
   - Display the loaded image using the `imshow` function.._____**(One Lab Session)**
2. Image Arithmetic Operations:
   - Perform addition, subtraction, and multiplication of images using basic arithmetic operations.
   - Display the results of each operation using the `imshow` function ._____**(One Lab Session)**

3. Implementation of Transformations of an Image._____**(One Lab Session)**
   a. Scaling & Rotation
   b. Gray level transformations, power law, logarithmic, negative.
4. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization.___**(One Lab Session)**

## Lab Sheet 2:

5. Edge Detection:
   a. Apply edge detection algorithms (e.g., Sobel, Canny) to detect edges in the image.
   b. Display the edge-detected images using imshow and compare them with the original. **(One Lab Session)**
6. Image Restoration:
   a. Introduce noise (e.g., Gaussian, salt and pepper) to the image using functions like imnoise.
   b. Apply suitable restoration techniques (e.g., median filtering, Wiener filtering) to remove the noise. **(One Lab Session)**
7. Image Segmentation:
   a. Convert the image to grayscale using the rgb2gray function.
   b. Perform thresholding using a suitable threshold value to segment the image.
   c. Display the segmented image using imshow and compare it with the original. **(One Lab Session) (Level 2)**

## Lab Sheet 3:

8. Feature Extraction:
   a. Texture feature extraction using methods like Gray-Level Co-occurrence Matrix (GLCM) or Local Binary Patterns (LBP).
   b. Shape feature extraction (e.g., area, perimeter, eccentricity) using region properties.
   c. Color feature extraction using color histograms or color moments. **(Two Lab Session) (Level 2)**

## Lab Sheet 4: (Group Project)

9. Object Detection and Recognition:
   - Haar cascade object detection (e.g., face detection or object detection using pre-trained classifiers).
   - Feature-based object detection using techniques like Speeded-Up Robust Features (SURF) or Scale-Invariant Feature Transform (SIFT).
   - Deep learning-based object detection using Convolutional Neural Networks (CNNs) or You Only Look Once (YOLO) algorithm.
10. Optical Character Recognition (OCR):
    a. Preprocessing of text images (e.g., binarization, noise removal, or skew correction).
    b. Text localization using techniques like connected component analysis or Stroke Width Transform (SWT).
    c. Character recognition using machine learning algorithms like Support Vector Machines (SVM) or Convolutional Neural Networks (CNNs).
11. Gesture Recognition:
    a. Hand segmentation using techniques like background subtraction or skin color detection.
    b. Feature extraction from hand regions (e.g., finger counting, hand shape descriptors).
    c. Classification of gestures using machine learning algorithms (e.g., k-Nearest Neighbors or Support Vector Machines).

**Tools/Software Required :**

1. OpenCV 4
2. Python 3.7
3. MATLAB

**Text Books**

1. "Machine Vision: Theory, Algorithms, Practicalities" by E.R. Davies 4th edition 2005

**References**

2. "Computer Vision: Algorithms and Applications" by Richard Szeliski 2nd edition 2022.
3. Ravishankar Chityala, Sridevi Pudipeddi, "Image Processing and Acquisition Using Python", Taylor & Francis, 2020.

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|---|---|---|---|---|---|---|
| **Course Code: CSE 3038** | **Course Title: Applied Data Science**<br>**Type of Course: Program Core**<br>**Theory and Laboratory Integrated** | **L-T- P-C** | 2 | 0 | 2 | 3 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | knowledge of statistics and Machine learning | | | | | |
| **Anti-requisites** | - | | | | | |

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| **Course Description** | This course introduces the core concepts of Data Science followed by programming using R. This course has the theory and lab component which emphasizes on understanding and programming right from Basics to Visualization, and analysis in R.<br>It helps the student to explore data by applying these concepts and also for effective problem solving, visualizing and analyzing. |
| **Course Objectives** | This course is designed to improve the learner's EMPLOYABILITY SKILLS by using real-world PROBLEM-SOLVING methodologies. |
| **Course Out Comes** | On successful completion of the course, the students shall be able to:<br>1. Discuss the process involved in Data Science (Knowledge)<br>2. Apply suitable models using machine learning techniques and analyze their performance (Application)<br>3. Analyze the performance of the model and the quality of the results (Application)<br>4. Demonstrate the different methodologies and evaluation strategies to real-world problems (Application) |
| **Course Content:** | |

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|---|---|---|---|---|
| **Module 1** | Introduction to Data Science | Assignment | Case Studies | **10 Sessions** |

**Data Science:** Basics – Digital Universe – Sources of Data – Information Commons – Data Science Project Life Cycle: OSEMN Framework

**Data Preprocessing** - Data Quality Assessment, Feature Aggregation, Feature Sampling, Dimensionality Reduction, Feature Encoding.

**Concept Learning**: Formulation of Hypothesis – Probabilistic Approximately Correct Learning - VC Dimension – Hypothesis elimination – Candidate Elimination Algorithm

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|---|---|---|---|---|
| **Module 2** | PREPARING MODEL USING R | Assignment | Programming | **10 Sessions** |

**Topics:**

Regression Models- Linear and Logistic Model, Classification Models – Decision Tree, Naïve Bayes, SVM and Random Forest, Clustering Models – K Means and Hierarchical clustering

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|---|---|---|---|---|
| **Module 3** | **Performance Evaluation** | Assignment | Programming | **8 Sessions** |

Model Evaluation Techniques: Hold out, cross-validation - Prediction Errors: Type I, Type II - Loss Function and Error: Mean Squared Error, Root Mean Squared Error – Model Selection and Evaluation criteria: Accuracy, F1 score – Sensitivity – Specificity – AUC

| | | | | |
|---|---|---|---|---|
| **Module 4** | **Applications of Data Science** | **Case Study** | Programming | **8 Sessions** |

Predictive Modeling: House price prediction, Fraud Detection Clustering: Customer Segmentation Time series forecasting: Weather Forecasting Recommendation engines: Product recommendation.

**List of Laboratory Tasks:**

**Experiment No 1:** Create an array and perform the following operations on it

**Level 1:** Basic Statistics, Copying, Slicing & Subsetting, Indexing, Flattening, Reshaping, Resizing,

**Level 2:** Sorting, Swapping, and Dealing with Missing Values

**Experiment No. 2:** Create an R Data frame and perform the following operations on it

**Level 1:** Descriptive Statistics, Indexing & ReIndexing, Renaming, Iteration, Sorting, Dealing with Missing Data

**Level 2:** Statistical functions, Window functions, Aggregations

**Experiment No. 3:** Create an R Data frame and perform the following operations on it

**Level 1:** Group by Operations, Merging/Joining, Concatenation,

**Level 2:** Time Series, Categorical Data, and Text Data

**Experiment No. 4:** Using R graphics perform the following

**Level 1:** Plot, Line, Scatter Plot, Pie Charts, Bars, Histogram, Box Plots,

**Level 2:** 3D Pie Charts, 3D Scatter Plot, GG Plot

**Experiment No. 5:** Using R Statistics perform the following

**Level 1:** Max & Min, Mean Median Mode, Subgroup Analyses,

**Level 2:** Probability Distributions and Pipes

**Experiment No. 6:** House rent prediction using linear regression

**Experiment No. 7:** Analysis of tweet and retweet data to identify the spread of fake news

**Experiment No. 8:** Perform analysis of power consumption data to suggest minimizing the usage

**Experiment No. 9 :** Agricultural data analysis for yield prediction and crop selection on Indian terrain data set

**Experiment No. 10 :** Behavioural analysis of customers for any online purchase model

**Targeted Applications & Tools that can be used:**

- Data Exploration
- Data classification
- Data Analysis

**Tools**:

- R Studio

**Project work/Assignment: Mention the Type of Project /Assignment proposed for this course**

- After completion of each module a programming-based Assignment/Assessment will be conducted.
- A scenario will be given to the students to be developed as a series of Program/ Application.
- On completion of Module 2 and Module 4, students will be asked to develop a Mini Project using R.

**Text Book**

1. The Essentials of Data Science, Knowledge Discovery Using R, Graham J Williams, CRC Press, 2017
2. HadleyWickhmen, Garrette Grolemund, R for Data Science: Import, Tidy, Transform, Visualize and Model Data, OReilly, 2017
3. Build A Career in Data Science**, March 2020,** by Emily Robinson, Jacqueline Nolis

**References**

**Books**

1. R for Data Science by Hadley Wickham & Garrett Grolemund, Reference, 2017
2. Practical Data Science CookBook, APRESS Publications, 2018

**Web Links:**

1. https://www.coursera.org/learn/introducton-r-programming-data-science (Coursera)
2. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAJ_1_02082022_1773 (E-Library Resource)
3. https://onlinecourses.nptel.ac.in/noc22_cs32/preview (NPTEL)

**Topics relevant to the development of "Foundation Skills":**

- Data Exploration R Programming.

**Topics relevant to the development of "Employability Skills":**

- Data Analysis and Visualization using R Programming.

| | | | | | |
|---|---|---|---|---|---|
| **Course Code: CSD1714** | **Course Title:** Predictive Intelligence in Data Science<br>**Type of Course: Program Core** | **L- P- C** | 2 | 0 | 2 |

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|---|---|---|---|---|
| **Version No.** | 1 | | | |
| **Course Pre-requisites** | | | | |
| **Anti-requisites** | NIL | | | |
| **Course Description** | Predictive Analytics subject is conceptual in nature. The students will be benefited in this course to know about modern data analytic concepts and develop the skills for analyzing and synthesizing data sets for decision making in the firms. | | | |
| Course Objective | The objective of the course is skill development of student by using Learning techniques | | | |
| **Course Out Comes** | **On successful completion of the course the students shall be able to:**<br>• CO 1: **Define** the nature of analytics and its applications. (Remember)<br>• CO 2: **Summarize** the concepts of predictive analytics and data mining.( Understand)<br>• CO 3: **Construct** the analytical tools in business scenarios to achieve competitive advantage.(Apply)<br>• CO 4: **Build** the real-world insights in decision trees and time series analysis methods in dynamic business environment.(Apply) | | | |
| **Course Content:** | | | | |
| **Module 1** | Introduction to Predictive Analytics | Self-Learning | Applications of analytics | **7 Sessions** |
| **Topics:**Analytics- Definition, importance, Analytics in decision making, Applications, Challenges, Experts perception on analytics; Popularity in Analytics; Predictive analytics in business Scenarios- case studies | | | | |
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| **Module 2** | **Principles and Techniques** | Case analysis | | **8 Sessions** |
| **Topics:**<br>Predictive modeling: Propensity models, cluster models, collaborative filtering, applications and limitations - Statistical analysis: Univariate Statistical analysis, Multivariate Statistical analysis | | | | |
| **Module 3** | **Model Selection** | Participative Learning & Case Analysis | | **7 Sessions** |
| Preparing to model the data: supervised versus unsupervised methods, statistical and data mining methodology, cross-validation, overfitting, bias-variance trade-off, balancing the training dataset, establishing baseline performance.<br>Measuring Performance in Regression Models - Linear Regression and Its Cousins - Non-Linear Regression Models - Regression Trees and Rule-Based Models<br>Measuring Performance in Classification Models - Discriminant Analysis and Other Linear Classification Models - Non-Linear Classification Models | | | | |
| **Module 4** | **Time Series Analysis** | Discussion & Presentation | | 8 Sessions |

Time series Model: ARMA, ARIMA, ARFIMA - Temporal mining - Box Jenkinson method, temporal reasoning, temporal constraint networks

**Text Book**

1.Jeffrey Strickland, Predictive analytics using R, Simulation educators, Colorado Springs, 2015
2.Max Kuhn and Kjell Johnson, Applied Predictive Modeling, 1st edition Springer, 2013.

**References**


**R1** Dinesh Kumar, U. (2021). Business Analytics: The Science of data-Driven Decision Making.

**R2** Business Analytics - Data Analysis & Decision Making", S. Christian Albright and Wayne L. Winston, Cengage Publication, 5th Edition, 2012

**E book link R1:** Raman, R., Bhattacharya, S., & Pramod, D. (2018). Predict employee attrition by using predictive analytics. Benchmarking: An International Journal. https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/BIJ-03-2018- 0083/full/html

**E book link R2:** Jing, Z., Luo, Y., Li, X., & Xu, X. (2022). A multi-dimensional city data embedding model for improving predictive analytics and urban operations. Industrial Management & Data Systems, (ahead-of-print). https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/IMDS-01-2022- 0020/full/html

**E book link R3:** Singh, R., Sharma, P., Foropon, C., & Belal, H. M. (2022). The role of big data and predictive analytics in the employee retention: a resource-based view. International Journal of Manpower. https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/IJM-03-2021- 0197/full/html

**E book link R4:** Mishra, D., Luo, Z., Hazen, B., Hassini, E., & Foropon, C. (2018). Organizational capabilities that enable big data and predictive analytics diffusion and organizational performance: A resource-based perspective. Management Decision. https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/MD-03-2018- 0324/full/html


**Web resources:**

W1.https://www.sas.com/en_in/insights/analytics/predictive-analytics.html

W2. https://www.techtarget.com/searchbusinessanalytics/definition/predictive-analytics

W3. https://www.cio.com/article/228901/what-is-predictive-analytics-transforming-data-intofuture-insights.html

W4. https://www.simplilearn.com/what-is-predictive-analytics-article

W5. https://www.northeastern.edu/graduate/blog/predictive-analytics/

W6.https://www.marketingevolution.com/knowledge-center/the-role-of-predictive-analyticsin-data-driven-marketing

Swayam & NPTEL Video Lecture Sessions on Predictive Analytics

1. https://onlinecourses.swayam2.ac.in/imb20_mg19/preview
2. https://onlinecourses.nptel.ac.in/noc19_mg42/preview

Case References

1. Predictive Analytics Industry Use cases.
2. https://www.rapidinsight.com/blog/11-examples-ofpredictive-analytics/
3. Srinivasan Maheswaran (2017). Predictive Analytics – Employee Attrition Case center.

**Topics relevant to development of "Skill Development":** ": Application of Business Analytics to enhances customer satisfaction and firms' success

**Topics relevant to development of "Environment and sustainability:** Focus on Predictive analytics to minimize the errors in decision making

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|---|---|---|---|---|---|---|
| **Course Code: CSE7000** | **Course Title: Internship**<br>**Type of Course:** | **L- T-P- C** | - | - | - | 2 |
| **Version No.** | **1.0** | | | | | |
| **Course Pre-requisites** | **Knowledge and Skills related to all the courses studied in previous semesters.** | | | | | |
| **Anti-requisites** | **NIL** | | | | | |
| **Course Description** | Students observe science and technology in action, develop an awareness of the method of scientific experimentation, and often get an opportunity to see, study and operate sophisticated and costly equipment. They also learn about the implementation of the principles of management they have learnt in class, when they observe multidisciplinary teams of experts from engineering, science, economics, operations research, and management deal with techno-economic problems at the micro and macro levels. Finally, it enables them to develop and refine their language, communication and inter-personal skills, both by its very nature, and by the various evaluation components, such as seminar, group discussion, project report preparation, etc. The broad-based core education, strong in mathematics and science and rich in analytical tools, provides the foundation necessary for the student to understand properly the nature of real-life problems. | | | | | | |
| **Course Objectives** | The objective of the course is to familiarize the learners with the concepts of Professional Practice and attain Employability Skills through Experiential Learning techniques. | | | | | |
| **Course Outcomes** | On successful completion of this course the students shall be able to:<br>1. Identify the engineering problems related to local, regional, national or global needs. (Understand)<br>2. Apply appropriate techniques or modern tools for solving the intended problem. (Apply)<br>3. Design the experiments as per the standards and specifications. (Analyze)<br>4. Interpret the events and results for meaningful conclusions. (Evaluate) | | | | | |

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|---|---|---|---|---|---|---|
| **Course Code: AID1705** | **Course Title:** Explainable AI (XAI)<br>**Type of Course:1] Program Core Theory Only** | **L-T-P-C** | **3** | **0** | **0** | **3** |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | NIL | | | | | |

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| **Anti-requisites** | | **NIL** |
| **Course Description** | | This course provides an in-depth exploration of Explainable AI (XAI) and Responsible AI (RAI), focusing on techniques and methods that allow AI models to be more interpretable, transparent, and fair. It covers foundational concepts of explainability, fairness, bias, and accountability in AI systems. Students will engage with case studies, real-world applications, and hands-on tools to understand how to design AI systems that are explainable and ethically responsible. |
| **Course Objective** | | By the end of this course, students will be able to:<br>1. Understand the principles of Explainable AI and Responsible AI.<br>2. Explore methods for enhancing transparency and interpretability in machine learning models.<br>3. Apply fairness, accountability, and transparency principles to AI systems.<br>4.A Evaluate the ethical considerations in the deployment of AI technologies. |
| **Course Out Comes** | | On successful completion of this course the students shall be able to:<br>**CO1: Explain the key concepts of Explainable AI and Responsible AI. *(Understanding – Level 2)***<br>**CO2: Analyze and apply techniques for improving the transparency and interpretability of AI models. *(Analyzing – Level 4)***<br>**CO3: Identify and mitigate bias and fairness issues in AI systems *Applying – Level 3)***<br>**CO4: Design AI systems with ethical considerations, ensuring accountability and fairness. *(Creating – Level 6)*** |
| **Course Content:** | | |

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|---|---|---|---|
| **Module 1** | Introduction to Explainable and Responsible AI | | **10 Hours** |
| Foundations of Explainable AI, Overview of Responsible AI, The importance of interpretability in machine learning, Bias and fairness in AI systems, Ethics and accountability in AI models. | | | |

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| **Module 2** | Methods and Techniques for Explainability | | **10 Hours** |
| Local and Global Explainability Methods, Feature Attribution and Importance, SHAP and LIME, Interpretable Machine Learning Models, Surrogate Models for Complex Systems. | | | |
| **Module 3** | Responsible AI Design and Implementation | | **13 Hours** |
| Fairness in AI, Bias Detection and Mitigation, Ethical AI Practices, Transparency in AI Algorithms, Legal and Regulatory Aspects of AI. | | | |
| **Module 4** | Practical Implementation and Case Studies | Assignment | **12 Hours** |
| Case Studies in Healthcare, Finance, and Law, Explainable AI in Autonomous Systems, Responsible AI in Social Media, Design and Deployment of Ethical AI Systems. | | | |

**Text Book**

**Explainable Artificial Intelligence: First World Conference, xAI 2023 – Proceedings**, Editors: Luca Longo, Publisher: Springer, Edition: 2023, ISBN-13: 978-3031440630.

**Explainable AI for Education: Recent Trends and Challenges**, Editors: Tanu Singh, Soumi Dutta, Sonali Vyas, Álvaro Rocha, Publisher: Springer, Edition: 2024, ISBN-13: 978-3031724091.

**References**

1.**Title Responsible AI in the Enterprise: Practical AI Risk Management for Explainable, Fair, and Compliant Machine Learning Models**, Author: Dan Zhang, Publisher: Packt Publishing, Edition: 2023, ISBN-13: 978-1803230528.

2.**Title**: **Responsible AI in Practice**, Authors: Rashida Richardson, Jason Schultz, Kate Crawford, Publisher:

Springer, Edition: 2023, ISBN-13: 978-9811681661.

| Course Code: UG COURSE: **CSD 1701** | Course Title: Social Media Analytics<br><br>Type of Course: Theory | L-T-P-C | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|---|
| Version No. | 1.0 | | | | | |
| Course Pre-requisites | NIL | | | | | |
| Anti-requisites | NIL | | | | | |
| Course Description | This course provides a comprehensive overview of social media analytics, focusing on the techniques and tools used to analyze social media data. Students will learn how to collect, process, and analyze data from various social media platforms to extract valuable insights. The course covers topics such as big data collection, demographic analysis, web analytics, and the use of analytics tools to understand online customer behavior and make data-driven decisions. | | | | | |
| Course Objective | The objective of the course is to familiarize the learners with the concepts Social Media Analytics and attain Skill Development through Experiential Learning techniques. | | | | | |
| Course Out Comes | On successful completion of the Social Media Analytics course, students can expect to achieve the following outcomes:<br><br>CO1: Understand the fundamental concepts and importance of social media analytics in modern business contexts. [Remember]<br>CO2: Effectively collect data from various social media platforms, ensuring they can gather relevant and accurate information. [Apply]<br>CO3: Develop the ability to process and analyze social media data, transforming raw data into meaningful insights. [Apply]<br>CO4: Acquire skills in visualizing data, enabling them to present findings in a clear and impactful manner. [Apply] | | | | | |
| Course Content: | | | | | | |
| Module 1 | **Introduction to Social Media Analytics** | Assignment | Practical | 11 Sessions Remember | | |
| The foundation for analytics, Social media data sources, Data sources and Factual Data Sources, Public and Private data, data gathering in social media analytics., Dealing with Unstructured Data, Challenges, Social media Mining Techniques, Social media data, Types of data, Text data formats, Text cleaning, tagging and storing. API: RESTful API, Stream API, OAuth Parsing API. | | | | | | |
| Module 2 | **Text Mining in Social Networks** | Assignment | Practical | 11 Sessions Apply | | |

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|---|---|---|---|---|
| Introduction, Keyword search, Classification Algorithms, Clustering Algorithms-Greedy Clustering, Hierarchical clustering, k-means clustering, Transfer Learning in heterogeneous Networks, Sampling of online social networks, Comparison of different algorithms used for mining, tools for text mining. | | | | |
| Module 3 | **Network Measures and Behavior Analytics** | Assignment | Practical | 12 Sessions Apply |
| Centrality: Degree Centrality , Eigenvector Centrality, Katz Centrality , PageRank, Between ness Centrality, Closeness Centrality , Similarity: Structural Equivalence, Regular Equivalence, Individual Behavior: Individual Behavior Analysis, Individual Behavior Modeling, Individual Behavior Prediction Collective Behavior: Collective Behavior Analysis, Collective Behavior Modeling, Collective Behavior Prediction | | | | |
| Module 4 | **Analyzing the Social Media Data** | Assignment | Practical | 11 Sessions Apply |
| Mining Facebook: Overview, Exploring Facebook's Social Graph API's, Analyzing Social Graph Connections. Mining Twitter: Overview, Exploring Twitter's API, Analyzing 140 Characters | | | | |
| REFERENCE MATERIALS:<br>(i) Textbooks<br>T1. Mining the Social Web – Mathew A. Rusell, 3rd Edition, O'Reilly, 2019.<br>T2 : Python Social Media Analytics – Michal Krystyanczuk and Siddhartha Chatterjee, PacktPub, 2017.<br>(ii) Reference Book(s)<br>R1. Charu C. Aggarwal, Social Network Data Analytics, Springer, 2011<br>R2:Mastering Social Media Mining with Python – Macro Bonzanini, PacktPub, 2016.<br>R3; Reza Zafarani Mohammad Ali Abbasi Huan Liu, Social Media Mining, Cambridge University Press, 2014<br><br>W1. NPTEL: https://onlinecourses.nptel.ac.in/noc21_cs28<br>W2. Coursera: https://www.coursera.org/learn/social-media-data-analytics<br>W3.Udemy:https://www.udemy.com/course/introduction-to-social-analytHYPERLINK "https://www.udemy.com/course/introduction-to-social-analytics/"ics/<br>W4. Others : https://research.facebook.com/publications/realtime-data-processing-at-facebook/ | | | | |
| Topics relevant to Entrepreneurial Skills: Extract and Analyze Social media Data for Entrepreneurship Development through Problem Solving methodologies/Participative Learning Techniques/ Experiential Learning Techniques. | | | | |

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| Course Code: UG COURSE: **CSD 1706** | Course Title Cloud Computing for the Data Science lab<br><br>Type of Course: LAB | L-T-P-C | 0 | 0 | 21 | |
| Version No. | 1.0 | | | | | |
| Course Pre-requisites | NIL | | | | | |
| Anti-requisites | NIL | | | | | |

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| Course Description | This lab enables students to practically apply cloud computing techniques in data science, using platforms like AWS, Azure, and GCP. Students will gain hands-on experience in cloud storage, data pipelines, model deployment, and real-time analytics with simplified, guided experiments. |
| Course Objective | To equip students with hands-on skills in applying cloud computing tools for data storage, processing, and machine learning in data science. The lab emphasizes practical exposure to cloud platforms such as AWS, Azure, and GCP for end-to-end data workflows. |
| Course Out Comes | On successful completion of the Social Media Analytics course, students can expect to achieve the following outcomes:<br><br>CO1: Set up cloud accounts and environments for data science tasks.<br>CO2: Store and access datasets using cloud storage tools.<br>CO3: Build basic data pipelines and perform ETL tasks on cloud platforms.<br>CO4: Train and deploy machine learning models using cloud-based services |
| Reference Book : | 2. "Data Science on the Google Cloud Platform: Implementing End-to-End Real-Time Data Pipelines" by Valliappa Lakshmanan (2023)<br>Hands-on guide to building scalable data science projects on Google Cloud.<br><br>3. "Machine Learning Engineering with Python: Deploy and Scale ML Models on AWS, Azure, and GCP" by Andrew P. McMahon (2024)<br>Recent guide on using cloud platforms for production-level ML systems. |

| **Course Code: CSE2074** | **Course Title:** Competitive Programming and Problem Solving<br>**Type of Course: Program Core** | L-T-P-C | 0 | 0 | 4 | 2 |
|---|---|---|---|---|---|---|
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | NIL | | | | | |
| **Anti-requisites** | **NIL** | | | | | |
| **Course Description** | The **Competitive Programming and Problem Solving** course equips students with efficient problem-solving skills for coding competitions and real-world challenges. Starting with brute-force solutions, students learn to optimize time and space complexity using advanced techniques like dynamic programming, greedy algorithms, and backtracking. Hands-on practice on platforms like CodeChef and Codeforces helps tackle problems involving number theory, data structures, and algorithmic paradigms. By understanding CP constraints and fostering a strategic mindset, students gain the confidence to excel in competitions, technical interviews, and practical applications. | | | | | |
| **Course Out Comes** | On successful completion of the course the students shall be able to:<br>CO1 : Understanding the issues of online platforms and Competitive Programming (CP) and developing brute force coding for commonly asked CP problems.<br>CO2 : Analyzing the space and time complexity of brute force solutions and designing efficient solutions.<br>CO3 : Evaluating the applicability of suitable algorithmic approaches to solve relevant CP problems.<br>CO4: Creating efficient solutions of CP problems using the learnt algorithmic approaches. | | | | | |

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| **Course Objective** | The objective of the course is to familiarize the learners with the concepts of **Competitive Programming and Problem Solving** and attain **Skill Development** through **Experiential Learning** techniques. |

**Module 1: Introduction to Competitive Programming**

Overview of Efficient Coding for Problem Solving and CP: Introduction to competitive programming (CP); revisit of complexity analysis; introduction to online platforms such as codechef, codeforces etc and online submission; constraints during CP, online testing process and common errors such as TLE; use of STL

**Module 2: Number Theory for Problem-Solving**

Use of Number Theory for problem-solving: reducing time/space complexity of brute force coding solution of Sieve Method, Inverse Module, Euclidian Method of factorization; efficient coding for Permutation Combination; XORing based and pattern-based solutions.

**Module 3: Optimizing Time & Space Using Sequential Storage**

Coding for Optimizing time and Space using Sequential Storage: two pointer approach; problem-solving using arrays and strings such as rotation on sorted arrays, duplicate removal, string matching algorithms; Kadane's algo, stacks, priority-queues and hashing based efficient coding; median based problems and alternate solutions.

**Module 4: Non-Linear Data Structures**

Applying Non-Linear Data Structures for real-life problems: design of efficient solutions for problems such as finding loops in a linked list, memory efficient DLL, block reversal in LL; problem solving using trees and binary trees, Catalan numbers, applications of graphs, spanning tree and path algos for CP problems with reduced time/space complexity.

**Module 5: Problem Solving using Advanced Topics**

CP Problem Solving using Advanced Topics: concept of disjoint sets and their efficient representation, algorithmic approaches such as Greedy, Backtracking, Dynamic Programming and applying them for CP problems using bottom-up dynamic programming.

**List of Laboratory Tasks:**

1. You are given the finishing times of 'N' runners in a marathon. Write a program to find the runner who finished in the third position. **Focus:** Basic data structures (arrays), sorting algorithms (e.g., insertion sort, selection sort), and basic input/output.
2. In the same marathon, you are given the finishing times of 'N' runners and their bib numbers. Write a program to efficiently find the top 10 runners and their corresponding bib numbers. **Focus:** Efficient sorting algorithms (e.g., merge sort, quick sort), data structures like priority queues, and optimizing for large datasets.
3. A library maintains a list of books with their unique IDs. Write a program to check if a given book ID is present in the library. Focus: Searching algorithms (linear search), basic data structures (arrays or lists).
4. The library wants to implement a system to quickly find books by their titles. Suggest an efficient data structure (e.g., a hash table or a trie) and explain how to implement it to achieve fast book lookups. Focus: Understanding the trade-offs between different data structures, choosing the most appropriate data structure for a specific problem, and implementing efficient search operations.
5. An online store sells products with different prices. Write a program to calculate the total cost of a given list of products. **Focus:** Basic arithmetic operations, working with arrays or lists to store product prices.
6. The online store offers discounts based on the total purchase amount. Design an algorithm to efficiently calculate the final cost of an order, considering different discount rules (e.g., percentage discounts, fixed amount discounts, tiered discounts). Focus: Algorithmic design, conditional statements, handling complex scenarios with multiple rules, and potentially using dynamic programming techniques for optimization.
7. You are given two integers, 'a' and 'm'. Calculate 'a' raised to the power 'm' modulo a large prime number 'p'. **Focus:** Basic modular arithmetic operations (modular exponentiation), understanding the modulo operator.
8. In a secure communication system, you need to efficiently compute the modular exponentiation for very large values of 'm'. Implement and analyze the efficiency of the binary exponentiation algorithm for this task. **Focus:** Efficient algorithms for modular exponentiation (binary exponentiation), time complexity analysis, and understanding the importance of efficient algorithms in cryptography.

9. You have a deck of 'N' cards. Calculate the total number of possible hands of size 'K' that can be drawn from the deck. **Focus:** Basic combinatorics (combinations), factorial calculations.
10. In a card game, you need to calculate the probability of drawing certain combinations of cards (e.g., a pair, a three-of-a-kind) from a shuffled deck. Design an efficient algorithm to calculate these probabilities. **Focus:** Advanced combinatorics (permutations and combinations with repetitions), probability calculations, and optimizing calculations to avoid overflows.
11. You are given a network of devices represented as a graph. Determine if there is a path between two given devices in the network. **Focus:** Graph traversal algorithms (depth-first search or breadth-first search).
12. In a secure network, you need to detect and isolate compromised devices. Design an algorithm that efficiently identifies devices that exhibit anomalous behavior (e.g., unusual traffic patterns) using XOR-based techniques for data comparison and pattern matching. **Focus:** Applying XOR operations for data comparison and pattern recognition, understanding the properties of XOR (e.g., commutative, associative), and designing algorithms for network anomaly detection.
13. You are given an array representing the speeds of cars on a highway. Find the minimum time required for all cars to pass a certain point. **Focus:** Basic array traversal, finding the minimum element in an array.
14. In a more realistic scenario, cars have different lengths. Implement a two-pointer approach to simulate the movement of cars and determine the minimum time for all cars to pass a given point. **Focus:** Two-pointer technique, simulating real-world scenarios with arrays, optimizing time complexity.
15. Given a string, find the number of occurrences of a specific substring within the string. **Focus:** Basic string manipulation, string matching (brute-force approach).
16. Implement the KMP (Knuth-Morris-Pratt) string matching algorithm to efficiently find all occurrences of a given pattern within a large text document. **Focus:** Advanced string matching algorithms, understanding the concept of the "next" array in KMP, optimizing for large input sizes.
17. An online auction platform receives bids for different items. Implement a data structure (e.g., a priority queue) to efficiently track the highest bid for each item. **Focus:** Priority queues, insertion and extraction operations on priority queues, basic implementation of a priority queue using an array or a suitable library.
18. The auction platform needs to handle a large number of bids concurrently. Design and implement a system that efficiently processes bids, updates the highest bid for each item, and handles potential race conditions. **Focus:** Concurrent data structures and algorithms, thread safety, handling race conditions, optimizing for high-throughput scenarios.
19. A social network can be represented as a graph where users are nodes, and connections between users are edges. Write an algorithm to find if two given users are connected in the network. **Focus:** Graph traversal algorithms (depth-first search or breadth-first search), basic graph representation (adjacency list or adjacency matrix).
20. In a large social network, efficiently finding the shortest path between two users is crucial. Implement Dijkstra's algorithm to find the shortest paths between users in the network, considering edge weights (e.g., representing the strength of connections). **Focus:** Shortest path algorithms (Dijkstra's algorithm), graph algorithms with weighted edges, optimizing for large graphs.
21. A file system can be modeled as a tree structure. Implement a function to traverse the file system and print the names of all files and directories. **Focus:** Tree traversal algorithms (depth-first search or breadth-first search), basic tree representation (using nodes and pointers).
22. Design and implement a file system that supports efficient operations like creating directories, deleting files, and finding files based on their names or paths. Consider using a combination of tree structures and hash tables for efficient indexing and searching. **Focus:** Designing and implementing file system structures, using multiple data structures together, optimizing for common file system operations.
23. An online shopping cart can be represented as a tree, where each node represents an item or a category of items. Write an algorithm to calculate the total price of all items in the shopping cart. **Focus:** Tree traversal, calculating sums within a tree structure.
24. Implement a system that allows customers to apply discounts and coupons to their shopping carts. Consider using a combination of trees and other data structures (e.g., hash tables) to efficiently apply discounts and calculate the final price. **Focus:** Applying discounts and promotions to tree-like structures, efficient implementation of discount rules, optimizing for complex pricing scenarios.
25. In a social network, users can form groups. Given a list of friendships, determine if all users in a specific group are connected (directly or indirectly) through friendships. **Focus:** Disjoint set union (DSU) data structure, basic connectivity checks.

26. Design an efficient algorithm to find the minimum number of new friendships needed to connect all users in the social network into a single, connected component. **Focus:** Applying DSU for finding connected components, greedy algorithms, optimization for minimizing connections.
27. A treasure hunt involves a series of clues leading to the final treasure. Given a list of possible paths and their associated costs, find the cheapest path to reach the treasure. **Focus:** Greedy algorithms (e.g., Dijkstra's algorithm for shortest paths), basic graph representation.
28. In a more complex treasure hunt, there are time constraints associated with each path. Design an algorithm to find the fastest path to the treasure while considering both path costs and time constraints.

**Focus:** Combining greedy approaches with other techniques (e.g., priority queues), handling multiple constraints, optimizing for time-critical scenarios.

29. In a simplified chess game with only rooks, determine the minimum number of moves required for a rook to reach a specific target square on an empty board. **Focus:** Breadth-first search (BFS) on a graph (the chessboard), basic graph traversal.
30. In a more realistic chess game with multiple pieces and obstacles, implement a minimax algorithm with alpha-beta pruning to determine the best move for a player. **Focus:** Game tree search, minimax algorithm, optimization techniques like alpha-beta pruning, handling complex game states.

**Targeted Application & Tools that can be used:**

1. C or C++ Compiler (g++): The standard compiler for CP. Familiarize students with compilation flags (e.g., -O2 for optimization).
2. IDE (Integrated Development Environment): Code:: Blocks, Visual Studio, CLion, or similar IDEs. These provide debugging capabilities, code completion, and other helpful features.
3. Online Judges (CodeChef, Codeforces, LeetCode, HackerRank): Essential for practicing and submitting solutions.
4. Debugger (gdb): Crucial for understanding code execution and finding bugs. Origin, excel and Mat lab soft wares for programming and data analysis.
5. Number Theory Libraries: Some libraries provide pre-built functions for number theory operations (though often it's better to implement them yourself for learning).
6. Wolfram Alpha: A useful tool for verifying number theory calculations and exploring concepts.
7. **String Libraries:** Familiarize students with the string manipulation functions available in C++.
8. **Graph Visualization Tools:** Tools like Graphviz can be helpful for visualizing graphs and understanding graph algorithms.
9. **DP Debugging Techniques:** Practice debugging DP solutions, as they can be complex. Visualizing the DP table can be helpful.

**Text Books:**

1. **Guide to Competitive Programming: Learning and Improving Algorithms Through Contests" (3rd Edition), *Antti Laaksonen, springer, 2024***
2. **"Data Structures and Algorithms in Java: A Project-Based Approach" – *Dan S. Myers, Cambridge University Press***

**Reference Books:**

1. **Data Structures and Algorithmic Thinking with Python/C++/Java", *Narasimha Karumanchi, 5th Edition, Career Monk, 2017*.**
2. **Introduction to Algorithms, Thomas H. Cormen (Author), Charles E. Leiserson (Author), Ronald L. Rivest , fourth edition April 2022**

**Web Resources**

1. **https://nptel.ac.in/courses/106106231**
2.

**Project work/Assignment: Mention the Type of Project /Assignment proposed for this course**

**Assessment Type**

- Midterm exam
- Assignment (review of digital/ e-resource from PU link given in references section - mandatory to submit screen shot accessing digital resource.)
- Quiz
- End Term Exam
- Self-Learning

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|---|---|---|---|---|---|---|
| Course Code: UG COURSE: **AID 1707** | Course Title : Generative AI and Prompt Engineering<br>Type of Course: Theory | L-T-P-C | 3 | 0 | 0 | 3 |
| Version No. | 1.0 | | | | | |
| Course Pre-requisites | CSE1005 (Programming in Python) | | | | | |
| Anti-requisites | NIL | | | | | |
| Course Description | This course introduces students to the concepts and techniques behind Generative AI (GenAI) systems and the art of Prompt Engineering. It explores the architecture of large language models (LLMs), diffusion models, generative adversarial networks (GANs), and the role of engineered prompts in eliciting specific and effective responses. Through practical applications, students will understand how GenAI is revolutionizing fields such as NLP, image generation, code generation, and human-AI interaction. | | | | | |
| Course Objective | By the end of this course, students will be able to:<br>1. Understand the fundamentals and architectures of generative models such as LLMs and GANs.<br>2. Apply prompt engineering strategies for optimizing generative AI outputs in various domains.<br>. | | | | | |
| Course Out Comes | On successful completion of the Social Media Analytics course, students can expect to achieve the following outcomes:<br><br>CO1: Explain the principles and types of generative AI models and their applications[Understanding].<br>CO2: Apply prompt engineering techniques to manipulate and fine-tune model outputs. [Apply]<br>CO3: Evaluate the effectiveness of generative models in NLP, vision, and multimodal tasks.[Apply]<br>CO4: Design task-specific prompts and solutions using GenAI platforms responsibly. [Apply] | | | | | |
| Course Content: | | | | | | |
| Module 1 | **Introduction to Generative AI** | 10 Sessions | | | | |
| Overview of Generative AI and its impact, Types of generative models: LLMs, GANs, Diffusion Models, Applications in NLP, vision, and creativity. Introduction to OpenAI GPT, Claude, Gemini, DALL·E, Mid Journey. | | | | | | |
| Module 2 | **Large Language Models and Diffusion Architectures** | 10 Sessions | | | | |
| Transformer architecture basics, Pretraining and fine-tuning, Diffusion models for image generation, Training paradigms: supervised, unsupervised, RLHF. | | | | | | |
| Module 3 | **Prompt Engineering Techniques** | 13 Sessions Apply | | | | |
| Basics of prompt design, Types of prompts (zero-shot, few-shot, chain-of-thought), Prompt tuning, Templates, Role-based prompting, Evaluating prompt performance. | | | | | | |
| Module 4 | **Applications and Ethics** | 12 Sessions Apply | | | | |

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|---|
| Code generation, Text-to-image generation, Chatbot design, Human-AI collaboration, Limitations and biases in GenAI, Safety and responsible AI use. |
| Text Book:<br>1.**The Art of Prompt Engineering with Generative AI"** by Nathan Hunter, 2024 Edition, O'Reilly Media.<br>2.**"Deep Learning for Natural Language Processing"** by Palash Goyal et al., Springer, 2023.<br>Reference Book:<br>*1.Hands-On Generative AI with OpenAI and ChatGPT"* by Sinan Ozdemir, 2023, Packt Publishing.<br>*2."GANs in Action: Deep learning with Generative Adversarial Networks"* by Jakub Langr and Vladimir Bok, Manning Publications, 2023. |

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|---|---|---|---|---|---|
| **Course Code: CSD3401** | **Course Title: Business Continuity and Risk Analysis for Data Science**<br>**Type of Course: Discipline elective** | **L- P- C** | 3 | 0 | 3 |
| **Version No.** | | | | | |
| **Course Pre-requisites** | CSD1716 | | | | |
| **Anti-requisites** | NIL | | | | |
| **Course Description** | This course provides data science students with a comprehensive understanding of business continuity planning (BCP) and risk analysis frameworks, integrating data-driven strategies for resilience and risk mitigation. It focuses on identifying potential threats, assessing vulnerabilities, and designing robust recovery strategies using data analytics. The course includes case studies from industries such as finance, manufacturing, and healthcare, emphasizing predictive risk models, disaster recovery, and regulatory compliance in a data-centric world. | | | | |
| **Course Out Comes** | On successful completion of the Financial Data Analysis course, students shall be able to:<br><br>1Explain the principles of business continuity planning and risk assessment<br>2) Apply statistical and data-driven techniques for risk identification and analysis.<br>3) Design data-supported continuity and disaster recovery strategies for business systems.<br>4) Evaluate risk management policies with regard to compliance, resilience, and sustainability. | | | | |
| **Course Content:** | | | | | |
| **Module 1** | Fundamentals of Business Continuity and Risk | **10 Hours** | | | |
| **Topics**: Introduction to Business Continuity Management (BCM); Definitions and types of risks; Risk management frameworks (ISO 31000, NIST); Key elements of BCP. | | | | | |
| **Module 2** | Risk Identification and Assessment using Data | **10 Hours** | | | |
| Data collection for risk analysis; Quantitative vs qualitative risk assessment; Risk matrices, scoring models; Statistical models for risk forecasting; Predictive analytics for risk detection. | | | | | |
| **Module 3** | **Risk Mitigation, Compliance, and Case Studies** | **13 Hours** | | | |
| Developing recovery objectives (RTO/RPO); Scenario planning and simulations; Business impact analysis (BIA) using analytics; Resource dependency and critical operations analysis. | | | | | |

| Module 4 | Applications in Real-World Financial Data | 12 Hours |
|---|---|---|
| Control design and monitoring; Regulatory and audit considerations (GDPR, HIPAA); Cyber resilience and data protection; Case studies in finance, healthcare, and supply chains. | | |
| Text Book:<br>1."Data Analytics for Risk-Based Decision Making" by Louis Anthony Cox Jr., Springer, 2023.<br>2."Operational Risk Modelling and Management" by Harry H. Panjer, Wiley, 2022.<br>3."Disaster Recovery, Crisis Response, and Business Continuity" by Jamie Watters, Packt, 2021. | | |

| Course Code: CSD3402 | Course Title: Web Data Analytics for Data Science<br>Type of Course: Integrated | L-T- P- C | 2 | 0 | 2 | 3 |
|---|---|---|---|---|---|---|
| Version No. | 1.0 | | | | | |
| Course Pre-requisites | CSE2074 | | | | | |
| Anti-requisites | NIL | | | | | |
| Course Description | **This course introduces tools and techniques for extracting, processing, and analyzing data from the web. Students will gain hands-on experience with web scraping, working with APIs, analyzing web server logs, and performing sentiment analysis using social media data. The course emphasizes deriving insights for real-world applications in data science.** | | | | | |
| Course Objective | 1.To provide practical exposure to web data extraction, preprocessing, and API handling.<br>2. To enable analysis of user behavior through web logs and social media trends for business and research decisions.<br>3. To develop visualization and reporting skills for web data-driven insights.<br>. | | | | | |
| Course Out Comes | **On successful completion of the course the students shall be able to:**<br>**CO1**: Extract and process structured/unstructured web data using automated tools.<br>**CO2**: Analyze user behavior patterns from web usage and clickstream data.<br>**CO3**: Perform sentiment and trend analysis using APIs and social media platforms.<br>**CO4**: Design dashboards and visualize web analytics results effectively. | | | | | |

**Course Content:**

| Module 1: Web Data Extraction and Preprocessing | 8 Sessions |
|---|---|
| Introduction to HTML, DOM, and web crawling, Web scraping using Python (BeautifulSoup, Scrapy), Working with REST APIs and JSON/XML data, Ethical and legal considerations in web data extraction | |

| Module 2: Web Usage and Log Data Analytics | 8 Sessions |
|---|---|
| Web server log structure and preprocessing, Session identification and user behavior modelling, Clickstream analysis and heatmap interpretation, Metrics: bounce rate, session duration, conversion tracking. | |

| Module 3 Social Media and Open Web Analytics | 7 Sessions |
|---|---|
| Sentiment analysis on Twitter, Reddit, etc.,Trend analysis and opinion mining, Google Trends and open web metrics,Case studies and dashboard creation with real-time data | |

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|---|---|
| | **Exp. No. Title**<br>1 Extract data from static web pages using BeautifulSoup<br>2 Perform web scraping from paginated or dynamic content using Scrapy<br>3 Access and parse REST APIs (e.g., GitHub, Twitter) with JSON data<br>4 Clean and preprocess web server logs (Apache or Nginx formats)<br>5 Identify sessions and users from clickstream logs<br>6 Perform sentiment analysis using Twitter API and TextBlob/VADER<br>7 Conduct trend analysis using Google Trends and visualize it<br>8 Create a live dashboard using Streamlit/Plotly to present web insigh |
| | Text Book<br>Title: Mining the Web: Discovering Knowledge from Hypertext Data, Author: Soumen Chakrabarti, Publisher: Morgan Kaufmann (Elsevier),Year of Publication: 2022 Reprint Edition (original concepts updated with modern tools and use cases),ISBN: 9780128164852 |
| | R1 :Title :Mining the Web: Discovering Knowledge from Hypertext Data, Author: Soumen Chakrabarti, Publisher: Morgan Kaufmann (Elsevier),Year: 2022 Reprint Edition,ISBN: 9780128164852<br>R2: Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data, Authors: Bing Liu, Publisher: Springer,Edition: 2nd Edition,Year: 2020,ISBN: 9783030421568.<br>R3: Data Wrangling with Python: Tips and Tools to Make Your Life Easier,Author: Jacqueline Kazil, Katharine Jarmul, Publisher: O'Reilly Media,Edition: 2nd Edition, Year: 2022, ISBN: 9781098102012 |

| **Course Code: CSD3403** | **Course Title: Optimization Techniques for Data Science**<br>**Type of Course: Theory Integrated** | **L- T-P-C**<br>**2-0-2-3** |
|---|---|---|
| **Version No.** | 1.0 | |
| **Course Pre-requisites** | **MAT 1001** | |
| **Anti-requisites** | **NIL** | |
| **Course Description** | This course provides a comprehensive introduction to optimization techniques with a strong focus on their applications in data science and machine learning. Students will explore the mathematical foundations of optimization, including convexity, duality, and gradient-based methods, and apply them to solve real-world problems involving regression, classification, clustering, and neural network training. The course covers both unconstrained and constrained optimization, delves into modern algorithms like stochastic gradient descent and Adam, and introduces advanced topics such as non-convex optimization and hyperparameter tuning. Through a blend of theory, algorithmic development, and hands-on coding assignments, students will gain the skills needed to formulate and solve optimization problems critical to effective data-driven decision making. | |

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| **Course Objectives** | The objective of the course is to familiarize the learners with the concepts of **Optimization for data science** and attain **Experiential Learning** and **Problem Solving** techniques. | | |
| **Course Out Comes** | On successful completion of this course the students shall be able to:<br>1. Describe the fundamental concepts of optimization, including convexity, gradients, and optimality conditions. [Remember]<br>2.Implement and analyze unconstrained optimization algorithms such as gradient descent, stochastic gradient descent, and quasi-Newton methods for solving machine learning models.[Remember]<br>3. Apply constrained optimization techniques, including KKT conditions and duality theory, to solve problems in support vector machines and resource-constrained data science scenarios. [Apply]<br>4.Evaluate and implement advanced optimization methods—including non-convex optimization, hyperparameter tuning, and metaheuristic approaches—in practical data science workflows.[Apply] | | |
| **Course Content:** | | | |
| **Module 1** | Foundations of Optimization | Assignment | **16 Session [L-8 + P-8]** |
| **Topics:**<br>Introduction to Optimization in Data Science - Types of Optimization Problems: Convex vs. Non-convex - Mathematical Foundations: Vectors, Norms, Gradients, Hessians - Linear Algebra essentials for optimization - Convex sets and functions -Optimization Problem Formulation- First-order and Second-order Optimality Conditions. | | | |
| **Module 2** | **Unconstrained Optimization Techniques** | Assignment | **16 Sessions [L-8 + P-8]** |
| **Topics:**<br>Gradient Descent and Variants - Stochastic Gradient Descent (SGD)- Mini-batch Gradient Descent - Momentum, RMSProp, Adam. Newton's Method and Quasi-Newton Methods (BFGS, L-BFGS) - Line Search and Step Size Strategies- Convergence Analysis. | | | |
| **Module 3** | Constrained Optimization and Duality | Quiz | **16 Sessions [L-8 + P-8]** |
| **Topics:**<br>Lagrange Multipliers - Karush-Kuhn-Tucker (KKT) Conditions- Convex Optimization with Constraints- Duality Theory: Lagrangian Dual, Strong/Weak Duality- Quadratic Programming (QP), Linear Programming (LP)- Optimization in Support Vector Machines (SVM). | | | |
| **Module 4** | Advanced Topics and Applications in Data Science | Mini Project | **12 Sessions [L-6 + P-6]** |
| Topics:<br>Non-convex Optimization in Deep Learning -Optimization landscapes of neural networks - Saddle points and local minima -Bayesian Optimization-Hyperparameter Tuning (Grid Search, Random Search, BO)-Optimization in Clustering (e.g., k-means)-Large-scale and Online Optimization-Metaheuristic Methods: Genetic Algorithms, Simulated Annealing. | | | |
| **List of Laboratory Tasks:**<br>**Lab Sheet 1:**<br>Implement objective functions and gradients using NumPy | | | |

Visualization of convex functions and gradient descent paths

**Lab Sheet 2:**

Optimization of logistic regression, linear regression

Comparative study of different optimizers on benchmark datasets

**Lab Sheet 3:**

Use of CVXPY for solving constrained optimization problems

Implementing SVM with quadratic programming

**Lab Sheet 4:**

Hyperparameter optimization for ML models using Optuna

Implement a basic neural network optimizer from scratch

**Targeted Application & Tools that can be used:** Google Colab

**Project work/Assignment: Mention the Type of Project /Assignment proposed for this course**

1] Programming: problem solving and implement it using optimization techniques.
2] Real-world data science problem involving optimization

**Text Book**


1] Stephen Boyd and Lieven Vandenberghe "Convex Optimization" , 1st Edition (2004), Cambridge University Press.
2] Jorge Nocedal and Stephen J. Wright "Numerical Optimization" 2nd Edition (2006), Springer.
3] Sébastien Bubeck "Convex Optimization: Algorithms and Complexity", 1st Edition (2015), Now Publishers.
4] Suvrit Sra, Sebastian Nowozin, and Stephen J. Wright "Optimization for Machine Learning" 1st Edition (2011), MIT Press.


E Book Link

1. https://web.stanford.edu/~boyd/cvxbook/bv_cvxbook.pdf
2. https://www.math.uci.edu/~qnie/Publications/NumericalOptimization.pdf
3. https://sbubeck.com/Bubeck15.pdf
4. https://vim.ustc.edu.cn/_upload/article/files/86/7f/bf0a1fff499994d5fd8d17a7b5d5/c0feccd1-f58a-40ca-8e2e-720d276be00c.pdf

**Web Links:**

1. Technology Enabled Learning - NPTEL offers as Course on "Optimization for Data Science" by Prof. Pravesh Biyani , IIT, Delhi.

**References**


1] R. Fletcher , Practical Methods of Optimization" 2nd Edition (2021)- Wiley-Interscience publishers
2] Amir Beck "First-Order Methods in Optimization" 1st Edition (2017), SIAM-Society for Industrial and Applied Mathematics publishers.


**Topics relevant to development of "Skill Development":**

Formulating optimization problems from real-world scenarios.

<table>
<tr><td>Course Code:<br>CSD3419</td><td colspan="3">Course Title: Edge Computing for Data Science<br>Type of Course:</td><td>L-T-P-C/3-0-0-3</td></tr>
<tr><td>Version No.</td><td colspan="4">1.0</td></tr>
<tr><td>Course Pre Requisite</td><td colspan="4"></td></tr>
<tr><td>Anti-requisites</td><td colspan="4">NIL</td></tr>
<tr><td>Course Description</td><td colspan="4">This course introduces the fundamentals and applications of Edge Computing integrated with Data Science techniques. It explores the architectures, frameworks, and algorithms used to perform intelligent data processing closer to data sources. Emphasis is placed on real-time analytics, machine learning at the edge, and privacy-preserving computation.</td></tr>
<tr><td>Course Outcomes</td><td colspan="4">On successful completion of this course the students shall be able to:<br>1] Explain the principles, architecture, and use cases of edge computing in modern applications.<br>2] Apply data science techniques and machine learning models to analyze data at the edge.<br>3] Design and evaluate edge-enabled intelligent systems with considerations of latency, bandwidth, and privacy.</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Fundamentals of Edge Computing</td><td>Assignment</td><td>Programming activity</td><td>[10 Session]</td></tr>
<tr><td colspan="5">Topics: Introduction to Edge and Fog Computing, Comparison with Cloud Computing, Edge Computing Architecture and Components, Use Cases: Smart Cities, IoT, Autonomous Systems</td></tr>
<tr><td>Module 2</td><td>Data Science Foundations</td><td>Assignment</td><td>Programming activity</td><td>[12 Session]</td></tr>
<tr><td colspan="5">Topics:Data Preprocessing and Feature Engineering, Introduction to Machine Learning Algorithms, Model Evaluation Techniques, Python for Data Analysis and Machine Learning</td></tr>
<tr><td>Module 3</td><td>Intelligent Edge Systems</td><td>Assignment</td><td>Programming activity</td><td>[12 Session]</td></tr>
<tr><td colspan="5">Topics:Edge AI Models and Deployment (TinyML, TensorFlow Lite), Model Compression Techniques: Pruning, Quantization, Case Studies: Real-Time Video Analytics, Predictive Maintenance, Edge Device Platforms: Raspberry Pi, NVIDIA Jetson, Coral</td></tr>
<tr><td>Module 4</td><td>Security, Privacy and Performance</td><td>Assignment</td><td>Programming activity</td><td>[ 11 Session ]</td></tr>
<tr><td colspan="5">Topics: Privacy-Preserving Computation at the Edge, Federated Learning Basics and Implementation, Data Security and Communication Protocols, Performance Metrics: Latency, Throughput, Energy Efficiency</td></tr>
<tr><td colspan="5">Text Books<br>1.Edge Computing: Models, Technologies and Applications, Authors: Amirhossein Farahani, Alberto Leon-Garcia, Publisher: Springer, 2022, ISBN: 978-3030862463</td></tr>
</table>

**References**

**R1.** *Edge Computing: A Prime,* **Author:** Jie Cao, Quan Zhang, Weisong Shi, **Publisher:** Springer, 2020, **ISBN:** 978-3030303706

**R2.** *Data Science from Scratch: First Principles with Python (2nd Edition)*, Joel Grus, O'Reilly Media, 2019, 978-1492041139

Web links:

**W1.** Edge Computing - Course

**W2.** https://www.coursera.org/learn/ai-principles-with-edge-computing

**W3.** https://www.edx.org/learn/edge-computing

**Library Link:**

**L1.** **https://puniversity.informaticsglobal.com/login**

**Topics Relevant to "Skill Development: Exploratory Data Visualization, Interactive Plots, Geospatial Data Visualization and Dashboard Development** for Skill development through Participative Learning Techniques. This is attained through assessment mentioned in the course handout

| Course Code: CSD3421 | CoTitle: mobile application for data science<br>Type of Course: Discipline Elective | L | L-T-P-C/3-0-0-3 |
|---|---|---|---|
| **Version No.** | 1.0 | | |
| **Anti-requisites** | **NIL** | | |
| **Course Description** | This course provides an introduction to building mobile applications with integrated data science capabilities. Students will learn how to collect, analyze, and visualize data using mobile platforms. The focus is on Android development, backend data services, and deploying machine learning models on mobile devices. | | |
| **Course Outcomes** | On successful completion of this course the students shall be able to:<br>1. students will be able to design and develop data-driven mobile application<br>2. Implement machine learning models on mobile platforms<br>3. Evaluate mobile-based data science solutions for real-world applications. | | |
| **Course Content:** | | | |

| | | | | |
|---|---|---|---|---|
| **Module 1** | **Introduction to Mobile Development and Data Science** | Assignment | Programming activity | [10 Session] |
| Topics:<br>Overview of mobile platforms (Android, iOS), Basics of Android Studio and Kotlin, Role of data science in mobile applications | | | | |
| **Module 2** | **Data Handling and Visualization on Mobile** | Assignment | Programming activity | [12 Session] |
| Topics:<br>Mobile data acquisition (sensors, user input, APIs), Local storage and cloud-based storage, Integrating data visualization libraries (MPAndroidChart, D3.js) | | | | |
| **Module 3** | **Machine Learning on Mobile Devices** | Assignment | Programming activity | [12 Session] |
| Topics:<br>Overview of TensorFlow Lite, Core ML, Deploying pre-trained models on Android, Real-time data prediction and analytics | | | | |
| **Module 4** | **End-to-End Mobile Data Science App Development** | Assignment | Programming activity | [ 11 Session] |
| Topics:<br>Case studies: Health tracking, Sentiment analysis, Image classification, Backend services integration (Firebase, AWS), App optimization and performance evaluation | | | | |

**Text Books**

5] *AI and Machine Learning for On-Device Development, Author: Laurence Moroney, Publisher: O'Reilly Media, Edition: 1st Edition, 2021, ISBN: 9781492081847*

**References**

**R1.** *Learning TensorFlow Lite for Mobile and Edge: Deploy Machine Learning Models on Mobile and Edge Devices, Author: Khriishi Narayanan, Publisher: Packt Publishing, Year: 2021, ISBN: 9781800565799*

**R2.** *Kotlin for Android Developers: Learn Kotlin the Easy Way While Developing an Android App,Author: Antonio Leiva, Publisher: Leanpub,Year: 2022 (Updated Edition),ISBN: N/A (Leanpub publication)*

Web links:

**W1.** https://www.oreilly.com/library/view/ai-and-machine/9781492081847/

**W2.** https://www.oreilly.com/library/view/data-science-from/9781492041124/

**Library Link:**

**L1.** **https://puniversity.informaticsglobal.com/login**

**Topics Relevant to "Skill Development: Exploratory Data Visualization, Interactive Plots, Geospatial Data Visualization and Dashboard Development** for Skill development through Participative Learning Techniques. This is attained through assessment mentioned in the course handout

| Course Code: CSD3422 | Title: Intelligent Interfaces and User Experience<br>Type of Course: Discipline Elective | | | L-T-P-C/3-0-0-3 |
|---|---|---|---|---|
| **Version No.** | 1.0 | | | |
| **Course Pre Requisite** | NIL | | | |
| **Anti-requisites** | **NIL** | | | |
| **Course Description** | This course introduces the principles and design techniques for building intelligent user interfaces (IUIs) that enhance user experience (UX) using AI-driven personalization, adaptive systems, and multimodal interaction. It covers usability, interaction design, user modeling, and the integration of machine learning for adaptive behavior. Students will analyze, design, and evaluate intelligent systems that effectively bridge human-computer interaction with artificial intelligence. | | | |
| **Course Objectives** | On successful completion of this course the students shall be able to:<br>4. To provide students with knowledge of user-centered design and intelligent system interfaces.<br>5. To develop skills in creating adaptive, data-driven, and interactive systems that optimize user experience. | | | |
| **Course Outcomes** | CO1:Explain the principles of human-computer interaction and intelligent interface design.<br>CO2: Design adaptive interfaces using user modeling and machine learning techniques.<br>CO3:Evaluate usability and user experience through qualitative and quantitative methods.<br>CO4:Build intelligent systems that respond dynamically to user behavior and context. | | | |
| **Course Content:** | | | | |
| **Module 1** | **Foundations of Intelligent Interfaces** | Assignment | Programming activity | [10 ession] |
| Human-Computer Interaction (HCI) fundamentals; User-centered design; Overview of Intelligent User Interfaces (IUIs); Principles of UX and usability; Case studies of intelligent systems. | | | | |
| **Module 2** | **User Modeling and Personalization** | Assignment | Programming activity | [10 Session] |
| User profiling, behavior tracking, preference learning; Recommender systems; Context-aware interaction; Adaptive content presentation; Ethics in personalization. | | | | |
| **Module 3** | **Interaction Techniques and Modalities** | Assignment | Programming activity | [13 Session] |
| Multimodal interfaces (speech, gesture, eye-tracking); Natural Language Interfaces; Conversational agents and chatbots; Emotion-aware interfaces; Feedback and reinforcement. | | | | |
| **Module 4** | **Design, Prototyping, and Evaluation** | Assignment | Programming activity | [12 session] |
| *UX design tools and wireframing; Prototyping intelligent interfaces; Heuristic evaluation and A/B testing; Metrics for user satisfaction; Usability testing frameworks.* | | | | |

***Textbook:***"Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Guidelines" *by Jeff Johnson, Morgan Kaufmann, 2020.*

*Reference Books:*

1. *"Intelligent User Interfaces: Adaptation and Personalization Systems and Technologies" by Fausto Giunchiglia, Springer, 2022.*
2. *"Human-Computer Interaction" by Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, Pearson, 4th Edition, 2023.*
3. *"UX Design and Usability Metrics: Key Techniques for Optimizing User Interfaces" by Tareq Ahram, CRC Press, 2021.*

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|---|---|---|---|---|---|---|
| **Course Code:CSE 7100** | **Course Title: Mini Project**<br>**Type of Course:** | **L- T-P- C** | 0 | 0 | 0 | 4 |
| **Version No.** | **1.0** | | | | | |
| **Course Pre-requisites** | **Knowledge and Skills related to all the courses studied in previous semesters.** | | | | | |
| **Anti-requisites** | **NIL** | | | | | |
| **Course Description** | Students observe science and technology in action, develop an awareness of the method of scientific experimentation, and often get an opportunity to see, study and operate sophisticated and costly equipment. They also learn about the implementation of the principles of management they have learnt in class, when they observe multidisciplinary teams of experts from engineering, science, economics, operations research, and management deal with techno-economic problems at the micro and macro levels. Finally, it enables them to develop and refine their language, communication and inter-personal skills, both by its very nature, and by the various evaluation components, such as seminar, group discussion, project report preparation, etc. The broad-based core education, strong in mathematics and science and rich in analytical tools, provides the foundation necessary for the student to understand properly the nature of real-life problems. The students have options to pursue this course as either Project Work and Dissertation at the university, or Project Work in an Industry/ Company/ Research Laboratory, or Internship Program in an Industry/Company. | | | | | |
| **Course Objectives** | The objective of the course is to familiarize the learners with the concepts of Professional Practice and attain Employability Skills through Experiential Learning techniques. | | | | | |
| **Course Outcomes** | On successful completion of this course the students shall be able to:<br>1. Identify the engineering problems related to local, regional, national or global needs. (Understand)<br>2. Apply appropriate techniques or modern tools for solving the intended problem. (Apply)<br>3. Design the experiments as per the standards and specifications. (Analyze)<br>4. Interpret the events and results for meaningful conclusions. (Evaluate)<br>5. Appraise project findings and communicate effectively through scholarly publications. (Create) | | | | | |

| Course Code: UG COURSE: **CSD 1706** | Course Title Cloud Computing for the Data Science lab<br>Type of Course: LAB | L-T-P-C | 0 | 0 | 2 | 1 |
|---|---|---|---|---|---|---|
| Version No. | 1.0 | | | | | |
| Course Pre-requisites | NIL | | | | | |
| Anti-requisites | NIL | | | | | |
| Course Description | This lab enables students to practically apply cloud computing techniques in data science, using platforms like AWS, Azure, and GCP. Students will gain hands-on experience in cloud storage, data pipelines, model deployment, and real-time analytics with simplified, guided experiments. | | | | | |
| Course Objective | To equip students with hands-on skills in applying cloud computing tools for data storage, processing, and machine learning in data science. The lab emphasizes practical exposure to cloud platforms such as AWS, Azure, and GCP for end-to-end data workflows. | | | | | |
| Course Out Comes | On successful completion of the Social Media Analytics course, students can expect to achieve the following outcomes:<br>CO1: Set up cloud accounts and environments for data science tasks.<br>CO2: Store and access datasets using cloud storage tools.<br>CO3: Build basic data pipelines and perform ETL tasks on cloud platforms.<br>CO4: Train and deploy machine learning models using cloud-based services | | | | | |

Content

| Exp. No. | Experiment Title | Hours |
|---|---|---|
| 1 | Introduction to Cloud Platforms: Setting up AWS, Azure, and GCP accounts | 2 |
| 2 | Creating Virtual Machines and Jupyter Notebooks on the Cloud | 2 |
| 3 | Cloud Storage Services: Uploading, managing, and sharing datasets (S3, Azure Blob, GCS) | 2 |
| 4 | Building a Data Lake vs Data Warehouse in the Cloud | 2 |
| 5 | Implementing ETL Pipeline using AWS Glue / Google Dataflow | 2 |
| 6 | Data Ingestion from External Sources (APIs, CSV, SQL) to Cloud Storage | 2 |
| 7 | Introduction to Hadoop/Spark on Cloud for Large-Scale Data Processing | 2 |
| 8 | Creating ML Models using AWS SageMaker / Azure ML Studio | 2 |
| 9 | Model Deployment and Monitoring on Cloud Platforms | 2 |
| 10 | Real-Time Data Analysis using BigQuery / Redshift | 2 |

| | | |
|---|---|---|
| 11 | AutoML Tools: Using Google AutoML or Azure AutoML for Model Training | 2 |
| 12 | Integrating Jupyter / Colab Notebooks with Cloud Storage and ML APIs | 2 |
| 13 | Introduction to Serverless Computing using AWS Lambda / Azure Functions | 2 |
| 14 | Generative AI and LLM APIs Integration (e.g., OpenAI with AWS Lambda) | 2 |
| 15 | Mini Project: Design and implement an end-to-end data science workflow on the cloud | 4 |

| | |
|---|---|
| Reference Book : | 3. "Data Science on the Google Cloud Platform: Implementing End-to-End Real-Time Data Pipelines" by Valliappa Lakshmanan (2023)<br>Hands-on guide to building scalable data science projects on Google Cloud.<br>4. "Machine Learning Engineering with Python: Deploy and Scale ML Models on AWS, Azure, and GCP" by Andrew P. McMahon (2024)<br>Recent guide on using cloud platforms for production-level ML systems. |

| | | | | | |
|---|---|---|---|---|---|
| **Course Code:** **CSD3426** | **Course Title:** Cloud Services for Big Data and Analytics<br>**Type of Course: Theory Only** | **L-P-C** | 3 | 0 | 3 |
| **Version No.** | 1.0 | | | | |
| **Course Pre-requisites** | NIL | | | | |
| **Anti-requisites** | NIL | | | | |
| **Course Description** | The Cloud Application Development Foundations Specialization program will teach students the tools and technologies that successful software developers use to build, deploy, test, run, and manage Cloud Native applications – putting them in an advantageous position to begin a new career in a highly in-demand area. The course will provide the students' knowledge on cloud computing and related concepts, cloud services, applications developments of Amazon web services, Cloud architecture and programming model, map reducing in cloud, virtualization, applying virtualization, Cloud Resource Management and Scheduling, Cloud Security issues. | | | | |

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| **Course Objective** | The objective of the course is to familiarize the learners with the concepts of **Cloud Application Development** and attain **Employability** through **Participative Learning** techniques. |
| **Course Out Comes** | On successful completion of this course the students shall be able to:<br>1. Understand the Define cloud computing and related concepts and Memorize the Cloud architecture and programming model. [Comprehension]<br>2. Identify compute intensive model and date intensive model and Understand the Cloud Resource Management and Scheduling. [Comprehension]<br>3. Understand the Cloud Security issues and Identify the how standards deal with cloud services and virtualization. [Application]<br>4. Understand the cloud resource virtualization and Identify the application virtualization, applying virtualization. [Application]<br>5. Understand compliance for the cloud provider vs compliance for the customer. [Comprehension] |
| **Course Content:** | |

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| **Module 1** | **INTRODUCTION AND CLOUD APPLICATION DEVELOPMENT** | **Assignment** | **Knowledge, Quizzes** | **No. of Classes:8** |

Topics:

Introduction: Definition, Characteristics, Benefits, challenges of cloud computing, cloud models: service IaaS(infrastructure as service),PaaS(platform as a service),SaaS(software as a service), deployment models-public, private, hybrid, community; Types of cloud computing: Grid computing utility computing, cluster; computing Cloud services: Amazon, Google, Azure, online services, open source private clouds, SLA; Applications of cloud computing: Healthcare, energy systems, transportation, manufacturing, education, government, mobile communication, application development.

**Assignment:** Types of cloud and their comparisons.

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| **Module 2** | **CLOUD ARCHITECTURE, PROGRAMMING MODEL** | **Assignment** | **Knowledge, Quizzes** | **No. of Classes:7** |

Topics:

Cloud Architecture, programming model: NIST reference architecture, architectural styles of cloud applications, single, multi, hybrid cloud site, redundant, non-redundant, 3 tier, multi-tier architectures; Programming model: Compute and data intensive.

**Assignment:** Cloud Architecture, architectural styles of cloud applications.

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| **Module 3** | **CLOUD RESOURCE VIRTUALIZATION** | **Case Study** | **Application, Quizzes** | **No. of Classes:8** |

Topics:

Cloud resource virtualization: Basics of virtualization, types of virtualization techniques, merits and demerits of virtualization, Full vs Para - virtualization, virtual machine monitor/hypervisor.

Virtual machine basics, taxonomy of virtual machines, process vs system virtual machines.

**Case Study:** Cloud resource virtualization: Basics of virtualization, types of virtualization techniques.

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| **Module 4** | **CLOUD RESOURCE MANAGEMENT AND SCHEDULING** | **Case study** | **Application, Quizzes** | **No. of Classes:9** |

Topics:

Cloud Resource Management and Scheduling: Policies and mechanisms for resource

management, resource bundling, combinatorial, fair queuing, start time fair queuing, borrowed virtual time, cloud scheduling subject to deadlines, scheduling map reduce applications subject to deadlines, resource management and application scaling.

**Case Study:** Cloud Resource Management and Scheduling.

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| **Module 5** | **CLOUD RESOURCE MANAGEMENT AND SCHEDULING** | **Case study** | **Application, Quizzes** | **No. of Classes:8** |

Topics:

Cloud Security: Risks, privacy and privacy impacts assessments; Multi-tenancy issues, security in VM, OS, virtualization system security issues and vulnerabilities; Virtualization system-specific attacks: Technologies for virtualization-based security enhancement, legal.

**Case Study:** Cloud Security: Risks, privacy and privacy impacts assessments.

**Targeted Application & Tools that can be used:**

Public cloud platforms like AWS, GCP and Azure.

**Project work/Assignment:**

1. **Create an Amazon EC2 Instance (Linux) or use equivalent other cloud platform such as Google Cloud or Azure to create a virtual machine service.**
2. **Create an Amazon S3 Bucket or use equivalent other cloud platform such as Google Cloud or Azure to create a storage service.**
3. **Create a static website in AWS using S3 and cloud front.**

**Textbook(s):**

1. **Dan Marinescu, "Cloud Computing: Theory and Practice||", M K Publishers, 1st Edition, 2013,**
2. **Kai Hwang, Jack Dongarra, Geoffrey Fox," Distributed and Cloud Computing, From Parallel Processing to the Internet of Things||", M K Publishers, 1st Edition, 2011.**

**References**

1. **Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", McGraw Hill, 1st Edition, 2009.**
2. **Arshdeep Bahga, "Cloud Computing: A Hands on Approach", Vijay Madisetti Universities Publications, 1 st Edition, 2013.**

**Web Resources and Research Articles:**

1. **https://www.oracle.com/in/cloud/application-development**
2. **http://computingcareers.acm.org/?page_id=12**
3. **http://en.wikibooks.org/wiki/cloud application**
4. **http://www.acadmix.com/eBooks_Download**
5. **http://www.ibm.com**
6. pu.informatics.global, **https://sm-nitk.vlabs.ac.in/**

**Topics relevant to "EMPLOYABILITY SKILLS":** EC2 **for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.**

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| **Catalogue prepared by** | **Dr. Madhura K** |
| **Recommended by the Board of Studies on** | BOS NO: SoCSE01, BOS held on 22/12/22<br>PU/SOCSE/BoS-01/2022-2023/NOTICE-01 |
| **Date of Approval by the Academic Council** | Academic Council Meeting No.20, Dated 15/02/23 |

| Course Code: CSD3413 | Course Title: Data Visualization and Dashboards<br>Type of Course: 1] Program core<br>2] Lab Integrated Course | L- T- P- C | 2 | 0 | 2 | 3 |
|---|---|---|---|---|---|---|
| **Version No.** | 1.0 | | | | | |
| **Anti-requisites** | **NIL** | | | | | |
| **Course Description** | This course introduces the fundamentals of data visualization and dashboard design. Students will learn visual perception principles and best practices for effective data communication. It covers data wrangling, statistical plots, geospatial visualization, and interactive graphics. Tools used include Matplotlib, Seaborn, Plotly, Bokeh, Folium, and Streamlit. Students will build dashboards using real-time and historical datasets. The course emphasizes hands-on learning through mini-projects. | | | | | |
| **Course Outcomes** | On successful completion of this course the students shall be able to:<br>4] Understand the design principles to visualize and explore data effectively. **[Understand]**<br>5] Use Python libraries to create interactive and meaningful visuals. **[Application]**<br>6] Analyze geospatial datasets visually. **[Application]**<br>7] Build and deploy interactive dashboards for decision-making. **[Application]** | | | | | |
| **Course Content:** | | | | | | |
| **Module 1** | **Introduction to Data Visualization (Comprehension)** | Assignment | Programming activity | [16 Session (L-8 +P-8)] | | |
| Topics:<br>Data collection, Data Preparation Basic Models- Overview of data visualization - Data Abstraction - Task Abstraction - Analysis: Four Levels for Validation, Interacting with Databases, Data Cleaning and Preparation, Handling Missing Data, Data Transformation.<br>Python Libraries: Matplotlib, Seaborn, GGplot, etc. | | | | | | |
| **Module 2** | **Data Visualization Techniques (Application)** | Assignment | Programming activity | [16 Session (L-8 +P-8)] | | |
| Topics:<br>Creating Static Plots: Histograms, Boxplots, Pairplots, Statistical Visualization: Correlation Matrix, Regression Plots. Scalar Visualization techniques – Vector visualization techniques. Matrix visualization-Heat Map. Visualization Techniques for Trees, Graphs, and Networks, Multidimensional data, Visual Variables, Map Color and Other Channels. | | | | | | |

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| **Module 3** | **Interactive Visualization a Geospatial Analysis** (Application) | Assignment | Programming activity | [16 Session (L-8 +P-8)] |

Topics:

Concepts of Interactivity: Filters, Hover, Zoom, Linking. Tools for Interactive Visualizations: Plotly, Bokeh. Real-time Visualization Basics- Introduction to Geospatial Visualization: Maps, Layers, Tiles

,Folium and GeoPandas for Geo Data- Multivariate data visualization- Spatial data visualization.

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| **Module 4** | **Dashboard Design and Deployment** (Application) | Assignment | Programming activity | [ 12 Session (L-6 +P-6)] |

Topics:

Fundamentals of Dashboard Design and Layout, Data Storytelling and Insight Communication

Dashboard Tools: Dash, Streamlit, Tableau (overview),Connecting to Live Data (APIs, Databases)

Deployment: Hosting Dashboards (Streamlit Cloud, GitHub Pages), Introduction to Power Bi.

List of Laboratory Tasks: (Perform 2 experiment based on Each sheet)

Lab Sheet 1: Exploratory Data Visualization using Matplotlib & Seaborn
Objective: Learn to create basic plots for EDA
Tools: Python, Matplotlib, Seaborn, Pandas
Tasks:

- Load a dataset (e.g., Titanic or Iris)
- Plot histograms, bar plots, and box plots

Lab Sheet 2: Exploratory Data Visualization using Matplotlib & Seaborn
Objective: Learn to create plots for EDA
Tools: Python, Matplotlib, Seaborn, Pandas
Tasks:

- Create correlation heatmaps and pair plots
- Identify outliers and trends visually

Lab Sheet 3: Data Wrangling and Visual Storytelling
Objective: Clean and transform raw data for visualization
Tools: Python, Pandas, Seaborn
Tasks:

- Clean null values, remove duplicates, fix datatypes
- Create pivot tables and melt data for plotting

Lab Sheet 4: Data Wrangling and Visual Storytelling
Objective: Clean and transform raw data for visualization
Tools: Python, Pandas, Seaborn
Tasks:

- Visualize time series data using line plots
- Create plots to compare categories (e.g., sales by region)

Lab Sheet 5: Interactive Plots with Plotly and Bokeh
Objective: Build responsive plots with interactivity
Tools: Plotly, Bokeh
Tasks:

- Create interactive scatter plots and line charts
- Add hover tools, sliders, and dropdowns

Lab Sheet 6: Interactive Plots with Plotly and Bokeh
Objective: Build responsive plots with interactivity
Tools: Plotly, Bokeh
Tasks:

- Use Bokeh layouts to arrange multiple linked plots

Lab Sheet 7: Interactive Plots with Plotly and Bokeh
Objective: Build responsive plots with interactivity
Tools: Plotly, Bokeh
Tasks:

- Create dashboards with widgets (basic version)

Lab Sheet 8: Geospatial Data Visualization with Folium & GeoPandas
Objective: Plot and analyze location-based data
Tools: Folium, GeoPandas
Tasks:

- Load shapefiles or GeoJSON data
- Create choropleth maps (e.g., population, COVID stats)

Lab Sheet 9: Geospatial Data Visualization with Folium & GeoPandas
Objective: Plot and analyze location-based data
Tools: Folium, GeoPandas
Tasks:

- Add markers, heatmaps, and custom layers
- Overlay data like schools, hospitals on city maps

Lab Sheet 10: Dashboard Development using Streamlit or Dash
Objective: Build and deploy a basic dashboard
Tools: Streamlit or Dash
Tasks:

- Build a multi-section dashboard (filters, charts, KPIs)
- Load data dynamically (CSV/API)

Lab Sheet 11: Dashboard Development using Streamlit or Dash
Objective: Build and deploy a basic dashboard
Tools: Streamlit or Dash
Tasks:

- Display tables, charts, and maps

Lab Sheet 12: Dashboard Development using Streamlit or Dash
Objective: Build and deploy a basic dashboard
Tools: Streamlit or Dash

Tasks:

- Add sidebar filters and text boxes for interactivity

Lab Sheet 13: Final Mini Project – End-to-End Dashboard
Objective: Apply all concepts in a real-world dataset
Tools: Any combination of Seaborn, Plotly, Folium, Streamlit/Dash
Tasks:

- Choose a dataset (e.g., Air Quality, IPL Stats, Sales Data)
- Clean and explore the data

Lab Sheet 14: Final Mini Project – End-to-End Dashboard
Objective: Apply all concepts in a real-world dataset
Tools: Any combination of Seaborn, Plotly, Folium, Streamlit/Dash
Tasks:

- Choose a dataset (e.g., Air Quality, IPL Stats, Sales Data)
- Clean and explore the data
- Create multiple visualizations

Lab Sheet 15: Final Mini Project – End-to-End Dashboard
Objective: Apply all concepts in a real-world dataset
Tools: Any combination of Seaborn, Plotly, Folium, Streamlit/Dash
Tasks:

- Choose a dataset (e.g., Air Quality, IPL Stats, Sales Data)
- Clean and explore the data
- Build an interactive dashboard and present insights

**Targeted Application & Tools that can be used:** Anaconda/Google Colab, Google Data Studio,T

**Project work/Assignment: Mention the Type of Project /Assignment proposed for this course**

3] Problem Solving: Choose an appropriate set of visualization elements and design for a dashboard.
4] Programming: Implementation of the chosen dashboard

**Text Books**


6] **Visualize This: The FlowingData Guide to Design, Visualization, and Statistics,** *Author:* Nathan Yau ,*Publisher:* Wiley,*Edition:* 2nd Edition (2023),*ISBN:* 978-1119694380
7] **Python Data Science Handbook: Essential Tools for Working with Data,***Author:* Jake VanderPlas,*Publisher:* O'Reilly Media,*Edition:* 2nd Edition (2022),*ISBN:* 978-1098121228
8] Dr. Ossama Embarak, "Data Analysis and Visualization Using Python", Apress,(2018)

| Course Code: CSD3421 | Title: mobile application for data science<br>Type of Course: Discipline Elective | L | L-T-P-C/3-0-0-3 |
|---|---|---|---|
| **Version No.** | 1.0 | | |
| **Anti-requisites** | **NIL** | | |
| **Course Description** | This course provides an introduction to building mobile applications with integrated data science capabilities. Students will learn how to collect, analyze, and visualize data using mobile platforms. The focus is on Android development, backend data services, and deploying machine learning models on mobile devices. | | |
| **Course Outcomes** | On successful completion of this course the students shall be able to:<br>6. students will be able to design and develop data-driven mobile application<br>7. Implement machine learning models on mobile platforms<br>8. Evaluate mobile-based data science solutions for real-world applications. | | |
| **Course Content:** | | | |

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| **Module 1** | **Introduction to Mobile Development and Data Science** | Assignment | Programming activity | [10 Session] |

Topics:

Overview of mobile platforms (Android, iOS), Basics of Android Studio and Kotlin, Role of data science in mobile applications

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| **Module 2** | **Data Handling and Visualization on Mobile** | Assignment | Programming activity | [12 Session] |

Topics:

Mobile data acquisition (sensors, user input, APIs), Local storage and cloud-based storage, Integrating data visualization libraries (MPAndroidChart, D3.js)

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| **Module 3** | **Machine Learning on Mobile Devices** | Assignment | Programming activity | [12 Session] |

Topics:

Overview of TensorFlow Lite, Core ML, Deploying pre-trained models on Android, Real-time data prediction and analytics

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| **Module 4** | **End-to-End Mobile Data Science App Development** | Assignment | Programming activity | [ 11 Session] |

Topics:

Case studies: Health tracking, Sentiment analysis, Image classification, Backend services integration (Firebase, AWS), App optimization and performance evaluation

**Text Books**

9] *AI and Machine Learning for On-Device Development, Author: Laurence Moroney, Publisher: O'Reilly Media, Edition: 1st Edition, 2021, ISBN: 9781492081847*

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|---|---|---|---|---|---|
| Course Code:<br>CSD3424 | Course Title: Data Warehousing and its Applications<br>Type of Course:<br>Theory | L- P- C | 3 | 0 | 3 |
| Version No. | 1.0 | | | | |
| Course Pre-requisites | NIL | | | | |
| Anti-requisites | NIL | | | | |
| Course Description | The Objective of this course is to create a trove of historical data that can be retrieved and analyzed to provide useful insight into the organization's operations. A data warehouse is a vital component of business intelligence. This course will introduce basic concepts of data warehousing, architecture, design principles, building data warehouse, data mining techniques and major application areas of data warehouse. | | | | |
| Course Objective | The objective of the course is to familiarize the learners with the concepts of Data Warehousing and its Applications and attain Employability through Participative Learning techniques. | | | | |
| Course Outcomes | On completion of this course, the students will be able to<br>Describe data warehousing architecture and considerations to build data warehouse. [Knowledge]<br>Discuss different multidimensional data models for data warehouse. [Comprehension]<br>Apply various techniques to build data warehouse [Application]<br>Apply different data mining techniques to mine insights [Application] | | | | |
| Course Content: | | | | | |
| Module 1 | Introduction To Data Warehousing | Assignment/Quiz | Benefits of data warehousing | 8 Session | |

Topics:

The need for data warehousing, paradigm shift, data warehouse definition and characteristics, Data warehouse architecture, sourcing, acquisition, cleanup and transformation, metadata, access tools, data marts, data warehouse administration and management, building a data warehouse: business consideration, technical consideration, design consideration, implementation consideration, integrated solutions, benefits of data warehousing. Data Warehouse Architecture: Two and Three tier Data Warehouse architecture.

Assignment: Benefits of data warehousing

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| Module 2 | Data Warehouse modelling | Assignment/Quiz | Data cube | 12 Session |
| Topics:<br><br>Data cube: A multidimensional data model, stars, snowflakes, and fact constellations: schemas for multidimensional data models, dimensions: the role of concept hierarchies, measures: their categorization and computation, typical OLAP operations, efficient data cube computation, the compute cube operator and the curse of dimensionality, partial materialization: selected computation of cuboids, indexing olap data: bitmap index and join index.<br><br>Assignment: Data cube | | | | |
| Module 3 | 8 | Case Study | Data Warehouse design principles | 12 Session |
| Topics:<br><br>Building a data warehouse: Introduction, Critical Success Factors, Requirement Analysis, Planning for the data Warehouse-The data Warehouse design stage, Building and implementing data marts. Building data warehouses, Backup and Recovery, Establish the data quality framework, Operating the Warehouse, Recipe for a successful warehouse, Data warehouse pitfalls.<br><br>Assignment: Data Warehouse design principles | | | | |
| Module 4 | Introduction to Data Mining | Case Study | Data Mining Techniques | 8 Session |
| Topics:<br><br>Introduction to Data mining, KDD versus data mining, data mining techniques, tools and applications. Mining complex data objects, Spatial databases, Multimedia databases, Time series and Sequence data; mining Text Databases and mining Word Wide Web. Applications of data warehousing across different industries- Retail industry, Manufacturing and distribution, Bank, insurance company, Government agencies etc<br><br>Assignment: Data Mining Techniques | | | | |
| Targeted Application & Tools that can be used:<br><br>Application Area includes Ecommerce, retail, manufacturing industry, government agencies, Finance, banking etc<br><br>Professionally Used Software: Microsoft Azure Synapse SQL, IBM DB2 warehouse, Terradata vantage, SAP data warehouse cloud, Google Bigtable, google sheets, BigQuery, MongoDB, MarkLogic, Talend, Informatica, Arm Treasure data, Micro focus vertica, Cloudera Enterprise data platform. | | | | |
| Assignment: | | | | |
| 1. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. Presidency University Library Link . | | | | |

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| 2. Presentation: Group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same. |
| Text Book(s):<br>T1. Alex Berson, Stephen J. Smith, "Data Warehousing, Data Mining & OLAP", McGraw Hill, 2016<br>T2. Jiawei Han, Micheline Kamber, Jian Pei, "Data-Mining.-Concepts-and-Techniques ", The-Morgan-Kaufmann, 3rd-Edition-Morgan-Kaufmann, 2015 |
| Reference(s):<br>R1. Sam Anahory, Dennis Murray, "Data Warehousing in the Real World", Pearson, 2016<br>R2. Tan P. N, Steinbach M and Kumar V, "Introduction to Data Mining", Pearson Education, 2016<br>Web Based Resources and E-books:<br>W1. NPTEL Course on "Business Analytics & Data Mining Modeling Using R", Prof. Gaurav Dixit.<br>https://onlinecourses.nptel.ac.in/noc22_mg67/preview<br>W2. NPTEL Course on "Data Mining", Mr. L. Abraham David<br>https://onlinecourses.swayam2.ac.in/cec22_cs06/preview<br>W3. Coursera course on "Data Warehousing for Business Intelligence Specialization", Michael Mannino, Jahangir Karimi<br>https://www.coursera.org/specializations/data-warehousing<br>W4. Journal on "Data Mining and Knowledge Discovery"<br>https://www.springer.com/journal/10618/<br>https://presiuniv.knimbus.com/user#/home |
| Topics relevant to "EMPLOYABILITY SKILLS": Building a data warehouse, data mining tools, for developing Employability Skills through Participative Learning Techniques. This is attained through assessment components mentioned in course handout. |

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|---|---|---|---|---|---|---|
| Course Code:<br>CSD3418 | Course Title: Business Oriented Data Analytics<br>Type of Course: Discipline Elective/ Theory Only Course | L- T-P- C | 3 | 0 | 0 | 3 |
| Version No. | | | | | | |
| Course Pre-requisites | | | | | | |
| Anti-requisites | | NIL | | | | |
| Course Description | This course introduces the core concepts of business data analytics, emphasizing the practical application of analytics techniques in business environments. Students will learn to harness data to solve business problems, improve decision-making, and support organizational objectives. The course covers all four stages of analytics – descriptive, | | | | | |

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| | diagnostic, predictive, and prescriptive – along with tools and techniques widely used in the industry. Case studies, real datasets, and project-based learning are integrated to develop industry-ready analytical thinking. | | | |
| Course Objective | To enable students to apply data analytics techniques in business scenarios, with an emphasis on deriving insights that support strategic and operational decision-making. This course bridges the gap between data science and business understanding, empowering students to translate data into actionable business strategies. | | | |
| Course Out Comes | Upon successful completion of this course, students will be able to:<br><br>At the end of the course, students will be able to:<br>CO1: Understand the foundations of data analytics in the context of business processes and decision-making.<br>CO2: Apply descriptive, diagnostic, predictive, and prescriptive analytics techniques to real-world business problems.<br>CO3: Develop interactive data visualizations and dashboards using contemporary tools.<br>CO4: Analyze business case studies to identify suitable data analytics methods and tools.<br>CO5: Interpret analytical results to provide data-driven business insights and recommendations. | | | |
| Course Content: | | | | |
| Module 1 | **Introduction to Business Analytics** | Assignment | Data Collection | 06 Sessions |
| Introduction to Business Analytics, Types of analytics: Descriptive, Diagnostic, Predictive, Prescriptive, Role of data analytics in business strategy, Analytics process and life cycle, Case examples from marketing, finance, HR, and operations | | | | |
| Module 2 | Data Preparation and Exploration | Quiz | Problem Solving | 08 Sessions |
| Data collection methods and business data sources, Data cleaning, transformation, and feature engineering, Exploratory Data Analysis (EDA), Outlier detection and handling missing values , Introduction to data visualization using tools like Excel, Power BI, Tableau, or Python libraries | | | | |
| Module 3 | Descriptive and Diagnostic Analytics | Assignment | Problem Solving | 07Sessions |
| Summary statistics and business KPIs, Trend, pattern, and anomaly detection, Hypothesis testing and correlation analysis, Cross-tabulation and drill-down analysis, Business dashboard design and reporting | | | | |
| Module 4 | Predictive Analytics for Business | Assignment | Problem Solving | 10 Sessions |
| Introduction to predictive modelling, Regression models, decision trees, and classification techniques, Model evaluation metrics (accuracy, precision, recall, F1-score, AUC), Forecasting techniques for | | | | |

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| business data (time series models), Case studies: Customer churn, sales forecasting, credit scoring<br>Module 5: 09 session |
| Introduction to optimization techniques,Linear programming and goal seeking,Simulation and scenario analysis<br>,Decision analysis under uncertainty,Applications in supply chain, logistics, and resource planning |
| **References:**<br><br>**R1: Evans, J. R. (2016). *Business Analytics*, 2nd Edition, Pearson.**<br>**R2: Sharda, R., Delen, D., & Turban, E. (2020). *Analytics, Data Science, and Artificial Intelligence: Systems for Decision Support*, 11th Edition, Pearson.**<br>**R3:Provost, F., & Fawcett, T. (2013). *Data Science for Business*, O'Reilly.** |

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|---|---|---|---|
| **Course Code:**<br>**CSE 3002** | **Course Title:**<br>Big Data Technologies<br>**Type of Course: Program Core**<br>**Theory and Lab Integrated Course** | **L-T- P- C** | 2 -0-2-3 |
| **Version No.** | 1.0 | | |
| **Course Pre-requisites** | CSE3156 | | |
| **Anti-requisites** | **NIL** | | |
| **Course Description** | The purpose of the course is to provide the fundamentals of Big data technology, to emphasize the importance of choosing suitable tools for processing and analyzing big data to gain insights.<br>The student should have knowledge and skill to select and use most appropriate big data tools to solve business problems.<br>The associated laboratory provides an opportunity to implement the concepts and enhance critical thinking and analytical skills.<br>With a good knowledge in the fundamentals of Big data technology, the student can gain practical experience in implementing them, enabling the student to be an effective solution provider for applications that involve huge volume of data. | | |
| **Course Objectives** | The objective of the course is to familiarize the learners with the concepts of Big Data Technologies and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques. | | |
| **Course Outcomes** | On successful completion of the course the students shall be able to:<br>• Apply Map-Reduce programming on the given datasets to extract required insights. (Application).<br>• Employ appropriate Hadoop Ecosystem tools such as scoop, Hbase, Hive, to perform data analytics for a given problem. (Application).<br>• Use Spark tool to analyze the given dataset for a given problem. (Application). | | |
| **Course Content:** | | | |
| **Module 1** | Introduction to Hadoop | Programming Assignment | Data Collection and Analysis | **10 Classes** |
| **Introduction to Big Data and its importance:** Basics of Distributed File System, Four Vs, Drivers for Big data, Big data applications, Structured, unstructured, semi-structured and quasi structured data. Big data Challenges-Traditional versus big data approach, The Big Data Technology Landscape: No-SQL. | | | |

**The Hadoop**: History of Hadoop-Hadoop use cases, The Design of HDFS, Blocks and replication management, Rack awareness, HDFS architecture, HDFS Federation, Name node and data node, Anatomy of File write. Anatomy of File read, Hadoop Map Reduce paradigm, Map and reduce tasks, Job Tracker and task tracker, Map reduce execution pipeline, Key value pair, Shuffle and sort, Combiner and Partitioner, APIs used to Write/Read files into/from Hadoop, Need for Flume and Sqoop.
**Anatomy of a YARN:** Hadoop 2.0 Features, Name Node High Availability, YARN Architecture, Introduction to Schedulers, YARN scheduler policies, FIFO, Fair And Capacity scheduler.

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| **Module 2** | Hadoop Ecosystem Tools | Programming Assignment | Data Collection and Analysis | **8 Classes** |

**Introduction to SQOOP**: SQOOP features, Sqoop Architecture, Sqoop Import All Tables, Sqoop Export All Tables, Sqoop Connectors, Sqoop Import from MySQL to HDFS, Sqoop vs flume.
**Hive:** Apache Hive with Hive Installation, Hive Data Types, Hive Table partitioning, Hive DDL commands, Hive DML commands, and Hive sort by vs. order by, Hive Joining tables, Hive bucketing.
**Hbase:** Introduction to HBase and its working architecture- Commands for creation and listing of tables-disabled and is disabled of table - enable and is enabled of table- describing and dropping of table-Put and Get command - delete and delete all command-commands for scan, count, truncate of tables.

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|---|---|---|---|---|
| **Module 3** | Spark | Programming Assignment | Data analysis | **8 Classes** |

Introduction to Apache Spark A unified Spark, Who uses Spark and for what?, A Brief History of Spark, Spark version and releases, Storage layers for Spark. Programming with RDDs: RDD Basics, Creating RDDs, RDD Operations, Passing functions to Spark, Common Transformations and Actions, Persistence. Spark SQL: Linking with Spark SQL, Using Spark SQL in Applications, Loading and Saving Data, JDBC/ODBC Server, User-defined functions, Spark SQL Performance.
Scala: The Basics, Control Structures and functions, Working with arrays, Maps and Tuples.

**List of Laboratory Tasks:**

1. **Level 1:** To install the Hadoop in pseudo cluster mode.
   **Level 1:** HDFS Shell Commands – Files and Folders.
   **Level 2:** HDFS Shell Commands – Management.

2. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
   **Level 1:** Find the number of occurrence of each word appearing in the input file(s)
   **Level 2:** Performing a Map Reduce Job for word search count (look for specific keywords in a file).

3. Write a Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather large volume of log data, which is a good candidate for analysis with Map Reduce, since it is record-oriented. Data available at: https://github.com/tomwhite/hadoopbook/tree/master/input/ncdc/all.
   **Level 1:** Find average, max and min temperature for each year in NCDC data set?
   **Level 2:** Programming assignment to analyze the social media data for business analytics.

4. **Level 1:** Finding out Number of Products Sold in Each Country using map reduce with sample dataset
   **Level 2:** Find matrix multiplication using map reduce

5. **Level 1:** Installation of Hive, working on basic hive commands. (Create, Alter and Drop tables)
   **Level 2:** Apply Hive commands to student database/employee database.

6. **Level 1:** Working on advance hive commands. (Static Partitioning & Dynamic partitioning)
   **Level 2:** Continue the previous experiment, select and apply suitable partitioning technique.

7. **Level 1:** Working on advance hive commands-2. (Bucketing)
   **Level 2:** Continue the previous experiment, apply bucketing technique to bring out the difference between partitioning and bucketing.

8. **Level 1:** Installing Ecosystem tools such as Scoop, Hbase.
**Level 2:** Scoop – Move Data into Hadoop.

9. **Level 1:** Working on basic Hbase commands (General commands, DDL Commands)
**Level 2:** Apply Hbase commands on Insurance database/employee dataset.

10. **Level 1:** Working on advanced Hbase commands. (DML).
**Level 2:** Continue the previous experiment to demonstrate CRUD operations.

11. **Level 1:** Install, Deploy & configure Apache Spark.
**Level 2:** Using RDD and FlatMap count how many times each word appears in a file and write out a list of words whose count is strictly greater than 4 using Spark

12. **Level 1:** Write a program in Apache spark to count the occurrences words in a given text file and display only those words starting with 'a' in ascending order of count.
**Level 2:** Apache access logs are responsible for recording data for all web page requests processed by the Apache server. An access log record written in the Common Log Format will look something like this: 127.0.0.1 - Scott [10/Dec/2019:13:55:36 – 0700] "GET /server-status HTTP/1.1" 200 2326 Where, HTTP 200 status response code indicates that the request has succeeded. Write a program to read the records of access log file log.txt and display the number of successful requests using Spark.

13. **Level 1:** Chess king moves horizontally, vertically or diagonally to any adjacent cell. Given two different cells of the chessboard, determine whether a king can go from the first cell to the second in one move.
Write a scala program that receives input of four numbers from 1 to 8, each specifying the column and row number, first two - for the first cell, and then the last two - for the second cell. The program should output YES if a king can go from the first cell to the second in one move, or NO otherwise.
**Level 2:** Data analytics using Apache Spark on Amazon food dataset, find all the pairs of items frequently reviewed together.
Write a single Spark application that:
- Transposes the original Amazon food dataset, obtaining a Pair RDD of the type:
- Counts the frequencies of all the pairs of products reviewed together;
- Writes on the output folder all the pairs of products that appear more than once and their frequencies. The pairs of products must be sorted by frequency.

**Targeted Application & Tools that can be used:**
- **Business Analytical Applications**
- **Social media Data Analysis**
- **Predictive Analytics**

**Tools: Hadoop Framework tools like map reduce, Hive, Hbase, Scoop, Spark.**

**Text Book**

Seema Acharya, Subhashini Chellappan. 2015. *Big Data and Analytics*. Wiley Publication.
Matei Zaharia, Bill Chambers. 2018. *SPARK: The Definitive Guide*. Oreilly.

**References**

Tom White. 2016. *Hadoop: The Definitive Guide*. O'Reilley.
Cay S. Horstmann. 2017. *Scala for the Impatient*. Wesley.

Topics relevant to development of "Skill Development": Real time application development using Hadoop Ecosystem tools through Experiential Learning as mentioned in the course handout.

| Course Code: CSE3428 | Course Title: .NET Full Stack Development | L-T- P- C | 2-0-2-3 |
|---|---|---|---|
| Version No. | 1.0 | | |
| Course Pre-requisites | CSE2258 | | |
| Anti-requisites | **CSE3427 Java Full Stack Development** | | |
| Course Description | This advanced level course enables students to perform full stack development using .NET, with emphasis on employability skills. The key technologies used for Full Stack development is based on either Java technology or .NET technology. In this course, the focus is on using .NET and the related technologies/tools like C#, ASP.NET, Entity Framework Core, etc. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course. | | |
| Course Objectives | This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies. | | |
| Course Outcomes | **On successful completion of the course the students shall be able to:**<br>**1] Practice the use of C# for developing a small application [Application]**<br>**2] Show web applications using Entity Framework. [Application]**<br>**3]Solve simple web applications that use SQL and ASP.NET [Application]**<br>**4] Apply concepts of ASP.NET to develop a Full Stack application. [Application]** | | |
| Course Content: | | | |

| Module 1 | C# Programming for Full Stack Development | Project | Programming | **10 Sessions** |
|---|---|---|---|---|

**Topics:**
.NET Framework Fundamentals, Visual Studio IDE Fundamentals, C# Language Features, Working with arrays and collections, Working with variables, operators, and expressions, Decision and iteration statements, Managing program flow and events, Working with classes and methods, OOP concepts, Properties, Auto Implemented, Delegates, Anonymous Methods and Anonymous Types, Extension methods, Sealed Classes/Methods, Partial Classes/Methods, Asynchronous programming and threading, Data validation and working with data collections including LINQ, Handling errors and exceptions, Working with Files, Unit Testing – Nunit framework
**Assignment:** Develop a small application for managing library using C#.

| Module 2 | Entity Framework Core 2.0 | Project | Programming | **06 Sessions** |
|---|---|---|---|---|

**Topics:**
Entity Framework Core 2.0 Code First Approach; Introduction To Entity Framework and EDM; Querying the EDM; Working With Stored Procedures; Advanced Entity Framework - DbContext [EF6]; Advanced Operations; Performance Optimization; Data Access with ADO.NET
**Assignment:** Develop an application for managing HR policies of a department.

| Module 3 | ASP.NET | Project | Programming | **06 Sessions** |
|---|---|---|---|---|

**Topics:**
ASP.NET Core, ASP.Net Core 3.1 MVC, ASP.NET Core Middleware and Request pipeline, Review of SQL using MS SQL, Working With Data In Asp.Net, Razor View Engine, State Management In Asp. Net MVC & Layouts;

**Assignment:** Develop a web application to mark entry/exit of guests in a building.

| Module 4 | ASP.NET | Project | Programming | **08 Sessions** |
|---|---|---|---|---|

**Topics:**

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| Introduction To Models, Validations In Asp.Net MVC, Authentication and Authorization In Asp.Net MVC, Advanced Asp.Net MVC - Ajax Action Link In MVC, Advanced Asp.Net MVC - Ajax Forms In MVC, Microsoft Testing Framework – Unit Testing the .NET Application<br>**Assignment:** Develop a software tool to do inventory management in a warehouse. |
| **Targeted Application & Tools that can be used:**<br><br>**Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers.**<br><br>**Professionally Used Software: Visual Studio** |
| **Project work/Assignment:** |
| 1. **Problem Solving: Design of Algorithms and implementation of programs.**<br>2. **Programming: Implementation of given scenario using .NET.** |
| **Text Book:**<br>T1. Fender, Young, "*Front-end Fundamentals",* Leanpub, 2015<br>T2. Valerio De Sanctis, *"ASP.NET Core 5 and Angular: Full-stack web development with .NET 5 and Angular 11"*, 4th Edition, Packt, 2021. |
| **References**<br>R1. Benjamin Perkins, Jon D. Reid, *"Beginning C# and .NET"*, Wiley, 2021 Reid, 2021.<br>R2. Piotr Gankiewicz, *"Full Stack .NET Web Development"*, Packt Publishing, 2017.<br>R3. Tamir Dresher, Amir Zuker, Shay Friedman, *"Hands-On Full-Stack Web Development with ASP.NET Core"*, Packt Publishing, 2018.<br>R4. Dustin Metzgar, *"Exploring .NET core with microservices, ASP.NET core, and Entity Framework Core"*, Manning, 2017. |

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|---|---|---|---|
| **Course Code:** **CSE3427** | **Course Title:** **Java Full Stack Development** | **L- T-P- C** | 2-0-2-3 |
| **Version No.** | 1.0 | | |
| **Course Pre-requisites** | **CSE2258** | | |
| **Anti-requisites** | **CSE3428 .NET Full Stack Development** | | |
| **Course Description** | This advanced level course enables students to perform full stack development using Java, with emphasis on employability skills. The key technologies used for Full Stack development is based on either Java technology or .NET technology. In this course, the focus is on using Java, and the related technologies/tools like Java EE, Java Persistence, Hibernate, Maven, Spring Core, etc. On successful completion of this course, the student shall be able to pursue a career in full-stack development. The students shall develop strong problem-solving skills as part of this course. | | |
| **Course Objectives** | This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies. | | |

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| **Course Outcomes** | **On successful completion of the course the students shall be able to:**<br>**1] Practice the use of Java for full stack development [Application]**<br>**2] Show web applications using Java EE. [Application]**<br>**3] Solve simple applications using Java Persistence and Hibernate [Application]**<br>**4] Apply concepts of Spring to develop a Full Stack application. [Application]**<br>**5] Employ automation tools like Maven, Selenium for Full Stack development. [Application]** | | | |
| **Course Content:** | | | | |
| **Module 1** | Introduction | Project | Programming | **03 Sessions** |
| **Topics:**<br>Review of Java; Advanced concepts of Java; Java generics; Java IO; New Features of Java. Unit Testing tools. | | | | |
| **Module 2** | Java EE Web Applications | Project | Programming | **05 Sessions** |
| **Topics:**<br>Introduction to Eclipse & Tomcat; JSP Fundamentals; Reading HTML form Data with JSP; State Management with JSP; JSP Standard Tag Library - Core & Function Tags; Servlet API Fundamentals; ServletContext, Session, Cookies; Request Redirection Techniques; Building MVC App with Servlets & JSP; Complete App - Integrating JDBC with MVC App<br>**Assignment:** Develop an application for managing HR policies of a department. | | | | |
| **Module 3** | Java Persistence using JPA and Hibernate | Project | Programming | **06 Sessions** |
| **Topics:**<br>Fundamentals of Java Persistence with Hibernate; JPA for Object/Relational Mapping, Querying, Caching, Performance and Concurrency; First & Second Level Caching, Batch Fetching, Optimistic Locking & Versioning; Entity Relationships, Inheritance Mapping & Polymorphic Queries; Querying database using JPQL and Criteria API (JPA)<br>**Assignment:** Design and develop a website that can actively keep track of entry-exit information of a housing society.. | | | | |
| **Module 4** | Spring Core | Project | Programming | **10 Sessions** |
| **Topics:**<br>Spring Core, Spring MVC, Spring Boot REST API; Understanding Spring Framework; Using Spring MVC; Building a Database Web App with Spring and Hibernate o Spring AOP (Aspect Oriented Programming); Implementing Spring Security; Developing Spring REST API; Using Spring Boot for Rapid Development<br>**Assignment:** Develop a software tool to do inventory management in a warehouse. | | | | |
| **Module 5** | Automation tools | Project | Programming | **06 Sessions** |
| **Topics:**<br>Introduction to Automation Tools; Apache Maven: Maven Fundamentals, Software Setup - Commandline and Eclipse, pom.xml and Directory Structure, Multi-Module Project Creation, Scopes, Dependency Management, Profiles; Functional/BDD Testing using Selenium, Selenium Fundamentals and IDE, Selenium WebDriver, Installation and Configuration, Locating WebElements, Driver Commands, WebElement Commands<br>**Assignment:** Illustrate the use of automation tools in the development of a small software project. | | | | |

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| **Targeted Application & Tools that can be used:**<br><br>**Application Area is to Design and Analyzing the efficiency of Algorithms. This fundamental course is used by all application developers.**<br><br>**Professionally Used Software: Eclipse, NetBeans, Hibernate, Selenium, Maven, GIT.** |
| **Project work/Assignment:** |
| 1. **Problem Solving: Design of Algorithms and implementation of programs.**<br>2. **Programming: Implementation of given scenario using Java.** |
| **Text Book:**<br>T1. Fender, Young, "*Front-end Fundamentals",* Leanpub, 2015 |
| **References**<br>R1. Soni, Ravi Kant. *"Full Stack AngularJS for Java Developers: Build a Full-Featured Web Application from Scratch Using AngularJS with Spring RESTful."* , Apress, 2017.<br>R2. Mardan, Azat. *"Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB."*, Apress, 2015 |

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|---|---|---|---|---|---|---|
| Course Code:<br><br>CSD3406 | Course Title: Business Oriented Data Analytics<br><br>Type of Course: Discipline Elective/ Theory Only Course | L- T-P- C | 3 | 0 | 0 | 3 |
| Version No. | | | | | | |
| Course Pre-requisites | | | | | | |
| Anti-requisites | | NIL | | | | |
| Course Description | This course introduces the core concepts of business data analytics, emphasizing the practical application of analytics techniques in business environments. Students will learn to harness data to solve business problems, improve decision-making, and support organizational objectives. The course covers all four stages of analytics – descriptive, diagnostic, predictive, and prescriptive – along with tools and techniques widely used in the industry. Case studies, real datasets, and project-based learning are integrated to develop industry-ready analytical thinking. | | | | | |
| Course Objective | To enable students to apply data analytics techniques in business scenarios, with an emphasis on deriving insights that support strategic and operational decision-making. This course bridges the gap between data science and business understanding, empowering students to translate data into actionable business strategies. | | | | | |
| Course Out Comes | Upon successful completion of this course, students will be able to:<br><br>At the end of the course, students will be able to:<br>CO1: Understand the foundations of data analytics in the context of business processes and decision-making.<br>CO2: Apply descriptive, diagnostic, predictive, and prescriptive analytics techniques to real-world business problems.<br>CO3: Develop interactive data visualizations and dashboards using contemporary | | | | | |

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| | tools.<br>CO4: Analyze business case studies to identify suitable data analytics methods and tools.<br>CO5: Interpret analytical results to provide data-driven business insights and recommendations. |

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| Course Content: | | | | |
| Module 1 | **Introduction to Business Analytics** | Assignment | Data Collection | 06 Sessions |
| Introduction to Business Analytics, Types of analytics: Descriptive, Diagnostic, Predictive, Prescriptive, Role of data analytics in business strategy, Analytics process and life cycle, Case examples from marketing, finance, HR, and operations | | | | |
| Module 2 | Data Preparation and Exploration | Quiz | Problem Solving | 08 Sessions |
| Data collection methods and business data sources, Data cleaning, transformation, and feature engineering, Exploratory Data Analysis (EDA), Outlier detection and handling missing values , Introduction to data visualization using tools like Excel, Power BI, Tableau, or Python libraries | | | | |
| Module 3 | Descriptive and Diagnostic Analytics | Assignment | Problem Solving | 07Sessions |
| Summary statistics and business KPIs, Trend, pattern, and anomaly detection, Hypothesis testing and correlation analysis, Cross-tabulation and drill-down analysis, Business dashboard design and reporting | | | | |
| Module 4 | Predictive Analytics for Business | Assignment | Problem Solving | 10 Sessions |
| Introduction to predictive modelling, Regression models, decision trees, and classification techniques, Model evaluation metrics (accuracy, precision, recall, F1-score, AUC), Forecasting techniques for business data (time series models), Case studies: Customer churn, sales forecasting, credit scoring | | | | |
| Module 5: 09 session | | | | |
| Introduction to optimization techniques,Linear programming and goal seeking,Simulation and scenario analysis<br>,Decision analysis under uncertainty,Applications in supply chain, logistics, and resource planning | | | | |

**References:**

**R1: Evans, J. R. (2016). *Business Analytics*, 2nd Edition, Pearson.**

**R2: Sharda, R., Delen, D., & Turban, E. (2020). *Analytics, Data Science, and Artificial Intelligence: Systems for Decision Support*, 11th Edition, Pearson.**

**R3:Provost, F., & Fawcett, T. (2013). *Data Science for Business*, O'Reilly.**

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|---|---|---|---|---|---|
| **Course Code: CSD3405** | **Course Title:** Text Mining and Analytics<br>**Type of Course: Program Core** | **L- P- C** | 3 | 0 | 3 |
| **Version No.** | 1 | | | | |
| **Course Pre-requisites** | Probability and Statistics -MAT2001 | | | | |
| **Anti-requisites** | NIL | | | | |
| **Course Description** | This course focuses on the extraction of meaningful information from unstructured textual data. It covers key concepts in natural language processing, text representation, information retrieval, and text-based predictive modeling. Students gain hands-on experience using tools like NLTK, Scikit-learn, and spaCy for analyzing large text corpora. | | | | |
| Course Objective | 1.To introduce students to techniques for extracting, analyzing, and interpreting patterns in large-scale text data.<br>2.To equip learners with practical skills in building text-based analytical models for real-world applications. | | | | |
| **Course Out Comes** | **On successful completion of the course the students shall be able to:**<br>**CO1**: Represent, preprocess, and tokenize textual data for analysis.<br>**CO2**: Apply algorithms for topic modeling, classification, and clustering of text.<br>**CO3**: Use sentiment analysis and opinion mining in real-world text datasets.<br>**CO4**: Build text mining pipelines for analytics-driven business and research problems. | | | | |
| **Course Content:** | | | | | |
| **Module 1** | **Fundamentals of Text Mining and NLP** | | | | **10 Sessions** |
| **Text preprocessing: tokenization, stemming, lemmatization,Text representation: Bag-of-Words, TF-IDF, word embeddings,N-gram models, POS tagging, stop word removal, Overview of NLP libraries: NLTK, spaCy, Hugging Face.** | | | | | |
| **Module 2** | **Text Classification and Clustering** | | | | **12 Sessions** |
| **Supervised models: Naïve Bayes, SVM, Logistic Regression, Unsupervised models: K-means, Hierarchical clustering, LDA, Sentiment analysis and spam detection, Evaluation: Precision, Recall, F1, ROC, Confusion matrix** | | | | | |
| **Module 3** | **Sentiment Analysis and Topic Modeling** | | | | **12 Sessions** |

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| **Lexicon-based and ML-based sentiment analysis,VADER, TextBlob, and transformer-based sentiment tools,Topic modeling using LDA and NMF, Case studies: reviews, tweets, customer feedback.** | | |
| **Module 4** | **Advanced Text Analytics and Applications** | **11 Sessions** |
| **Deep learning in NLP: RNNs, LSTMs, Transformer models (BERT, GPT), Text summarization, semantic search, and similarity matching, Information retrieval and question answering systems, Applications in healthcare, finance, legal, and e-commerce** | | |
| **Text Book**<br>1.Title: ***Speech and Language Processing,*****Authors**: Daniel Jurafsky and James H. Martin,**Publisher**: Pearson,**Edition**: 3rd Edition (Draft, updated content online),**Year**: **2023 (latest version online)**<br><br>2.Title : T***ext Mining with R: A Tidy Approach,*****Authors**: Julia Silge, David Robinson,**Publisher**: O'Reilly Media,**Edition**: 2nd Edition,**Year**: **2022** | | |
| **References**<br>**R1** ***Natural Language Processing with Transformers,*****Authors**: Lewis Tunstall, Leandro von Werra, Thomas Wolf,**Publisher**: O'Reilly Media,**Year**: **2022.** | | |

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|---|---|---|---|---|---|---|
| **Course Code: CSD3412** | **Course Title: Graph Analytics**<br>**Type of Course: Professional Core** | **L-P-C** | 3 | 0 | 0 | 3 |
| **Version No.** | 1.0 | | | | | |
| **Anti-requisites** | NIL | | | | | |
| **Course Description** | This course introduces the fundamentals of graph theory and analytics, covering key algorithms and metrics. Students will learn to model and analyze real-world networks using tools like Neo4j and NetworkX. Topics include centrality, community detection, and graph querying. Applications in social networks, recommendation systems, and cybersecurity are explored. | | | | | |
| **Course Objectives** | The objective of the course is to familiarize the learners with the concepts of **Graph Analytics** and attain **Skill Development** through **Experiential Learning** techniques. | | | | | |
| **Course Out Comes** | On successful completion of this course the students shall be able to:<br>1.Understand graph theory fundamentals and key algorithms.**[Understand]**<br>2.Gain skills in graph querying, analytics, and visualization.**[Application]**<br>3.Apply graph-based techniques to real-world problems.**[Application]**<br>4. Explore graph databases and machine learning applications.**[Application]** | | | | | |
| **Course Content:** | | | | | | |

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|---|---|---|---|---|
| **Module 1** | **Introduction to Graphs and Graph Algorithms** | **Quiz** | **Knowledge based** | [16 Session (L-8 +P-8)] |
| Basics of Graph Theory: Vertices, Edges, Types of Graphs, Graph Representations: Adjacency Matrix, Adjacency List,Graph Traversal: BFS, DFS,Shortest Path Algorithms: Dijkstra's, Bellman-Ford,Minimum Spanning Trees: Prim's, Kruskal's<br>Real-world Applications: Social, Biological, and Web Graphs | | | | |
| **Module 2** | **Graph Metrics, Centrality, and Clustering** | **Assignment** | **Implementation** | [16 Session (L-8 +P-8)] |
| Graph Properties: Degree, Density, Diameter, Clustering Coefficient, Centrality Measures: Degree, Closeness, Betweenness, Eigenvector, PageRank, Community Detection: Modularity, Louvain Method, Label Propagation, Applications: Influence Analysis, Fraud Detection, Recommendation Systems | | | | |
| **Module 3** | **Graph Databases and Query Languages** | **Term paper/Assignment** | **Implementation** | [16 Session (L-8 +P-8)] |
| Graph Data Models: Property Graphs, RDF,Introduction to Graph Databases: Neo4j, OrientDB,Querying Graphs with Cypher (Hands-on examples),Introduction to SPARQL (for semantic web),Data Modeling and Importing Graph Data | | | | |
| **Module 4** | **Graph Analytics Tools & Machine Learning Applications** | **Term paper/Assignment** | **Implementation** | [12 Session (L-6 +P-6)] |
| Link Prediction, Node Classification,Graph Embeddings: Node2Vec, DeepWalk (Basics), Introduction to Graph Neural Networks (GNNs),Tools & Frameworks: NetworkX, Gephi, Neo4j, PyTorch Geometric,Case Studies: Social Networks, E-commerce, Cybersecurity | | | | |

**List of Laboratory Tasks:**

1. **Graph Representation and Visualization**
   Represent graphs using adjacency lists and matrices.
   Visualize with layouts like spring, circular, and planar.
   **Tools:** NetworkX, Matplotlib
2. **Graph Traversals: BFS and DFS**
   Implement Breadth-First Search and Depth-First Search.
   Highlight differences in traversal order.
   **Tools:** Python
3. **Shortest Path Algorithms**
   Implement Dijkstra's
   Visualize shortest paths between nodes.
   **Tools:** NetworkX, Gephi
4. **Shortest Path Algorithms**

Implement Bellman-Ford algorithms.
Visualize shortest paths between nodes.
**Tools:** NetworkX, Gephi

5. **Minimum Spanning Tree**
   Implement Prim's and Kruskal's algorithms.
   Highlight selected edges on graph visualization.
   **Tools:** NetworkX, custom implementation
6. **Graph Metrics Computation**
   Calculate Degree, Density, Diameter, Clustering Coefficient.
   **Tools:** NetworkX
7. **Graph Metrics Computation**
   Understand their meaning in real-world graphs.
   **Tools:** NetworkX
8. **Centrality Analysis**
   Compute Degree, Closeness, Betweenness Centrality, and PageRank.
   Identify key influencers or critical nodes.
   **Tools:** NetworkX, Neo4j
9. **Community Detection**
   Detect communities using Louvain or Girvan–Newman algorithms.
   Visualize modular structure in Gephi.
   **Tools:** NetworkX + community, Gephi
10. **Graph Querying with Neo4j (Cypher)**
    Create and query graphs using MATCH, WHERE, RETURN.
    **Tools:** Neo4j
11. **Graph Querying with Neo4j (Cypher)**
    Run queries to explore relationships and paths.
    **Tools:** Neo4j
12. **Graph Pattern Matching**
    Identify patterns like triangles, paths, and cliques.
    Use Cypher to detect fraud rings or friend circles.
    **Tools:** Neo4j
13. **Link Prediction**
    Predict new edges using heuristics: Common Neighbors, Jaccard, Adamic/Adar.
    Apply to social or citation networks.
    **Tools:** NetworkX, Scikit-learn
14. **Real-world Graph Analysis**
    Load datasets like Facebook, Twitter, or citation networks (from SNAP).
    Perform metrics, centrality, and visualization.
    **Tools:** NetworkX, Gephi
15. **Mini Project / Case Study**
    Choose an application: e.g., traffic networks, recommender systems, or fraud detection.
    Combine multiple techniques from previous labs.
    **Tools:** Python + Neo4j or Gephi

**Targeted Application & Tools that can be used:**

- Implementing key algorithms and metrics- Anaconda-Jupyter Notebook/ Google-Colab.
- Mini-project on real-world graph dataset

- Hands-on with NetworkX (Python), Neo4j, Graph visualization with Gephi

**Project work/Assignment:**

1. Design and implementation of a real-world problem with Graph
2. Research paper review and presentation on a selected graph application

Textbook(s):

1. "Graph-Powered Analytics and Machine Learning with TigerGraph" Authors: Victor Lee, Dr. Yu Xu,Publisher: O'Reilly Media,Year: 2022
2. "Graph Data Analytics: A Practical Guide to Process", Visualize, and Analyze Complex Graph Data,Author: Sumit Raj,Publisher: BPB Publications,Year: 2023

**References:**

1. "The Practitioner's Guide to Graph Data", Authors: Denise Gosnell, Matthias Broecheler, Publisher: O'Reilly Media,Year: 2020
2. "Graph Data Science for Dummies (2nd Edition)", Author: Alicia Frame, Publisher: Wiley / Neo4j,Year: 2022
3. "Managing and Mining Graph Data", Editors: Charu C. Aggarwal, Haixun Wang, Publisher: Springer ,Year: 2010
4. Frank Harary: Graph Theory, CRC Press, 2018 (originally published in 1969).

**Weblinks:**

5. https://presiuniv.knimbus.com/user#/home
6. Udemy: https://www.udemy.com/course/sdn-made-simple/?couponCode=LETSLEARNNOWPPNPTEL online course

**Topics relevant to "SKILLS Development":** Graph Analytics **Skills development** through **Experiential Learning techniques.**
**This is attained through assessment component mentioned in course handout.**

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|---|---|
| **Catalogue prepared by** | Dr. Srabana Pramanik -Assistant Professor (Senior Scale) |
| **Recommended by the Board of Studies on** | |
| **Date of Approval by the Academic Council** | Academic Council Meeting No. |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Course Code: CSE3415** | **Course Title:** **NextGen Predictive Analysis** **Type of Course:** **Theory Integrated Lab Course** | **L-T-P-C** | 2 | 0 | 2 | 3 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | Statistics & Probability , Machine Learning Fundamentals, Programming in Python | | | | | |
| **Anti-requisites** | **NIL** | | | | | |

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|---|---|---|
| **Course Description** | | This course introduces advanced predictive modeling techniques using machine learning, deep learning, and AI-driven analytics. Students will learn to design, train, and deploy predictive models for real-world applications, including business forecasting, healthcare diagnostics, and automated decision-making systems. Hands-on lab sessions will reinforce theoretical concepts through industry-relevant case studies. |
| **Course Objectives** | | The objective of the course is to familiarize the learners with the concepts of **Streaming Data Analytics** as mentioned above and attain **Skill Development** through **experiential Learning** techniques. |
| **Course Outcomes** | | On successful completion of the course the students shall be able to:<br>CO1: **Recognize** the foundational principles and significance of predictive analytics in various sectors<br>CO2: **Demonstrate** proficiency in preparing and exploring datasets to identify meaningful patterns and insights.<br>CO3: **Apply** appropriate predictive modeling techniques to analyze data and generate accurate forecasts<br>C04 : **Implement** the various predictive models and assess ethical considerations in their application. |
| **Course Content:** | | |

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|---|---|---|---|---|---|
| **Module 1** | Introduction to Next-Generation Analytics | Assignment/ Problem Solving | Knowledge [L1] | | **16 Sessions** (L- 8 & P-8) |

- **Fundamentals of Advanced Analytics** :Definitions and Core Concepts in Analytics Evolution from Traditional to Advanced Analytical Techniques, Types of predictive models (regression, classification, time-series). Data cleaning, outlier detection, and feature scaling

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|---|---|---|---|---|---|
| **Module 2** | Classical Machine Learning for Prediction | Programming Assignment | Apply [L3] | | **16 Sessions** (L- 8 & P-8) |

**Classical Machine Learning for Prediction** supervised learning techniques for predictive analytics, including Linear & Logistic Regression for continuous and binary outcomes, Decision Trees & Random Forests for interpretable and ensemble-based classification/regression, and Support Vector Machines (SVM) for high-dimensional data separation. Ensemble Methods (Boosting, Bagging to enhance model accuracy and robustness, hyperparameter tuning, performance evaluation (e.g., RMSE, precision-recall)

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| **Module 3** | Deep Learning & Advanced Models | Programming Assignment | Apply [L3] | | **14 Sessions** (L- 7 & P-7) |

Deep Learning models: Introduction to deep learning technique, Neural networks (MLPs, CNNs, RNNs), Time-series forecasting (LSTMs), Transformer-based models (e.g., BERT for text), Overview of predictive modeling techniques and their applications.

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| **Module4** | Prescriptive Analytics and Optimization | Programming Assignment | Streaming Data analysis | | **14 Sessions** (L- 7 & P-7) |

**Basics of Prescriptive Analytics:** Concepts and Methods in Prescriptive Analytics, Using Optimization and Simulation to Inform Decision Making. Ethics in Analytics: Ethical Considerations in Data Collection and Analysis, Developing Guidelines for Ethical Use of Analytics.

**List of Laboratory Tasks:**

1. **Design and implement data preprocessing techniques:** Perform data cleaning, handle missing values, detect outliers, and apply feature scaling on a raw dataset.

2. **Design and implement exploratory data analysis (EDA):** Use visualization tools to uncover patterns, correlations, and insights within a dataset.
3. **Design and implement regression models:** Develop and evaluate linear regression models to predict continuous outcomes.
4. **Design and implement classification models:** Apply logistic regression to classify binary outcomes in a dataset.
5. **Design and implement decision tree algorithms:** Build and interpret decision trees for classification tasks.
6. **Design and implement ensemble methods:** Implement Random Forest and evaluate its performance compared to individual decision trees.
7. **Design and implement support vector machines (SVM):** Train SVM models for classification tasks and visualize decision boundaries.
8. **Design and implement artificial neural networks (ANN):** Construct and train a multi-layer perceptron for a predictive task.
9. **Design and implement convolutional neural networks (CNN):** Develop a CNN for image classification problems.
10. **Design and implement recurrent neural networks (RNN):** Implement an RNN, such as LSTM, for time-series forecasting.
11. **Design and implement optimization models:** Formulate and solve linear programming problems relevant to business scenarios.
12. **Design and implement simulation models:** Use simulation techniques to model and analyze complex systems for decision-making.

**Targeted Application & Tools that can be used:**

- **IDEs: Jupyter Notebook, Google Colab, VS Code (with Python extensions)**
- **Finance for risk assessment, and healthcare for patient outcome forecasting**
- **Predictive Analytics**

**Project work/Assignment:**

Students will be asked to Design and Implement a Comprehensive Analytical Solution for a Hypothetical Business Scenario.

**Text Book**


1. Drake, Alyson, and Amanda Watson. "Legal Research in the NextGen Era." *U of Houston Law Center Forthcoming, Buffalo Law Review Forthcoming* (2024).
2. Yan, Zhen, Kevin Kim, Haeuk Kim, Brendan Ha, Anaïs Gambiez, Jason Bennett, Marcus Fabiano de Almeida Mendes et al. "Next-generation IEDB tools: a platform for epitope prediction and analysis." *Nucleic acids research* 52, no. W1 (2024): W526-W532.


**References**


Anita Margret, A., Chrisanne Freeman, Mrs Merlyn Diana AS, and Preyenga Ramesh. *Next-gen Biology: Ai's Transformative Impact On Life Sciences: Ai Innovations In Biotechnology, Healthcare, And Agriculture*. OrangeBooks Publication, 2025.


**Weblinks:**

http://www.liaad.up.pt/area/jgama/DataStreamsCRC.pdf
https://presiuniv.knimbus.com/user#/home

**Topics relevant to "SKILL DEVELOPMENT":**

NextGen Predictive analysis of real time datasets like health monitoring analysis , finance for risk management using various tolls and libraries for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

| **Catalogue prepared by** | | Dr. Manjula H M |
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| **Recommended by the Board of Studies on** | | |
| **Date of Approval by the Academic Council** | | |

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|---|---|---|---|---|---|---|
| Course Code:<br>CSD3416 | Course Title: Probabilistic Modeling for Machine Learning<br>Type of Course: Discipline Elective/ Theory Only Course | L- T-P- C | 3 | 0 | 0 | 3 |
| Version No. | | 2.0 | | | | |
| Course Pre-requisites | | | | | | |
| Anti-requisites | | NIL | | | | |
| Course Description | | This course provides an in-depth understanding of probabilistic models and their application in machine learning. It explores techniques such as Bayesian inference, graphical models, and latent variable models for handling uncertainty in data. The focus is on both the theoretical foundations and practical implementations using modern libraries. | | | | |
| Course Objective | | The objective of the course is to familiarize the learners with the concepts of Data Mining and attain Employability through Problem Solving Methodologies | | | | |
| Course Out Comes | | Upon successful completion of this course, students will be able to:<br>1. Understand the fundamental principles of probabilistic modeling and reasoning.<br>2. Design and implement probabilistic models for supervised and unsupervised learning.<br>3. Apply inference techniques and evaluate probabilistic models in real-world scenarios. | | | | |
| Course Content: | | | | | | |
| Module 1 | Foundations of Probability and Statistics for ML | Assignment | | Data Collection | 10 Sessions | |
| | Topics:<br>Basics of probability theory, Random variables and distributions, Statistical decision theory, Introduction to Bayesian inference | | | | | |
| Module 2 | Bayesian Methods and Inference Techniques | Quiz | | Problem Solving | 10 Sessions | |

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| | Topics:<br>Prior, likelihood, and posterior, Bayesian parameter estimation, Conjugate priors and exponential families, MCMC and Variational Inference | | | | |
| Module 3 | Probabilistic Graphical Models | Assignment | | Problem Solving | 10Sessions |
| | Topics:<br>Directed (Bayesian networks) and Undirected (Markov Random Fields) models, Structure learning and parameter learning, Exact and approximate inference algorithms | | | | |
| Module 4 | Advanced Topics and Applications | Assignment | | Problem Solving | 11 Sessions |
| | Latent variable models (e.g., Gaussian Mixture Models, LDA), Deep probabilistic models (e.g., Variational Autoencoders), Temporal models (e.g., Hidden Markov Models), Real-world case studies and project work | | | | |
| | Text Book<br>1. **Murphy, Kevin P.** *Probabilistic Machine Learning: An Introduction*, MIT Press, 2022.<br>2. **Bishop, Christopher M.** *Pattern Recognition and Machine Learning*, Springer, 2006. | | | | |
| | **References:**<br>**R1 Koller, Daphne, and Nir Friedman.** *Probabilistic Graphical Models: Principles and Techniques*, MIT Press, 2009.<br>**R2 Ghahramani, Zoubin.** *An Introduction to Probabilistic Machine Learning*, Cambridge University Press (Forthcoming / Preprints), Latest Edition.<br>**Additional web-based resources:**<br>W1. https://onlinecourses.swayam2.ac.in/cec20_cs12/preview Text book of Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamber and Jian Pei, Morgan Kaufmann Publishers, 2012.<br>W2.https://puniversity.informaticsglobal.com:2284/ehost/detail/detail?vid=7&sid=e2d7362a-fd3049a98f0393e963521dbd%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=377411&db=nlebk https://nptel.ac.in/courses/105105157 | | | | |
| | Topics relevant to "EMPLOYABILITY SKILLS": Data Mining Techniques, FP Growth for developing Employability Skills through Participative Learning techniques. This is attained through the assessment component mentioned in the course handout. | | | | |

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| Catalogue prepared by | | Shaik Salma Begum |
| Recommended by the Board of Studies on | | |

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| Date of Approval by the Academic Council | | |

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| Course Code:<br>**CSD3411** | Course Title: **Cyber Security and Data Privacy**<br>Type of Course: Theory | L- P- T-C | **3** | **0** | **0** | **3** |
| Version No. | 1.0 | | | | | |
| Course Pre-requisites | NIL | | | | | |
| Anti-requisites | NIL | | | | | |
| Course Description | This course provides a foundational yet comprehensive understanding of modern cyber security practices and data privacy principles. Students will explore real-world cyber threats, security frameworks, cryptographic techniques, and regulatory frameworks for privacy. Emphasis is placed on practical approaches to securing networks, ethical hacking, and forensic analysis to prepare learners for dynamic challenges in digital security. | | | | | |
| Course Outcomes | On successful completion of this course the students shall be able to:<br>• Assess cyber threats across various domains and evaluate potential security risks. *(Bloom's Level: **Evaluate**)*<br>• Apply cryptographic methods to secure data and communications. *(Bloom's Level: **Apply**)*<br>• Implement security tools for protecting networks and systems. *(Bloom's Level: **Apply**)*<br>• Understand data privacy laws, including frameworks like GDPR. *(Bloom's Level: **Understand**)*<br>• Perform basic penetration testing and digital forensics investigations to detect and analyze security breaches.<br>*(Bloom's Level: **Analyze**)* | | | | | |
| Course Content: | | | | | | |
| Module 1 | **Foundations of Cyber Security** | Assignment | | | | |
| Topics:<br>Introduction to Cyber Security – Cyber threat landscape: malware, ransomware, phishing – Risk assessment and management – Security policies and standards (e.g., ISO 27001) – Security protocols and layers of defense. | | | | | | |
| Module 2 | **Cryptography and Network Security** | Assignment | | | | 13 |

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|---|---|---|---|
| | | | Classes |
| Topics:<br>Symmetric and asymmetric encryption – Hash functions and digital signatures – Public Key Infrastructure (PKI) – Secure communication protocols (TLS, SSH) – Network security fundamentals: firewalls, IDS/IPS, VPNs. | | | |
| Module 3 | **Data Privacy and Legal Frameworks** | Assignment | 10<br>Classes |
| Topics:<br>Principles of data privacy and data governance – GDPR, HIPAA, and Indian IT Act – Data classification and anonymization techniques – Privacy-by-design in systems – Consent, rights, and responsibilities of data subjects. | | | |
| Module-4 | **Ethical Hacking and Digital Forensics** | Assignment | 12<br>Classes |
| Topics:<br>Introduction to ethical hacking & penetration testing – Footprinting, scanning, and enumeration techniques – Common tools: Nmap, Metasploit, Wireshark – Incident response and log analysis – Basics of digital forensics and evidence handling. | | | |
| Project work/Assignment: | | | |
| Assignment 1 on (Module 1 and Module 2 )<br>Assignment 2 on (Module 3 and Module 4) | | | |

REFERENCE MATERIALS:

TEXTBOOKS


1. *Engebretson, P. The Basics of Hacking and Penetration Testing. Syngress, 2nd Edition, 2013. ISBN: 978-0124116443.*
2. *Singer, P. W., & Friedman, A. Cybersecurity and Cyberwar: What Everyone Needs to Know. Oxford University Press, 1st Edition, 2014. ISBN: 978-0199918119.*
3. *Kolah, A. The GDPR Handbook: A Guide to Implementing the EU General Data Protection Regulation. Kogan Page, 1st Edition, 2018. ISBN: 978-0749474942.*


REFERENCES


1. *William Stallings. Cryptography and Network Security: Principles and Practice. Pearson, 8th Edition, 2024. ISBN: 978-1292742366.*
2. *William Stallings and Lawrie Brown. Computer Security: Principles and Practice. Pearson, 5th Edition, 2023. ISBN: 978-0138091712.*
3. *William Stallings. Network Security Essentials: Applications and Standards. Pearson, 6th Edition, 2017. ISBN: 978-0134527338.*


JOURNALS/MAGAZINES

1. IEEE Security & Privacy Magazine
2. IEEE Transactions on Information Forensics and Security

3. IEEE Transactions on Dependable and Secure Computing
4. IEEE Internet Computing
5. IEEE Communications Magazine

SWAYAM/NPTEL/MOOCs:

1. NPTEL on SWAYAM – Cyber Security and Privacy

   Weblink: https://onlinecourses.nptel.ac.in/noc24_cs121/preview

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| Catalogue prepared by | Dr.K.Marimuthu |
| Recommended by the Board of Studies on | |
| Date of Approval by the Academic Council | |

| Course Code: CSD3429 | Course Title: Cognitive Robotics<br>Type of Course: 1] Program core | L- T- P- C | 3 | 0 | 0 | 3 |
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| **Version No.** | 1.0 | | | | | |
| **Anti-requisites** | **NIL** | | | | | |
| **Course Description** | Cognitive Robotics explores the next generation of intelligent robotic systems capable of reasoning, learning, and adapting in uncertain environments. The course blends cognitive science, artificial intelligence, machine learning, control theory, and human-robot interaction. Emphasis is placed on perceptual processing, probabilistic decision-making, cognitive architectures, and real-world robot behaviors. Students will learn how robots perceive their surroundings, build internal models, and take autonomous decisions through hands-on simulations and algorithmic implementations. The course promotes the development of ethically-aware, adaptive robotic agents ready for dynamic real-world deployment. | | | | | |
| **Course Outcomes** | On successful completion of this course the students shall be able to:<br>8] Explain cognitive models and architectures used in intelligent robotic systems. **[Comprehension]**<br>9] Apply machine learning and perception techniques for robotic decision-making. **[Application]**<br>10] Design planning, reasoning, and learning components in autonomous robots. **[Evaluate]**<br>11] Evaluate robotic behaviour in dynamic, uncertain, and interactive environments. **[Synthesis]** | | | | | |
| **Course Objective** | 1. Understand cognitive architectures used in intelligent robotic systems.<br>2. Apply AI techniques such as planning, learning, and reasoning to robotic agents.<br>3. Explore embodied cognition through sensorimotor integration and perception.<br>4. Analyze human-robot interaction and ethical concerns in cognitive robotics. | | | | | |
| **Course Content:** | | | | | | |
| **Module 1** | **Foundations of Cognitive Robotics (Comprehension)** | Assign ment | Programming activity | [12 Session | | |
| Introduction to cognitive robotics and cognitive science foundations<br>Embodied cognition and situated intelligence<br>Architectures for cognition: Reactive, Deliberative, Hybrid, Subsumption<br>Symbolic vs. sub-symbolic representations<br>Overview of AI and control system integration | | | | | | |

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| **Module 2** | **Perception, Mapping, and World Modeling (Application)** | Assign ment | Programming activity | [12 Session |
| Sensor modalities and fusion: cameras, LiDAR, IMU<br>Perception pipelines: object detection, localization, semantic mapping<br>Probabilistic world modeling: Kalman filter, Particle filter<br>SLAM (Simultaneous Localization and Mapping) overview<br>Robot Operating System (ROS) integration with perception modules | | | | |
| **Module 3** | **Learning and Decision-Making in Robots (Evaluate)** | Assign ment | Programming activity | [12 Session |
| Reinforcement learning (Q-learning, Deep Q Networks)<br>Learning from demonstration (LfD), Imitation learning<br>Cognitive planning: STRIPS, PDDL, Hierarchical Task Networks<br>Goal reasoning and behavioural adaptation<br>Markov Decision Processes (MDP), POMDPs for decision making | | | | |
| **Module 4** | **Human-Robot Interaction and Ethical Considerations (Synthesis)** | Assign ment | Programming activity | [ 12 Session |
| Socially assistive robotics and natural language interfaces<br>Theory of Mind and human intention understanding<br>Adaptive HRI frameworks and collaborative decision making<br>Ethical design of cognitive robots (transparency, explainability, bias)<br>Case studies in healthcare, education, and autonomous driving | | | | |
| **Targeted Application & Tools that can be used:**<br>**ROS** (Robot Operating System),<br>**Gazebo / Webots** for simulation<br>**Python**, **OpenCV**, **PyTorch**<br>**Jupyter Notebooks, Colab for prototyping** | | | | |
| **Project work/Assignment: Mention the Type of Project /Assignment proposed for this course** | | | | |

**Text Books**

10] **Cognitive Robotics,** Author: Angelo Cangelosi, Minoru Asada, Publisher: MIT Press, Edition: 1st Edition (2022), ISBN: 9780262046792

11] **Introduction to Autonomous Robots:** Mechanisms, Sensors, Actuators, and Algorithms, Author: Nikolaus Correll et al., Publisher: CreateSpace, Edition: 2nd Edition (2022) – freely available online URL: correll.cs.colorado.edu/book

12] **Human-Robot Interaction: An Introduction,** Author: Christoph Bartneck et al., Publisher: Cambridge University Press, Edition: 2nd Edition (2020), ISBN: 9781108742132

**References**

**R1. Reinforcement Learning: An Introduction,Authors:** Richard S. Sutton, Andrew G. Barto,**Publisher:** MIT Press,**Edition:** 2nd Edition (2020),

**ISBN:** 9780262039244

**R2. Cognitive Science: An Introduction to the Science of the Mind, Author:** José Luis Bermúdez ,**Publisher:** Cambridge University Press ,**Edition:** 3rd Edition (2022)

**ISBN:** 9781316631286

**R3. Probabilistic Robotics ,Author:** Sebastian Thrun, Wolfram Burgard, Dieter Fox ,**Publisher:** MIT Press,**Edition:** 13th reprint (2023),

**ISBN:** 9780262201627

Web links:

**W1.** https://onlinecourses.nptel.ac.in/noc20_me92/preview

**W2.** https://alison.com/course/fundamentals-in-cognitive-robotics#google_vignette

**W3.** https://www.edx.org/learn/robotics/osaka-university-cognitive-neuroscience-robotics-part-a

**W4.** https://ocw.mit.edu/courses/16-412j-cognitive-robotics-spring-2016

**Library Link:**

**L1**. **https://puniversity.informaticsglobal.com/login**

**Topics Relevant to "Skill Development: Human-Robot Interaction, socially assistive robotics and natural language interfaces** for Skill development through Participative Learning Techniques. This is attained through assessment mentioned in the course handout

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| **Catalogue preparedby** | Dr. Srabana Pramanik -Assistant Professor (Senior Scale) |
| **Recommended bythe Board of Studies on** | |
| **Date of Approval by the Academic** | Academic Council Meeting No. |

| Council | |
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| Course Code: CSD3407 | Course Title: Statistical Inference and Modeling<br>Type of Course:1] Program Core | L-T-P-C | 3 | 0 | 0 | 3 |
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| **Version No.** | | 1.0 |
| **Course Pre-requisites** | | Introduction to Probability<br>Calculus II |
| **Anti-requisites** | | **NIL** |
| **Course Description** | | This course introduces students to the principles and methods of statistical inference and modeling. Topics include estimation, hypothesis testing, confidence intervals, and both parametric and non-parametric models. Emphasis is placed on understanding theoretical foundations and applying statistical models to real-world data through computational tools. The course aims to build a strong conceptual and practical understanding of inference and modeling to prepare students for more advanced statistical and data science coursework. Students will learn how to analyze data, draw meaningful conclusions, and build predictive models using statistical techniques. |
| **Course Objective** | | The objective of the course is to familiarize the learners with the concepts of Statistical Inference and Modeling for **Employability** through **Problem Solving** Methodologies. |
| **Course Out Comes** | | On successful completion of this course the students shall be able to:<br>1. Apply sampling and estimation procedures to appropriately use and construe complex data. (Understand)<br>2. Design experiments by ANOVA and determine the existence of a statistically significant difference among several groups means. (Apply)<br>3. Develop appropriate regression models to predict the desired parameters. (Apply)<br>4. Apply non-parametric tests for uncertain distributions and decision analysis to identify feasible and viable decision alternatives. (Apply) |
| **Course Content:** | | |

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| **Module 1** | **SAMPLING AND ESTIMATION, HYPOTHESIS TESTING** | Assignment | **14 Hours** |

Random vs Non-random sampling, Errors in sampling, Central Limit Theorem, Types of estimates, Estimating population mean using z and t statistics, Confidence interval estimation, Maximum likelihood estimation. Procedure for Hypothesis testing, Two tailed and one tailed Hypothesis testing, Type 1 and Type 2 errors, Hypothesis testing using z and t statistics, Chi-square test

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| **Module 2** | **ANALYSIS OF VARIANCE AND EXPERIMENTAL DESIGNS** | Assignment | **10 Hours** |
| Analysis of variance, Completely Randomized design (One way ANOVA), Randomized Block design, Factorial Design (Two way ANOVA) | | | |
| **Module 3** | **REGRESSION MODELING STRATEGIES** | Assignment | **10 Hours** |
| Planning for modeling, Choice of the model, model formulation, Interpreting Modeling parameters, Assessment of model fit, Missing data; describing, Resampling, validating and simplifying the model; Simple and Multiple Linear Regression, residual analysis, Collinearity, Multiple regression model with two independent variables . | | | |
| **Module 4** | **NON-PARAMETRIC STATISTICS AND STATISTICAL DECISION THEORY** | Assignment | **11 Hours** |
| Runs Test, Mann-Whitney Test, Wilcoxon Test, Kruskal-Walis Test, Friedman Test, Spearman's Rank correlation. Decision making under uncertainty - Laplace, Hurwicz and Savage criteria; Decision making under risk – Expected monetary Value, Expected Opportunity Loss, Expected Value of Perfect Information; Decision trees. | | | |
| **Text Book**<br>1. Naval Bajpai, Business Statistics, Pearson, Second Edition 2013.<br>2. Casella and Berger, Statistical Inference, Cengage Learning, 2001. | | | |
| **References**<br>1. Frank E HarrelJr.,Regression Modeling Strategies, Springer, Second Edition, 2006<br>2. Andrew Gelman and Jennifer Hill, Data Analysis using Regression and multi level/hierarchical models, Cambridge, 2007<br>3. J K Sharma, Business Statistics, Vikas, Fifth Edition, 2020 | | | |
| **Catalogue prepared by** | Dr. Manjunath KV | | |
| **Recommended by the Board of Studies on** | | | |
| **Date of Approval by the Academic Council** | | | |

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| **Course Code: CSD3409** | **Course Title: Ffinancial Data Analysis**<br>**Type of Course: Discipline elective/Lab oriented** | **L- P- C** | 2 | 2 | 3 |
| **Version No.** | | | | | |
| **Course Pre-requisites** | NIL | | | | |
| **Anti-requisites** | NIL | | | | |
| **Course Description** | The Financial Data Analysis course is designed to equip students with essential skills for analyzing financial data to inform investment decisions, risk management, and strategic planning. Beginning with an overview of financial data types, sources, and structures, the course emphasizes data integrity and quality in financial analysis. Students will learn to apply various statistical methods and analytical tools, including descriptive statistics, time series analysis, regression analysis, and financial ratios, while also exploring data visualization techniques to effectively communicate findings. Through hands-on projects and | | | | |

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| | real-world case studies, participants will gain practical experience using software tools for financial modeling and analysis, ultimately enabling them to confidently analyze financial data and apply their skills across various financial contexts, including investment analysis, portfolio management, and corporate finance. | |
| **Course Out Comes** | On successful completion of the Financial Data Analysis course, students shall be able to:<br><br>1) Analyze and interpret various financial data types and their implications for decision-making. [Understand]<br>2) Utilize statistical methods to assess financial performance and identify trends in data. [Apply]<br>3) Conduct comprehensive financial data collection, processing, and analysis to support investment and risk management strategies. [Apply]<br>4) Create and interpret visualizations of financial data to effectively communicate insights to stakeholders. [Apply] | |
| **Course Content:** | | |
| **Module 1** | Foundations of Financial Data Analysis | **15 Hours** |
| **Topics**: Introduction to Financial Analytics - What is financial data analytics? - Types of financial data: structured vs unstructured, Data challenges - Role of analytics in portfolio management and trading, Overview of analytics tools and languages, Case Study: Application of financial analytics in a real-world scenario; Financial Instruments and Data Sources - Overview of stock markets, bonds, and derivatives - Financial statements and macroeconomic data - Common financial databases - Data frequency - Understanding time stamps and event-driven data; Python Setup for Finance; NumPy and pandas Essentials<br><br>**Lab Activities:**<br>Python Environment Setup for Finance - Data Structures in NumPy & pandas - Reading & Writing Financial Data - Exploratory Data Analysis (EDA) - Working with DateTime and Time Series Indexing | | |
| **Module 2** | Statistical Methods & Financial Time Series | **15 Hours** |
| Topics: Descriptive Statistics: Central tendency - Dispersion: Variance, Standard deviation, Range, MAD - Distribution shapes: Skewness, Kurtosis - Covariance and correlation - Statistical visualization techniques; Probability and Distributions - Financial Time Series Basics - Returns and Performance Metrics<br><br>**Lab Activities:**<br>Descriptive Statistics in Python - Probability Distributions - Time Series Analysis - Rolling Windows and Moving Averages - Mini Project 2: Time Series Forecasting | | |
| **Module 3** | Machine Learning & Optimization for Finance | **15 Hours** |
| Topics: Introduction to Machine Learning in Finance - Regression Analysis - Portfolio Optimization - Risk and Portfolio Management<br>Lab Activities:<br><br>Machine Learning Workflow - Regression Analysis - Regularization Techniques - Advanced Machine Learning Techniques - Mini Project 3: Predictive Modeling | | |
| **Module 4** | Applications in Real-World Financial Data | **15 Hours** |
| Topics: Case Studies in Finance - Ethics and Interpretability - Trading Strategies and Backtesting - Derivatives and Option Pricing<br>Lab Activities: | | |

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| Case Study Analysis - Ethical Considerations in Financial Models - Trading Strategy Development - Option Pricing Models |
| **Targeted Application & Tools that can be used:**<br>**Application Area are Decision making in business, health care, financial sector, Medical diagnosis etc...**<br>**Microsoft excel, r studio, SaaS, python, Graphana, Dashbuilder.** |
| **Project work/Assignment: Mention the Type of Project /Assignment proposed for this course** |
| **1.** Statistical Analysis of Financial Performance.<br>**2.** Business Problem Identification and Financial Visualization<br>**3.** Predictive Modeling for Stock Prices.<br>**4.** Interactive Dashboard for Financial KPIs. |
| **Text Book**<br>1. Financial Data Analytics with Machine Learning, Optimization, and Statistics, Cheng-Few Lee, John C. Lee, Jow-Ran Chang, and Tzu Tai, Wiley, 2023.<br>2. Python for Finance: Mastering Data-Driven Finance, Yves Hilpisch, O'Reilly Media, 2nd edition, 2018. |
| **References**<br>1. Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter (3rd Edition), Wes McKinney, O'Reilly Media, 2022.<br>**2.** Data Science and Analytics with Python, A.K. Tyagi, Chapman and Hall/CRC, 2021. |
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| **Catalogue prepared by** | Dr. Leelambika KV |
| **Recommended by the Board of Studies on** | |

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|---|---|---|---|---|---|---|
| Course Code:<br>**CSD3410** | Course Title: **IoT and Sensor Data Analysis**<br>Type of Course: Theory | L- P- T-C | **3** | **0** | **0** | **3** |
| Version No. | 1.0 | | | | | |
| Course Pre-requisites | NIL | | | | | |
| Anti-requisites | NIL | | | | | |
| Course Description | This course provides an in-depth understanding of IoT and sensor data analysis, focusing on data acquisition, storage, processing, and interpretation. Students will explore scalable platforms, data flow architectures, and analytical techniques for extracting meaningful insights from sensor-generated data. Emphasis is placed on real-time processing, system integration, and the use of tools like Spark, Kafka, and NoSQL databases in IoT environments. | | | | | |
| Course Outcomes | On successful completion of this course the students shall be able to:<br>• Design IoT data pipelines for efficient data acquisition and processing. *(Bloom's Level: **Create**)*<br>• Manage sensor data using appropriate storage systems such as NoSQL and distributed databases.*(Bloom's Level: **Apply**)*<br>• Apply real-time and historical data analysis techniques using platforms like Apache Spark and Kafka.*(Bloom's Level: **Apply**)* | | | | | |

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| | • Interpret sensor data to support data-driven decision-making in real-world IoT scenarios.*(Bloom's Level: **Analyze**)*<br>• Demonstrate practical skills in using big data platforms for sensor data analytics in IoT environments.*(Bloom's Level**: Apply**)* |

Course Content:

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|---|---|---|---|---|
| Module 1 | **Introduction to IoT and Sensor Data** | Assignment | | 10 Classes |

IoT ecosystem and architecture – Types and characteristics of sensors – Sensor data acquisition and communication protocols – Data quality and preprocessing – Overview of data analysis in IoT systems.

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| Module 2 | **Sensor Data Storage and Management** | Assignment | | 13 Classes |

Sensor data modeling – Storage formats and time-series databases – NoSQL databases: Cassandra, MongoDB – Data retention and access strategies – Comparison with traditional storage systems.

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| Module 3 | **Data Processing and Analysis** | Assignment | | 10 Classes |

Batch vs. real-time analysis – Data pipelines and stream processing – Tools and platforms: Spark, Kafka – Sensor data ingestion and transformation – Data visualization and reporting.

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|---|---|---|---|---|
| Module-4 | **Applications and Case Studies** | Assignment | | 12 Classes |

Machine learning for sensor data analysis – Use cases in smart cities, healthcare, and industry – Predictive maintenance and anomaly detection – Integration with cloud and edge platforms .

Project work/Assignment:

Assignment 1 on (Module 1 and Module 2 )

Assignment 2 on (Module 3 and Module 4)

REFERENCE MATERIALS:

TEXTBOOKS


1. Harry G. Perros, *An Introduction to IoT Analytics*, Chapman & Hall/CRC, 1st Edition, 2021, ISBN: 978-0367686314.
2. Hwaiyu Geng (Editor), *Internet of Things and Data Analytics Handbook*, Wiley, 1st Edition, 2017, ISBN: 978-1119173625.


REFERENCES


1. Gerard Maas and François Garillot, *Stream Processing with Apache Spark: Mastering Structured Streaming and Spark Streaming*, O'Reilly Media, 1st Edition, 2019, ISBN: 978-1491944240.

2. Pramod J. Sadalage and Martin Fowler, *NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence*, Addison-Wesley, 1st Edition, 2012, ISBN: 978-0321826626.

3. Anghel Leonard, *Data Stream Development with Apache Spark, Kafka, and Spring Boot*, Packt Publishing, 1st Edition, 2019, ISBN: 978-1789539585.

JOURNALS/MAGAZINES

1. IEEE Internet of Things Journal
2. IEEE Sensors Journal
3. IEEE Internet of Things Magazine
4. ACM Transactions on Sensor Networks (TOSN)

SWAYAM/NPTEL/MOOCs:

**2.** MOOCs(Udemy) –IoT Data Analytics

Web link: https://www.udemy.com/course/iot-data-analytics/?couponCode=LEARNNOWPLANS

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| Catalogue prepared by | Dr.K.Marimuthu |
| Recommended by the Board of Studies on | |
| Date of Approval by the Academic Council | |

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|---|---|---|---|---|---|---|
| **Course Code: CSD3404** | **Course Title:** E-Business and Marketing Analytics<br>**Type of Course: Theory** | **L-T- P- C** | 2 | 0 | 0 | 2 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | | | | | | |
| **Anti-requisites** | NIL | | | | | |
| **Course Description** | **This course provides an in-depth exploration of how data-driven decision-making is transforming digital marketing and e-business strategies. Students will learn to use analytical tools to measure, interpret, and optimize marketing campaigns and online business performance. The course integrates concepts of digital marketing, e-commerce, customer behavior analytics, and ROI optimization.** | | | | | |
| Course Objective | The objective of the course is to familiarize the learners with the concepts of E-Business and Marketing Analytics and attain **Employability** through **Participative Learning** techniques. | | | | | |
| **Course Out Comes** | **On successful completion of the course the students shall be able to:**<br><br>**CO1**: Understand the foundations and business models of e-commerce and digital marketing. | | | | | |

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| | **CO2**: Apply analytics tools to measure and improve online customer acquisition, conversion, and retention.<br><br>**CO3**: Analyze marketing campaigns using web, social media, and customer data.<br><br>**CO4**: Evaluate marketing performance using KPIs, dashboards, and ROI metrics. |
| **Course Content:** | |

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| **Module 1: Foundations of Machine Learning and Intelligent Systems** | | **8 Sessions** |
| | E-business models, architecture, and trends, Introduction to digital marketing channels, Customer journey and digital touchpoints, Online consumer behavior | |
| **Module 2: Web and Social Media Analytics** | | **8 Sessions** |
| | Web analytics (Google Analytics, metrics, funnels), Traffic sources and visitor segmentation, Social media listening and engagement metrics, Sentiment analysis and trend tracking | |
| **Module 3 Customer and Marketing Analytics** | | **7 Sessions** |
| | Customer segmentation and profiling, RFM and CLV analysis, A/B testing and experimentation, Predictive modeling in marketing (churn, conversion) | |
| **Module 4 Campaign Measurement and ROI Optimization** | | **7 Sessions** |
| | Marketing KPIs and dashboards, Attribution models and ROI measurement, Marketing automation and CRM analytics, Case studies in e-commerce and digital campaigns. | |
| | **Text Book**<br>***Title: Marketing Analytics: A Practical Guide to Real Marketing Science,Author**: Mike Grigsby,**Publisher**: Kogan Page,**Edition**: 2nd Edition,**Year of Publication**: **2022,ISBN**: 9781398604083* | |
| | **R1 :Title :E-Commerce 2023: Business, Technology, Society,Authors**: Kenneth C. Laudon, Carol Guercio Traver,**Publisher**: Pearson Education, **Edition**: 17th Global Edition,**Year**: **2023**<br>**ISBN**: 9781292409538<br>R2: **Marketing Data Science: Modeling Techniques in Predictive Analytics with R and Python,Author**: Thomas W. Miller,**Publisher**: Pearson FT Press,**Edition**: 2nd Edition,**Year**: **2021, ISBN**: 9780135267042 | |
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| **Catalogue prepared by** | Dr.Saira Banu Atham |
| **Recommended by the** | |

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| **Board of Studies on** | |
| **Date of Approval by the Academic Council** | |

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| **Course Code: CSD3407** | **Course Title: Statistical Inference and Modeling**<br>**Type of Course:1] Program Core** | **L-T-P-C** | **3** | **0** | **0** | **3** |

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| **Version No.** | | 1.0 |
| **Course Pre-requisites** | | Introduction to Probability<br>Calculus II |
| **Anti-requisites** | | **NIL** |
| **Course Description** | | This course introduces students to the principles and methods of statistical inference and modeling. Topics include estimation, hypothesis testing, confidence intervals, and both parametric and non-parametric models. Emphasis is placed on understanding theoretical foundations and applying statistical models to real-world data through computational tools. The course aims to build a strong conceptual and practical understanding of inference and modeling to prepare students for more advanced statistical and data science coursework. Students will learn how to analyze data, draw meaningful conclusions, and build predictive models using statistical techniques. |
| **Course Objective** | | The objective of the course is to familiarize the learners with the concepts of Statistica Inference and Modeling for **Employability** through **Problem Solving** Methodologies. |
| **Course Out Comes** | | On successful completion of this course the students shall be able to:<br>1. Apply sampling and estimation procedures to appropriately use and construe complex data. (Understand)<br>5. Design experiments by ANOVA and determine the existence of a statistically significant difference among several groups means. (Apply)<br>6. Develop appropriate regression models to predict the desired parameters. (Apply)<br>7. Apply non-parametric tests for uncertain distributions and decision analysis to identify feasible and viable decision alternatives. (Apply) |
| **Course Content:** | | |

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| **Module 1** | **SAMPLING AND ESTIMATION, HYPOTHESIS TESTING** | Assignment | **14 Hours** |
| Random vs Non-random sampling, Errors in sampling, Central Limit Theorem, Types of estimates, Estimating population mean using z and t statistics, Confidence interval estimation, Maximum likelihood estimation. Procedure for Hypothesis testing, Two tailed and one tailed Hypothesis testing, Type 1 and Type 2 errors, Hypothesis testing using z and t statistics, Chi-square test | | | |

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| **Module 2** | **ANALYSIS OF VARIANCE AND EXPERIMENTAL DESIGNS** | Assignment | **10 Hours** |
| Analysis of variance, Completely Randomized design (One way ANOVA), Randomized Block design, Factorial Design (Two way ANOVA) | | | |
| **Module 3** | **REGRESSION MODELING STRATEGIES** | Assignment | **10 Hours** |
| Planning for modeling, Choice of the model, model formulation, Interpreting Modeling parameters, Assessment of model fit, Missing data; describing, Resampling, validating and simplifying the model; Simple and Multiple Linear Regression, residual analysis, Collinearity, Multiple regression model with two independent variables . | | | |
| **Module 4** | **NON-PARAMETRIC STATISTICS AND STATISTICAL DECISION THEORY** | Assignment | **11 Hours** |
| Runs Test, Mann-Whitney Test, Wilcoxon Test, Kruskal-Walis Test, Friedman Test, Spearman's Rank correlation. Decision making under uncertainty - Laplace, Hurwicz and Savage criteria; Decision making under risk – Expected monetary Value, Expected Opportunity Loss, Expected Value of Perfect Information; Decision trees. | | | |

**Text Book**

3. Naval Bajpai, Business Statistics, Pearson, Second Edition 2013.
4. Casella and Berger, Statistical Inference, Cengage Learning, 2001.

**References**

4. Frank E HarrelJr.,Regression Modeling Strategies, Springer, Second Edition, 2006
5. Andrew Gelman and Jennifer Hill, Data Analysis using Regression and multi level/hierarchical models, Cambridge, 2007
6. J K Sharma, Business Statistics, Vikas, Fifth Edition, 2020

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| **Catalogue prepared by** | Dr. Manjunath KV |
| **Recommended by the Board of Studies on** | |
| **Date of Approval by the Academic Council** | |

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| **Course Code: CSD3403** | **Course Title: Optimization Techniques for Data Science**<br>**Type of Course: Theory Integrated** | **L- T-P-C** | **2** | **0** | **2** | **3** |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | **MAT 1001** | | | | | |

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| **Anti-requisites** | **NIL** | | | |
| **Course Description** | This course provides a comprehensive introduction to optimization techniques with a strong focus on their applications in data science and machine learning. Students will explore the mathematical foundations of optimization, including convexity, duality, and gradient-based methods, and apply them to solve real-world problems involving regression, classification, clustering, and neural network training. The course covers both unconstrained and constrained optimization, delves into modern algorithms like stochastic gradient descent and Adam, and introduces advanced topics such as non-convex optimization and hyperparameter tuning. Through a blend of theory, algorithmic development, and hands-on coding assignments, students will gain the skills needed to formulate and solve optimization problems critical to effective data-driven decision making. | | | |
| **Course Objectives** | The objective of the course is to familiarize the learners with the concepts of **Optimization for data science** and attain **Experiential Learning** and **Problem Solving** techniques. | | | |
| **Course Out Comes** | On successful completion of this course the students shall be able to:<br>1. Describe the fundamental concepts of optimization, including convexity, gradients, and optimality conditions. [Remember]<br>2.Implement and analyze unconstrained optimization algorithms such as gradient descent, stochastic gradient descent, and quasi-Newton methods for solving machine learning models.[Remember]<br>3. Apply constrained optimization techniques, including KKT conditions and duality theory, to solve problems in support vector machines and resource-constrained data science scenarios. [Apply]<br>4.Evaluate and implement advanced optimization methods—including non-convex optimization, hyperparameter tuning, and metaheuristic approaches—in practical data science workflows.[Apply] | | | |
| **Course Content:** | | | | |
| **Module 1** | Foundations of Optimization | Assignment | | **16 Sessions [L-8 + P-8]** |
| **Topics:**<br>Introduction to Optimization in Data Science - Types of Optimization Problems: Convex vs. Non-convex - Mathematical Foundations: Vectors, Norms, Gradients, Hessians - Linear Algebra essentials for optimization - Convex sets and functions -Optimization Problem Formulation- First-order and Second-order Optimality Conditions. | | | | |

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| **Module 2** | **Unconstrained Optimization Techniques** | Assignment | | **16 Sessions [L-8 + P-8]** |
| **Topics:** Gradient Descent and Variants - Stochastic Gradient Descent (SGD)- Mini-batch Gradient Descent - Momentum, RMSProp, Adam. Newton's Method and Quasi-Newton Methods (BFGS, L-BFGS) - Line Search and Step Size Strategies- Convergence Analysis. | | | | |
| **Module 3** | Constrained Optimization and Duality | Quiz | | **16 Sessions [L-8 + P-8]** |
| **Topics:** Lagrange Multipliers - Karush-Kuhn-Tucker (KKT) Conditions- Convex Optimization with Constraints- Duality Theory: Lagrangian Dual, Strong/Weak Duality- Quadratic Programming (QP), Linear Programming (LP)- Optimization in Support Vector Machines (SVM). | | | | |
| **Module 4** | Advanced Topics and Applications in Data Science | Mini Project | | **12 Sessions [L-6 + P-6]** |
| Topics: Non-convex Optimization in Deep Learning -Optimization landscapes of neural networks - Saddle points and local minima -Bayesian Optimization-Hyperparameter Tuning (Grid Search, Random Search, BO)-Optimization in Clustering (e.g., k-means)-Large-scale and Online Optimization-Metaheuristic Methods: Genetic Algorithms, Simulated Annealing. | | | | |
| **List of Laboratory Tasks:**<br>**Lab Sheet 1:**<br>Implement objective functions and gradients using NumPy<br>Visualization of convex functions and gradient descent paths<br>**Lab Sheet 2:**<br>Optimization of logistic regression, linear regression<br>Comparative study of different optimizers on benchmark datasets<br>**Lab Sheet 3:**<br>Use of CVXPY for solving constrained optimization problems<br>Implementing SVM with quadratic programming<br>**Lab Sheet 4:**<br>Hyperparameter optimization for ML models using Optuna<br>Implement a basic neural network optimizer from scratch | | | | |
| **Targeted Application & Tools that can be used:** Google Colab | | | | |
| **Project work/Assignment: Mention the Type of Project /Assignment proposed for this course** | | | | |
| 5] Programming: problem solving and implement it using optimization techniques.<br>6] Real-world data science problem involving optimization | | | | |

**Text Book**

13] Stephen Boyd and Lieven Vandenberghe "Convex Optimization" , 1st Edition (2004), Cambridge University Press.
14] Jorge Nocedal and Stephen J. Wright "Numerical Optimization" 2nd Edition (2006), Springer.
15] Sébastien Bubeck "Convex Optimization: Algorithms and Complexity", 1st Edition (2015), Now Publishers.
16] Suvrit Sra, Sebastian Nowozin, and Stephen J. Wright "Optimization for Machine Learning" 1st Edition (2011), MIT Press.

E Book Link

1. https://web.stanford.edu/~boyd/cvxbook/bv_cvxbook.pdf
2. https://www.math.uci.edu/~qnie/Publications/NumericalOptimization.pdf
3. https://sbubeck.com/Bubeck15.pdf
4. https://vim.ustc.edu.cn/_upload/article/files/86/7f/bf0a1fff499994d5fd8d17a7b5d5/c0feccd1-f58a-40ca-8e2e-720d276be00c.pdf

**Web Links:**

2. Technology Enabled Learning - NPTEL offers as Course on "Optimization for Data Science" by Prof. Pravesh Biyani , IIT, Delhi.

**References**

3] R. Fletcher , Practical Methods of Optimization" 2nd Edition (2021)- Wiley-Interscience publishers
4] Amir Beck "First-Order Methods in Optimization" 1st Edition (2017), SIAM-Society for Industrial and Applied Mathematics publishers.

**Topics relevant to development of "Skill Development":**
Formulating optimization problems from real-world scenarios.

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| **Catalogue prepared by** | Dr.S.Saravana Kumar |
| **Recommended by the Board of Studies on** | |
| **Date of Approval by** | |

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| **the Academic Council** | |

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| **Course Code:** CSD3432 | **Course Title: Quantum Computing and AI**<br>**Type of Course: Integrated** | **L- P-C** | 3 | 0 | 3 |
| **Version No.** | 1 | | | | |
| **Course Pre-requisites** | CSE1500 | | | | |
| **Anti-requisites** | | | | | |
| **Course Description** | This course provides an introduction to the theory and practice of quantum computation. Topics covered include: quantum mechanics to understand quantum computation. Quantum algorithms. The Shor's factorization algorithm Grover's search algorithm Mathematical models of quantum computation, Quantum Machine Learning, and to physical systems. | | | | |
| Course Objective | The objective of the course is to familiarize the learners with the concepts of **Quantum Computing** and attain EMPLOYABILITY SKILLS through EXPERIENTIAL LEARNING techniques | | | | |
| **Course Out Comes** | **On successful completion of the course the students shall be able to:**<br>• Understand the basic principles of quantum computation and quantum mechanics.<br>• Design quantum circuits using quantum gates.<br>• Analyze the behavior of basic quantum algorithms.<br>• Understand the difference between classical and quantum machine learning approach. | | | | |
| **Course Content:** | | | | | |
| **Module 1** | **INTRODUCTION** | **Quiz** | **Quiz** | | **10 sessions (8 T + 2 L)** |
| **Topics:**<br>Introduction to quantum computing. Qubits, Bloch sphere, multiple qubits, quantum states and measurements, Postulates of quantum mechanics, Classical computation vs quantum computation. | | | | | |
| **Module 2** | **QUANTUM MODEL OF COMPUTATION** | **Quiz** | **Quiz** | | **12 sessions (8 T + 4 L)** |
| **Topics:**<br>The model of quantum computation, Quantum circuits: single qubit gates, multiple qubit gates, design of quantum circuits. | | | | | |
| **Module 3** | **QUANTUM ALGORITHMS** | **Assignment** | **Case Studies** | | **12 sessions** |

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| | | | | **(8 T + 4 L)** |
| **Topics:** Deutsch-Jozsa algorithm and Grover's search algorithm. Shor's algorithm for factoring, Quantum Fourier transform. | | | | |
| **Module 4** | **QUANTUM INFORMATION THEORY & QUANTUM MACHINE LEARNING** | **Assignment** | **Case Studies** | **11 sessions (9 T + 2 L)** |
| **Topics:** Comparison between classical and quantum information theory, Applications of quantum information, Bell states, Quantum Machine Learning, no cloning theorem. | | | | |

**Targeted Application & Tools that can be used**

1. Framework- Qiskit
2. Language- Python
3. Applications:
   - Quantum Circuits
   - Quantum Gates
   - Quantum Machine Learning Algorithms

**Project work/Assignment:**

**Assignment:**

- Create quantum circuit functions that can compute the XOR, AND, NAND and OR gates using the NOT gate (expressed as x in Qiskit), the CNOT gate (expressed as cx in Qiskit) and the Toffoli gate (expressed as ccx in Qiskit) .
- Measure the Bloch sphere coordinates of a qubit using the Aer simulator and plot the vector on the Bloch sphere
- Investigate the relationship between the number of qubits required for the desired accuracy of the phase estimation with high probability.

**Project Work:**

- Create a program that builds an oracle for a given string (e.g. given 01101, will return a QuantumCircuit that inverts the phase of the state $|01101\rangle$ and leaves all other states unchanged.
- Tackle an open issue in the Qiskit Terra repo.
- Create a program that builds an oracle circuit from a problem (like the PhaseOracle class does in the previous page). Assess how the size of your circuits grow with the size of the problem.

**Text Book**

1. Nielsen, M., & Chuang, I. (2010). Quantum Computation and Quantum Information: 10th Anniversary Edition. Cambridge: Cambridge University Press. doi:10.1017/CBO9780511976667
2. McMahon D. Quantum Computing Explained. Hoboken N.J: Wiley-Interscience : IEEE Computer Society; 2008.

**References**

1. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific. (2004)
2. Pittenger A. O., An Introduction to Quantum Computing Algorithms (2000).

**E book link R1:**

http://community.qiskit.org/textbook

**E book link R2**

https://github.com/Qiskit

**Web resources:**

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| • Abraham Asfaw and Antonio Corcoles & et al. "Learn Quantum Computation Using Qiskit", 2020, http://community.qiskit.org/textbook<br>• IBM Qiskit Global Summer School 2021: Quantum Machine Learning, https://qiskit.org/events/summer-school/<br>• https://quantum-computing.ibm.com/<br>• https://qiskit.org/<br>• https://presiuniv.knimbus.com/u |
| **Topics relevant to development of "Employability Skills"**<br>• Designing Quantum circuits<br>• Visualizing Quantum Circuit outputs<br>• Analyzing and Comparing Quantum Algorithm Performance for developing Employability Skills through Experiential Learning techniques. This is attained through assessment component mentioned in course handout. |

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| **Catalogue prepared by** | Dr. Jayakumar V |
| **Recommended by the Board of Studies on** | BOS NO: SoCSE01, held on 22/12/2022 |
| **Date of Approval by the Academic Council** | Academic Council Meeting No.20, Dated 15/02/2023 |

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|---|---|---|---|---|---|
| **Course Code:**<br>CSD3433 | **Course TitleComputational Intelligence Research**<br>**Type of Course: Professional Elective& Theory Only** | **L- P- C** | 3 | 0 | 3 |
| **Version No.** | 1.0 | | | | |
| **Course Pre-requisites** | CSE1700 | | | | |
| **Anti-requisites** | - | | | | |
| **Course Description** | This course introduces students to advanced topics and current trends in Computational Intelligence (CI), with an emphasis on research methodologies and problem-solving using intelligent systems. It covers the theoretical foundations and real-world applications of neural networks, evolutionary algorithms, swarm intelligence, fuzzy logic, and hybrid systems. Students will explore research problems, conduct literature reviews, and develop mini-projects or proposals with a focus on innovation and interdisciplinary applications. | | | | |
| **Course Objectives** | 1.The objective of the course is to familiarize the learners with the concepts of To develop an in-depth understanding of advanced computational intelligence techniques. | | | | |

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| | 2.To foster research skills and innovation through the exploration of emerging CI applications. | | |
| **Course Out Comes** | On successful completion of the course the students shall be able to:<br>**CO1:** Analyze the foundations and advancements in computational intelligence methods.<br>**CO2:** Evaluate and compare various CI techniques for real-world problem-solving.<br>**CO3:** Formulate research questions and design experimental setups using CI approaches.<br>**CO4:** Develop research proposals or projects in emerging areas of computational intelligence. | | |
| **Course Content:** | | | |
| **Module 1** | **Introduction to Foundations of Computational Intelligence** | Assignment | 8 |
| **Overview of CI paradigms: neural networks, fuzzy systems, evolutionary computing, and swarm intelligence; History and scope of CI in research.** | | | |
| **Module 2** | **Advanced CI Techniques and Hybrid Models** | Assignment | 10 |
| Neuro-fuzzy systems; Evolutionary-fuzzy hybrid models; Deep neuroevolution; Applications in optimization, robotics, and data analytics. | | | |
| **Module 3** | **Research Methodology in CI** | Assignment /Quiz | 13 |
| Problem formulation; Literature review techniques; Benchmarking and metrics; Tools for scientific computing; Reproducible research in AI. | | | |
| **Module 4** | **Emerging Trends and Research Applications** | Assignment | 12 |
| CI in healthcare, smart cities, cybersecurity, environmental systems; Recent research publications and project case studies; Proposal writing and peer review. | | | |

**Textbook:**

1. ***"Computational Intelligence: Principles, Techniques and Applications"*** **by Jacek M. Zurada, Wiley, 2021.**

**Reference Books:**

1. ***"Swarm Intelligence: From Natural to Artificial Systems"*** **by Eric Bonabeau, Marco Dorigo, Guy Theraulaz, Oxford University Press, 2023.**
2. ***"Fuzzy Logic with Engineering Applications"*** **by Timothy J. Ross, Wiley, 4th Edition, 2023.**
3. ***"Research Methods in Computer Science"*** **by Mannino & Leong, Springer, 2022.**

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|---|---|---|---|---|---|---|
| Course Code:<br>CSD3418 | Course Title: Feature Engineering and Model Optimization<br>Type of Course: Discipline Elective/ Theory Only Course | L- T-P- C | 3 | 0 | 0 | 3 |
| Version No. | | 2.0 | | | | |
| Course Pre-requisites | | | | | | |
| Anti-requisites | | NIL | | | | |
| Course Description | | This course provides a deep dive into the techniques of transforming raw data into valuable inputs for machine learning models through effective feature engineering. It explores strategies for feature selection, transformation, dimensionality reduction, and hyperparameter tuning. Emphasis is placed on model optimization techniques including regularization, ensemble methods, and automated machine learning pipelines. | | | | |
| Course Objective | | The objective of the course is to familiarize the learners with the concepts of Data Mining and attain Employability through Problem Solving Methodologies | | | | |
| Course Out Comes | | Upon successful completion of this course, students will be able to:<br>4. Apply various feature engineering techniques to preprocess and transform data effectively.<br>5. Evaluate and optimize machine learning models using advanced tuning and selection techniques.<br>6. Integrate feature engineering and model optimization strategies into complete machine learning pipelines. | | | | |
| Course Content: | | | | | | |

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| Module 1 | Introduction to Feature Engineering | Assignment | | Data Collection | 10 Sessions |
| | Topics:<br>Understanding data types and quality, Missing value handling, outlier detection, encoding categorical variables, Feature scaling and normalization techniques | | | | |

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| Module 2 | Feature Selection and Extraction | Quiz | | Problem Solving | 10 Sessions |
| | Topics:<br>Filter, wrapper, and embedded methods, Principal Component Analysis (PCA), LDA, t-SNE, Feature importance and interpretability in models | | | | |
| Module 3 | Model Optimization Techniques | Assignment | | Problem Solving | 10Sessions |
| | Topics:<br>Hyperparameter tuning (Grid Search, Random Search, Bayesian Optimization), Cross-validation strategies, Regularization techniques (L1, L2, ElasticNet) | | | | |
| Module 4 | Advanced Techniques and AutoML | Assignment | | Problem Solving | 12 Sessions |
| | Feature generation using domain knowledge and interactions, Ensemble learning and stacking, Introduction to AutoML frameworks (e.g., AutoSklearn, H2O.ai, TPOT) | | | | |
| | 1. Feature Engineering and Selection: A Practical Approach for Predictive Models",Author: Max Kuhn, Kjell Johnson, Publisher: CRC Press, Taylor & Francis Group, Year: 2019<br>2. "Hands-On Feature Engineering with Python", Author: Soledad Galli, Publisher: Packt Publishing, Year: 2020 | | | | |
| | **References:**<br><br>**R1 "Automated Machine Learning: Methods, Systems, Challenges",** Editors: Frank Hutter, Lars Kotthoff, Joaquin Vanschoren, Publisher: Springer, Year: 2021<br><br>**R2 "Machine Learning Engineering",** Author: Andriy Burkov, Publisher: True Positive Inc., Year: 2020<br><br>**Additional web-based resources:**<br><br>W1. https://onlinecourses.swayam2.ac.in/cec20_cs12/preview Text book of Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamber and Jian Pei, Morgan Kaufmann Publishers, 2012. | | | | |

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| | W2.https://puniversity.informaticsglobal.com:2284/ehost/detail/detail?vid=7&sid=e2d7362a-fd3049a98f0393e963521dbd%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=377411&db=nlebk https://nptel.ac.in/courses/105105157 |
| | Topics relevant to "EMPLOYABILITY SKILLS": Data Mining Techniques, FP Growth for developing Employability Skills through Participative Learning techniques. This is attained through the assessment component mentioned in the course handout. |

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| Catalogue prepared by | | Shaik Salma Begum |
| Recommended by the Board of Studies on | | |
| Date of Approval by the Academic Council | | |

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| Course Code:<br>CSD3417 | Course Title: Scientific Computing for Intelligent Systems<br><br>Type of Course: Discipline Elective/ Theory Only Course | L- T-P- C | 3 | 0 | 0 | 3 |
| Version No. | | 2.0 | | | | |
| Course Pre-requisites | | | | | | |
| Anti-requisites | | NIL | | | | |
| Course Description | | This course introduces the fundamentals of scientific computing techniques tailored for intelligent systems. It covers numerical methods, data-driven modeling, optimization, and high-performance computing frameworks. Emphasis is placed on applying computational strategies to AI, machine learning, and large-scale simulation problems. | | | | |

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| Course Objective | | The objective of the course is to familiarize the learners with the concepts of Data Mining and attain Employability through Problem Solving Methodologies |
| Course Out Comes | | Upon successful completion of this course, students will be able to:<br>7. Apply numerical techniques to solve scientific and engineering problems.<br>8. Develop and optimize intelligent algorithms using scientific computing methods.<br>9. Implement data-driven and model-based solutions in real-world intelligent systems.<br>10. Utilize parallel and high-performance computing tools to handle computational complexity. |
| Course Content: | | |

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| Module 1 | Fundamentals of Scientific Computing | Assignment | | Data Collection | 10 Sessions |
| | Topics:<br>Floating point arithmetic and error analysis, Matrix operations and linear algebra, Interpolation, approximation, and numerical differentiation/integration | | | | |
| Module 2 | Solving Scientific Problems using Numerical Methods | Quiz | | Problem Solving | 10 Sessions |
| | Topics:<br>Numerical solutions to linear and non-linear equations, Eigenvalue problems, Ordinary and partial differential equations | | | | |
| Module 3 | Intelligent Systems and Computational Modeling | Assignment | | Problem Solving | 10Sessions |
| | Topics:<br>Basics of intelligent systems and soft computing, Computational modeling in intelligent applications, Data-driven modeling techniques for simulations | | | | |
| Module 4 | High-Performance and Parallel Computing for AI | Assignment | | Problem Solving | 13 Sessions |

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| | Introduction to HPC frameworks (MPI, OpenMP, CUDA), Scientific computing libraries (NumPy, SciPy, TensorFlow, PyTorch), Case studies in scientific applications of AI and machine learning |
| | 3. **"Numerical Analysis"** by Richard L. Burden and J. Douglas Faires, Cengage Learning, 11th Edition, 2022.<br>4. **"Scientific Computing: An Introductory Survey"** by Michael T. Heath, McGraw Hill Education, 2nd Edition, 2018. |
| | **References:**<br><br>**R1** "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython" by Wes McKinney, O'Reilly Media, 3rd Edition, 2022**.**<br><br>**R2 "**Parallel and High-Performance Computing" by Robert Robey and Yuliana Zamora, O'Reilly Media, 2021.<br><br>.<br><br>**Additional web-based resources:**<br><br>W1. https://onlinecourses.swayam2.ac.in/cec20_cs12/preview Text book of Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamber and Jian Pei, Morgan Kaufmann Publishers, 2012.<br><br>W2.https://puniversity.informaticsglobal.com:2284/ehost/detail/detail?vid=7&sid=e2d7362a-fd3049a98f0393e963521dbd%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=377411&db=nlebk https://nptel.ac.in/courses/105105157 |
| | Topics relevant to "EMPLOYABILITY SKILLS": Data Mining Techniques, FP Growth for developing Employability Skills through Participative Learning techniques. This is attained through the assessment component mentioned in the course handout. |

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| Catalogue prepared by | | Shaik Salma Begum |
| Recommended by the Board of Studies on | | |
| Date of Approval by the | | |

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|---|---|---|---|---|---|---|
| **Course Code: CSD3408** | **Course Title:** Data Mining and Warehousing<br>**Type of Course:1] Program Core** | **L-T-P-C** | **3** | **0** | **0** | **3** |

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| **Version No.** | | 1.0 |
| **Course Pre-requisites** | | CSE1510 |
| **Anti-requisites** | | **NIL** |
| **Course Description** | | This course covers the fundamental concepts, techniques, and tools used in data mining and data warehousing. Students will learn how to design and implement data warehouses and how to extract meaningful patterns and knowledge from large datasets using data mining methods. Topics include data preprocessing, association rules, classification, clustering, OLAP operations, and warehouse schema design. Real-world applications and hands-on projects using industry-standard tools form an essential part of the learning experience. |
| **Course Objective** | | To teach principles, concepts and applications of data warehousing and data mining To introduce the task of data mining as an important phase of knowledge recovery process To inculcate Conceptual, Logical, and Physical design of Data Warehouses OLAP applications and OLAP deployment. for **Employability** through **Problem Solving** Methodologies. |
| **Course Out Comes** | | On successful completion of this course the students shall be able to:<br>1. Design a data mart or data warehouse for any organization (Understand)<br>8. Extract knowledge using data mining techniques. (Apply)<br>9. Adapt to new data mining tools. (Apply)<br>10. Explore recent trends in data mining such as web mining, spatial-temporal mining. (Apply) |
| **Course Content:** | | |

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|---|---|---|---|
| **Module 1** | **Introduction to Data Mining** | Assignment | **10 Hours** |
| Data Mining - Definition - DM Techniques - Current Trends in Data Mining - Different forms of Knowledge - Data Selection, Cleaning, Integration, Transformation, Reduction and Enrichment. Data: Types of Data - Data Quality - Data Preprocessing - Measures of Similarity and Dissimilarity. Exploration: Summary Statistics Visualization. | | | |

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| **Module 2** | **Data Warehouse** | Assignment | **10 Hours** |
| Introduction to Data Ware House, Differences between operational data base systems and data Ware House, Data Ware House characteristics, Data Ware House Architecture and its components, Extraction-Transformation-Loading, Logical (Multi- Dimensional), Data Modeling, Schema Design, star and snow-Flake Schema, Fact Constellation, Fact Table, Fully Addictive, Semi-Addictive, Non-Addictive Measures. | | | |
| **Module 3** | **ASSOCIATION RULE MINING AND CLASSIFICATION** | Assignment | **13 Hours** |
| Introduction: - Clustering Paradigms - Partitioning Algorithms - K Means & K Medoid Algorithms - CLARA - CLARANS - Hierarchical Clustering - DBSCAN - BIRCH - Categorical Clustering Cluster Density-Based Clustering, Graph-Based Clustering, Scalable Clustering Algorithms. | | | |
| **Module 4** | **WEB MINING** | Assignment | **12 Hours** |
| Introduction: Web Content Mining - Web Structure Mining - Web Usage Mining - Text Mining - Text Clustering, Temporal Mining - Spatial Mining. Visual Data Mining: Knowledge Mining - Various Tools and Techniques for Implementation using Weka, Rapidminer and MATLAB. | | | |

**Text Book**

5. Introduction to Data Mining, Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Pearson Education.
6. Data Mining-Concepts and Techniques- Jiawei Han, Micheline Kamber, Morgan Kaufmann Publishers, Elsevier, 2 Edition, 2006.

**References**

7. Data Mining Techniques, Arun K Pujari, 3rd Edition, Universities Press.
8. Data Ware Housing Fundamentals, Pualraj Ponnaiah, Wiley Student Edition.
9. The Data Ware House Life Cycle Toolkit- Ralph Kimball, Wiley Student Edition.
10. Data Mining, Vikaram Pudi, P Radha Krishna, Oxford University

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| **Catalogue prepared by** | Dr. Manjunath KV |
| **Recommended by the Board of Studies on** | |
| **Date of Approval by the Academic Council** | |

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| **Course Code: CSD3402** | **Course Title:** Web Data Analytics for Data Science<br>**Type of Course: Integrated** | **L-T- P- C** | 2 | 0 | 2 | 3 |
| **Version No.** | 1.0 | | | | | |

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| **Course Pre-requisites** | CSE2074 |
| **Anti-requisites** | NIL |
| **Course Description** | **This course introduces tools and techniques for extracting, processing, and analyzin data from the web. Students will gain hands-on experience with web scrapin working with APIs, analyzing web server logs, and performing sentiment analys using social media data. The course emphasizes deriving insights for real-worl applications in data science.** |
| Course Objective | 1.To provide practical exposure to web data extraction, preprocessing, and API handling.<br>2. To enable analysis of user behavior through web logs and social media trends for business and research decisions.<br>3. To develop visualization and reporting skills for web data-driven insights.<br>. |
| **Course Out Comes** | **On successful completion of the course the students shall be able to:**<br>**CO1**: Extract and process structured/unstructured web data using automated tools.<br>**CO2**: Analyze user behavior patterns from web usage and clickstream data.<br>**CO3**: Perform sentiment and trend analysis using APIs and social media platforms.<br>**CO4**: Design dashboards and visualize web analytics results effectively. |

**Course Content:**

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| **Module 1: Web Data Extraction and Preprocessing** | | **8 Sessions** |
| | Introduction to HTML, DOM, and web crawling, Web scraping using Python (BeautifulSoup, Scrapy Working with REST APIs and JSON/XML data, Ethical and legal considerations in web data extractio | |
| **Module 2: Web Usage and Log Data Analytics** | | **8 Sessions** |
| | Web server log structure and preprocessing, Session identification and user behavior modellin Clickstream analysis and heatmap interpretation, Metrics: bounce rate, session duration, conversio tracking. | |
| **Module 3 Social Media and Open Web Analytics** | | **7 Sessions** |
| | Sentiment analysis on Twitter, Reddit, etc.,Trend analysis and opinion mining, Google Trends an open web metrics,Case studies and dashboard creation with real-time data | |

| Exp. No. | Title |
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| 1 | Extract data from static web pages using BeautifulSoup |
| 2 | Perform web scraping from paginated or dynamic content using Scrapy |
| 3 | Access and parse REST APIs (e.g., GitHub, Twitter) with JSON data |

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| | 4 | Clean and preprocess web server logs (Apache or Nginx formats) |
| | 5 | Identify sessions and users from clickstream logs |
| | 6 | Perform sentiment analysis using Twitter API and TextBlob/VADER |
| | 7 | Conduct trend analysis using Google Trends and visualize it |
| | 8 | Create a live dashboard using Streamlit/Plotly to present web insigh |
| | Text Book<br>Title: Mining the Web: Discovering Knowledge from Hypertext Data, Author: Soumen Chakrabarti, Publisher: Morgan Kaufmann (Elsevier),Year of Publication: 2022 Reprint Edition (original concepts updated with modern tools and use cases),ISBN: 9780128164852 | |
| | R1 :Title :Mining the Web: Discovering Knowledge from Hypertext Data, Author: Soumen Chakrabart Publisher: Morgan Kaufmann (Elsevier),Year: 2022 Reprint Edition,ISBN: 9780128164852<br>R2: Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data, Authors: Bing Liu, Publishe Springer,Edition: 2nd Edition,Year: 2020,ISBN: 9783030421568.<br>R3: Data Wrangling with Python: Tips and Tools to Make Your Life Easier,Author: Jacqueline Kazi Katharine Jarmul, Publisher: O'Reilly Media,Edition: 2nd Edition, Year: 2022, ISBN: 9781098102012 | |

| Course Code: **PPS 4004** | **Course Title: Aptitude Training-Intermediate**<br>Type of Course: Practical Only Course | L- T - P- C | 0 | 0 | 2 | 1 |
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| Version No. | 1.0 | | | | | |
| Course Pre-requisites | Students should have the basic concepts of Quantitative aptitude along with its applications in real life problems. | | | | | |
| Anti-requisites | NIL | | | | | |

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| Course Description | This is a skill-based training program for the students. This course is designed to enable the students to enhance their skills in Quantitative Aptitude. | | |
| **Course Objective** | **The objective of the course is to familiarize the learners with the concepts of Aptitude and attain Skill Development through Problem Solving techniques.** | | |
| Course Out Comes | **On successful completion of this course the students shall be able to:**<br>CO1: Recall all the basic mathematical concepts.<br>CO2: Identify the principle concept needed in a question.<br>CO3: Solve the quantitative and logical ability questions with the appropriate concept.<br>CO4: Analyze the data given in complex problems. | | |
| Course Content: | | | |
| Module 1 | **Quantitative Ability 1** | Assignment | **16 Hours** |
| Topics:<br>Number System, Percentage, Ratio and Proportion, Average, Mixture and Allegation, Time and Work, Profit and Loss | | | |

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| Module 2 | Quantitative Ability 2 | Assignment | **14 Hours** |
| Topics:<br>Time Speed and Distance, Boats and Streams, Simple Interest, Compound Interest, Probability, Permutation and Combination | | | |
| Targeted Application & Tools that can be used:<br>Application area: Placement activities and Competitive examinations. Tools:<br>LMS | | | |
| **Continuous Evaluation:** | | | |
| CA1 – Online Test<br>CA2 – Online Test<br>CA3 – Online Test<br>Assignment | | | |
| **Text Book:**<br>1. Fast Track Objective by Rajesh Verma<br>2. R S Aggarwal<br>3. Rakesh Yadav<br><br>**References:**<br>**1. www.indiabix.com**<br>**2. www.testbook.com**<br>**3. www.youtube.com/c/TheAptitudeGuy/videos** | | | |
| Topics relevant to Skill Development: Quantitative aptitude for Skill Development through Problem solving Techniques. This is attained through components mentioned in course handout. | | | |

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| Catalogue prepared by | Faculty of L&D |
| Recommended by the Board of Studies on | **BOS held on** |
| Date of Approval by the Academic Council | **Academic Council Meeting held on** |

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

# PRESIDENCY UNIVERSITY

Private University Estd. in Karnataka State by Act No. 41 of 2013

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| **Course Code:** APT4026 | **Course Title:** Aptitude For Employability<br>**Type of Course:** Practical Only | **L- T-P- C** | 0 | 0 | 2 | 0 |

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| **Version No.** | | 1.0 |
| **Course Pre-requisites** | | Students should have the basic concepts of Quantitative aptitude, Verbal ability along with its applications in real life problems. |
| **Anti-requisites** | | Nil |
| **Course Description** | | This course is designed to enable the students to enhance their skills in quantitative aptitude and verbal ability skills. |
| **Course Objective** | | The objective of the course is to familiarize the learners with concepts in Quantitative Aptitude and Verbal ability through problem solving techniques suitable for their career development. |
| **Course Outcomes** | | On successful completion of the course the students shall be able to:<br>CO1] **Recall** all the basic mathematical concepts<br>CO2] **Identify** the principle concept needed in a question<br>CO3] **Solve** the quantitative and logical ability questions with the appropriate concept. |
| **Course Content:** | | |

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| **Module 1** | Quantitative Ability | Lab-10hrs | | Platform Assessment-10hrs | **20 Hours** |
| | Topics:<br>Number System, Percentage, Ratio and Proportion, Average, Mixture and Allegation, Time and Work, Profit and Loss, Time Speed and Distance, Simple Interest and Compound Interest, Probability, Permutation and Combination. | | | | |
| **Module 2** | Verbal Ability | Lab-5hrs | | Platform Assessment-5hrs | **10 Hours** |
| | Topics: - Parts of Speech, Subject Verb Agreement, Spotting Error, Cloze Test, Verbal Analogies, Reading Comprehension, Idioms & Phrases, Para Jumbles | | | | |
| | **Targeted Application & Tools that can be used:**<br>Application area: Placement activities and Competitive examinations.<br>Tools: LMS | | | | |
| **Evaluation** | **Continuous Evaluation**<br>• Topic wise evaluation | | | | |

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| | **Text Book**<br>1. Fast track objective by Rajesh Verma<br>2. R S Aggarwal<br>3. S.P Bakshi |
| | **References**<br>1. www.indiabix.com<br>2. www.testbook.com<br>3. www.youtube.com/c/TheAptitudeGuy/videos |
| | **Topics relevant to Skill development:** Quantitative and reasoning aptitude for Skill Development through Problem solving Techniques. This is attained through assessment component mentioned in course handout. |

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| **Catalogue prepared by** | | Faculty of L&D |
| **Recommended by the Board of Studies on** | | |
| **Date of Approval by the Academic Council** | | |

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|---|---|---|---|---|---|---|
| **Course Code: APT4006** | **Course Title: Logical and Critical Thinking**<br>**Type of Course:** Audited | **L- T-P- C** | 0 | 0 | 2 | 0 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | Students should have the basic concepts of Logical reasoning and Critical thinking, along with its applications in real life problems. | | | | | |
| **Anti-requisites** | Nil | | | | | |
| **Course Description** | This is a skill-based training program for the engineering students (Undergraduate). This course is designed to enable the students to enhance their skills in Logical reasoning and Critical thinking. | | | | | |
| **Course Objective** | The objective of the course is to familiarize the learners with concepts in in Logical reasoning and Critical thinking through problem solving techniques suitable for their career development. | | | | | |
| **Course Outcomes** | On successful completion of the course the students shall be able to: | | | | | |
| | CO1] **Understand** all the concepts. | | | | | |
| | CO2] **Apply** the concepts in problem solving (Bloom's taxonomy Level 3) | | | | | |
| | CO3] **Analyze** and structure the reasoning techniques and spatial visualization skills | | | | | |
| **Course Content:** | | | | | | |
| **Module 1** | Logical Thinking | Assignment | | | | **16 Hours** |
| | **Topics:** | | | | | |
| | Syllogisms, Cubes and Dices, Mirror and Water images, Paper cutting and Folding, Embedded figures & Completion of figures, Data Interpretation, Data sufficiency | | | | | |
| **Module 2** | Critical Thinking | Assignment | | | | **14 Hours** |
| | **Topics:** | | | | | |
| | Analogy, Symbol and Notations, Statement and assumption, Cause of action, Statement and conclusion, Puzzles | | | | | |
| | **Targeted Application & Tools that can be used:** | | | | | |
| | Application area: Placement activities and Competitive examinations. | | | | | |
| | Tools: LMS | | | | | |
| **Evaluation** | **Continuous Evaluation** | | | | | |
| | · Topic wise evaluation | | | | | |
| | · Internal Assessments | | | | | |
| | **Text Book** | | | | | |
| | 1. A new approach to reasoning verbal, non-verbal & analytical by BS Sijwali | | | | | |
| | 2. R S Aggarwal | | | | | |
| | 3. Kiran publications | | | | | |
| | **References** | | | | | |
| | 1. www.indiabix.com | | | | | |

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| | 2. www.testbook.com<br>3. www.youtube.com/c/TheAptitudeGuy/videos |
| | **Topics relevant to Skill Development:** Logical reasoning and Critical thinking for Skill Development through Problem solving Techniques. This is attained through assessment component mentioned in course handout. |
| **Catalogue prepared by** | L&D Department Faculty Member |
| **Recommended by the Board of Studies on** | |
| **Date of Approval by the Academic Council** | |

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|---|---|---|---|---|---|---|
| Course Code: PPS 4027 | **Course Title: Preparedness for Interview**<br>Type of Course: Practical Only Course | L- T- P- C | 0 | 0 | 2 | 0 |

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| Version No. | | 1.0 |
| Course Pre-requisites | | Students are expected to understand Basic English.<br>Students should have desire and enthusiasm to involve, participate and learn. |
| Anti-requisites | | NIL |
| Course Description | | This course is designed to enable students to understand soft skills concepts to be corporate ready. The modules are set to improve self-confidence, communicate effectively and Prepare for the Interview to assist in employability. It helps the students to get a glimpse of the acceptable corporate readiness and equip them with the fundamental necessities of being able to confidently deal with the highly competitive corporate environment and helps in crafting different types of resumes. The pedagogy used will be group discussions, flipped classrooms, continuous feedback, role-play and mentoring. |
| **Course Objective** | | The objective of the course is to familiarize the learners with the concepts of "**Preparing for Interview**" and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques. |
| Course Out Comes | | **On successful completion of this course the students shall be able to:**<br>CO1: **Develop** professional Resumes<br>CO2: **Illustrate** Resumes effectively<br>CO3: **Apply** skills and knowledge learnt for active and effective Group Discussions and Interview |

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| Course Content: | | | | |
| Module 1 | **Resume Building** | **Classroom activity** | | 10 Hours |
| | **Topics:** Resume structure, use of templates, Do's and Don'ts, ATS methods, Cover Letter and Video Resume<br>**Activity:** Real world scenarios | | | |

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| Module 2 | **Group Discussion** | **Mock G D** | | 9 Hours |
| | **Topics: -**Group discussion as a placement process, GD techniques like Keyword. SPELT & POV of affected parties. Do & Don't of GD, Case-lets and topics for GD, practice session and evaluation<br>**Activity:-** Real world scenarios | | | |
| Module 3 | **Personal Interview** | **Grooming checks + Evaluation + Mock Interview+ Role Play** | | 9 Hours |
| | **Topics:** Placement process, Different interview rounds, HR interviews, Interview questions and desired answers, Different types of interviews, Do's and Don'ts.<br>**Activity: -** Role Play & Real-world scenario | | | |
| Module 4 | **Recap/Revision /Feedback Session** | **Practice sessions** | | 2 Hours |
| | Targeted Application & Tools that can be used:<br>1. TED Talks<br>2. You Tube Links<br>3. Role Play activities | | | |
| | **Project work/Assignment: Mention the Type of Project /Assignment proposed for this course** | | | |
| | Continuous Individual Assessment | | | |
| | **The Topics related to Skill Development:**<br>Art Of Presentation and Group Discussion for **Skill Development** through **Participative Learning** Techniques. This is attained through assessment Component mentioned in course handout. | | | |

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| **Catalogue prepared by** | | **Faculty of L&D** |
| **Recommended by the Board of Studies on** | | **BOS held on** |
| **Date of Approval by the Academic Council** | | **Academic Council Meeting held on** |

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|---|---|---|---|---|---|---|
| Course Code: **PPS 1012** | **Course Title: Enhancing Personality through Soft Skills**<br><br>Type of Course: Practical Only Course | L- T - P- C | 0 | 0 | 2 | 1 |
| Version No. | 1.0 | | | | | |
| Course Pre-requisites | • Students are expected to understand Basic English.<br>• Students should have the desire and enthusiasm to be involved, participate and learn. | | | | | |
| Anti-requisites | NIL | | | | | |
| Course Description | This course is designed to enable students to understand soft skills concepts and improve confidence, communication, and professional skills to give the students a competitive advantage and increase chances of success in the professional world. The course will benefit learners in presenting themselves effectively through various activities and learning methodologies. | | | | | |
| **Course Objective** | The objective of the course is to **familiarize the learners with the concepts of "Enhancing Personality through Soft Skills" and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.** | | | | | |
| Course Out Comes | **On successful completion of this course, the students shall be able to:**<br>CO 1 **Identify the stages of** team formation (Remember) CO<br>2 **Demonstrate** effective presentation skills (Apply) CO3<br>**Prepare** professional social media profile (Apply) | | | | | |
| Course Content: | | | | | | |
| Module 1 | Professional Brand Building | Brand Framework Activity | | | **6 Hours** | |

**Topics:** Personal brand definition, Crafting a compelling LinkedIn profile, Networking strategies, Leveraging AI tools for developing content for brand visibility.

**Activity:** Create a post and enhancing LinkedIn profile

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| Module 2 | Art of Questioning | Role plays | **4 Hours** |
| **Topics:** Framing Questions, 5W1H Technique, Open-ended and Close-ended questions, Funnel technique, Probing questions, Leading questions | | | |
| Module 3 | Presentation Skills | Practice and evaluation of individual/group presentation | **12 Hours** |
| **Topics:** Content development, Delivery techniques, Audience Analysis, Timing and Pacing, handling questions and challenges.<br><br>**Activity:** Individual presentations or team presentation | | | |
| Module 4 | Team Building | Team building activities | **6 Hours** |
| **Topics:** Importance of team, stages of Team Formation, Trust and collaboration.<br><br>**Activity: Team Building Activity** | | | |
| Module 5 | Recap / Revision /Feedback Session | Discussion, Quiz | **2 Hours** |
| Targeted Applications & Tools that can be used:<br>4. TED Talks<br>5. You Tube Links<br>6. Activities | | | |
| Project work/Assignment: Mention the Type of Project /Assignment proposed for this course | | | |
| 3) Presentation Evaluation<br>4) LinkedIn assessment | | | |
| **Targeted Applications & Tools that can be used:**<br><br>5. TED Talks<br>6. YouTube Links<br>**7.** Videos by L&D Team shared on Edhitch/YouTube.com<br>**8.** LMS | | | |

**Assignments proposed for this course**

1. Evaluation on Presentation
2. Assignment on LinkedIn Post

YouTube Links: https://youtu.be/z_jxoczNWc (Steve Jobs Introducing the iPhone 4 in June 2010)

References

1. "Talk Like TED - The 9 Public-Speaking Secrets of the World's Top Minds" By Carmine Gallo St. Martin's Press Copyright © 2014 Carmine Gallo All rights reserved. ISBN: 978-1-250-04112-8
2. "The Presentation Secrets of Steve Jobs: How to Be Insanely Great in Front of Any Audience" MP3 CD – Import, 22 April 2014
3. "The Definitive Book of Body Language: The Hidden Meaning Behind People's Gestures and Expressions" Hardcover – Illustrated, 25 July 2006
4. "Crucial Conversations: Tools for Talking When Stakes Are High" Paperback – Import, 1 July 2002

**Web links:**

1. https://www.wordstream.com/blog/ws/2014/11/19/how-to-improve-presentation-skills

https://www.cbs.de/en/blog/15-effective-presentation-tips-to-improve-presentation-skills/

2. https://hbr.org/2022/05/the-art-of-asking-great-questions

**Topics relevant to the development of "SKILL":** Art of Presentation, Team building, Art of questioning, and Personal Branding for Skill Development through Participative Learning Techniques. This is attained through the assessment component mentioned in the course handout.

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| Catalogue prepared by | Faculty of L&D |
| Recommended by the Board of Studies on | |
| Date of Approval by the Academic Council | |

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| Course Code: PPS 1001 | **Course Title: Introduction to Soft Skills**<br>**Type of Course: Practical Only Course** | L- P- C | 0 | 2 | 1 |
| Version No. | 1.0 | | | | |
| Course Pre-requisites | Students are expected to understand Basic English.<br>Students should have desire and enthusiasm to involve, participate and learn. | | | | |
| Anti-requisites | NIL | | | | |
| Course Description | This course is designed to enable students understand soft skills concepts and improve confidence, communication and professional skills to give the students a competitive advantage and increase chances of success in the professional world. The course will benefit learners in presenting themselves effectively through various activities and learning methodologies. | | | | |
| Course Objective | The objective of the course is to **familiarize the learners with the concepts of "Soft Skills" and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.** | | | | |
| Course Out Comes | **On successful completion of this course the students shall be able to:**<br>CO1: **Recognize** significance of soft skills<br>CO2: **Illustrate** effective communication while introducing oneself and others<br>CO3: **List** techniques of forming healthy habits<br>CO4: **Apply** SMART technique to achieve goals and increase productivity | | | | |
| Course Content: | | | | | |

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| Module 1 | INTRODUCTION TO SOFT SKILLS | **Classroom activity** | **04 Hours** |
| **Topics:** Setting Expectations, Ice Breaker, Significance of soft skills, Formal grooming, punctuality | | | |
| Module 2 | EFFECTIVE COMMUNICATION | **Individual Assessment** | **10 Hours** |
| **Topics:** Different styles of communication, Difference between hearing and listening, Effective communication for success, Email etiquette, Self-introduction framework, Video introduction, email- writing, Resume Building- Digital, Video, Traditional. | | | |
| Module 3 | HABIT FORMATION | **Worksheets & Assignment** | **4 Hours** |
| **Topics:** Professional and personal ethics for success, Identity based habits, Domino effect, Habit Loop, Unlearning, standing up for what is right | | | |
| Module 4 | Goal setting & Time Management | **Goal sheet** | **8 Hours** |
| A session where students will be introduced to Time management, setting SMART Goals, Introduction to OKR Techniques, Time Management Matrix, steps to managing time through outbound group activity, making a schedule, Daily Plan and calendars (To Do List), Monitoring/charting daily activity | | | |
| Targeted Application & Tools that can be used: LMS | | | |
| Project work/Assignment: Mention the Type of Project /Assignment proposed for this course | | | |
| 1) Individual Assessment<br>2) LMS MCQ | | | |
| The topics related to Skill Development: Communication and professional grooming, Goal setting and presentation for skill development through participative learning techniques. This is attained through assessment component mentioned in course handout. | | | |
| Catalogue prepared by | L&D Department Faculty members | | |
| Recommended by the Board of Studies on | | | |

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| Date of Approval by the Academic Council | |

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| Course Code: PPS 1002 | **Course Title: Soft skills for Engineers**<br>Type of Course: **Practical Only Course** | L- P- C | 0 | 2 | 1 |
| Version No. | 1.0 | | | | |
| Course Pre-requisites | Students are expected to understand Basic English.<br>Students should have desire and enthusiasm to involve, participate and learn. | | | | |
| Anti-requisites | NIL | | | | |
| Course Description | This course is designed to develop effective communication skills and boost confidence levels. The activity-based modules cover the art of Questioning, how to ask questions, goal setting with emphasis on time and stress management, creating the first impression and introducing one self and finally culminating with the etiquettes of email writing. The pedagogy used will be group discussions, flipped classrooms, continuous feedback, role-play and mentoring. | | | | |
| Course Objective | The objective of the course is to **familiarize the learners with the concepts of "Soft Skills for Engineers and attain Skill Development" through Experiential Learning techniques.** | | | | |
| Course Out Comes | **On successful completion of this course the students shall be able to:**<br><br>CO1 **Employ** effective communication skills<br><br>CO2 **Practice** questioning techniques for better decision making<br><br>CO3 **Differentiate** individual strengths and weaknesses for self-awareness and stress management<br><br>CO4 **Recognise** the need to set SMART GOALS | | | | |

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| Course Content: | | | |
| Module 1 | Art of Questioning | Role plays | 4 classes |
| **Topics:** Note Taking, Framing Open-ended and Close-ended questions, Funnel technique, Probing questions, Leading questions, Rhetorical questions, 5W1H Technique | | | |
| | Vocab Building | | Every Class |
| Dedicate 5-10minutes towards vocabulary building in every session | | | |
| Module 2 | Goal Setting & Time Management | Journal + Outbound training | 8 Classes |
| Goal Setting (SMART Goals), Time Management Matrix, Steps to managing time through outbound group activity, Making a schedule, Daily Plan and calendars (To Do List), Monitoring/charting daily activity | | | |
| Module 3 | Self-introduction and Creating an Impression | Grooming checks + Evaluation | 8 classes |
| **Topics:** Body Language, Grooming guidelines for boys/girls, Common mistakes in Grooming at workplace and social gathering, Etiquettes at work place & social gathering, SWOT – Self-awareness analysis, Self-introduction template, evaluation of self-introduction in class | | | |
| Module 4 | E-mail Etiquette | Industry expert / Trainer | 4 Classes |
| **Topics**: Dos and Don'ts of professional email etiquette, practice writing emails (activity) | | | |
| REVISION | Recap & Summary | | 2 Classes |
| Revision of all the modules, overall feedback from the students with regards to the syllabus. | | | |
| **The topics related to Skill Development:**<br>Communication and professional grooming, SWOT and PEST Analysis time management and goal setting, writing and the art of asking questions for Skill Development through Participative Learning Techniques. This is attained through student self-introduction as mentioned in course handout. | | | |
| Targeted Application & Tools that can be used: LMS | | | |

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| **Topics relevant to development of "SKILL":** Art of Questioning, Goal Setting & Time Management, Self-introduction and Creating an Impression, E-mail Etiquette. | |
| Catalogue prepared by | Faculty of L&D department |
| Recommended by the Board of Studies on | BOS NO 3 Dated 10 Feb 23 |
| Date of Approval by the Academic Council | 20 ACM dated 15 Feb 23 |

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| **Course Code: PPS4002** | **Course Title: Introduction to Aptitude**<br>**Type of Course: Practical Only Course** | **L- P- C** | 0 | 2 | 1 |
| **Version No.** | 1.0 | | | | |
| **Course Pre-requisites** | Students should know the basic Mathematics & aptitude along with understanding of English | | | | |
| **Anti-requisites** | Nil | | | | |
| **Course Description** | The objective of this course is to prepare the trainees to tackle the questions on various topics and various difficulty levels based on Quantitative Ability, and Logical Reasoning asked during the placement drives. There will be sufficient focus on building the fundamentals of all the topics, as well as on solving the higher order thinking questions. The focus of this course is to teach the students to not only get to the correct answers, but to get there faster than ever before, which will improve their employability factor. | | | | |

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| **Course Objective** | The objective of the course is to familiarize the learners with the concepts of Aptitude and attain Skill Development through Problem Solving techniques. | | | |
| **Course Outcomes** | On successful completion of the course the students shall be able to:<br>CO1] **Recall** all the basic mathematical concepts they learnt in high school. CO2] **Identify** the principle concept needed in a question.<br>CO3] **Solve** the quantitative and logical ability questions with the appropriate concept.<br>CO4] **Analyze** the data given in complex problems.<br>CO5] **Rearrange** the information to simplify the question | | | |
| **Course Content:** | | | | |
| **Module 1** | Quantitative Ability | Assignment | Bloom's Level : Application | **02 Hours** |
| Topics:<br>Introduction to Aptitude, working of Tables, Squares, Cubes | | | | |
| **Module 2** | Logical Reasoning | Assignment | Bloom's Level : Application | **18 Hours** |
| Topics:<br>Linear & Circular Arrangement Puzzle, Coding & Decoding, Blood Relations, Directions, Ordering and Ranking, Clocks and Calendars, Number Series, Wrong number series, Visual Reasoning | | | | |

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| **Targeted Application & Tools that can be used:**<br>Application area: Placement activities and Competitive examinations. Tools:<br>LMS |
| **Text Book**<br>1. Quantitative Aptitude by R S Aggarwal<br>2. Verbal & Non-Verbal Reasoning by R S Aggarwal |
| **References**<br>1. www.indiabix.com<br>2. www.youtube.com/c/TheAptitudeGuy/videos |
| **Topics relevant to Skill development:** Quantitative and reasoning aptitude for Skill Development through Problem solving Techniques. This is attained through assessment component mentioned in course handout. |

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| **Catalogue prepared by** | L&D Department faculty members |
| **Recommended by the Board of Studies on** | BOS No.: 3<br>BOS Date: 10/02/2023 |
| **Date of Approval by the Academic Council** | Academic Council Meeting No.: 20 Date of the meeting: 15/02/2023 |

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|---|---|---|---|---|---|---|
| Course Code: CIV7601 | Course Title: Universal Human Values and Ethics<br>Type of Course: MAC course | L-T-P-C | - | - | - | 0 |
| Course Pre-requisites | NIL | | | | | |
| Anti-requisites | NIL | | | | | |
| Course Description | The purpose of the course is to develop a holistic perspective in students' life. The course adopts a self-reflective methodology of teaching and is designed to equip the students to explore their role in all aspects of living as a part of the society. It presents a universal approach to value education by developing the right understanding of reality through the process of self-exploration.<br><br>This self-exploration develops more confidence and commitment in students enabling them to critically evaluate their pre-conditioning and present beliefs. As an outcome of the holistic approach, the students will be able to practice the ethical conduct in the social and professional life. The prime | | | | | |

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| | focus throughout the course is toward affecting a qualitative transformation in the life of the student rather than just a transfer of information.<br><br>This course is designed to cater to Human Values and Professional Ethics. | | | |
| Course Objective | The objective of the course is 'SKILL DEVELOPMENT' of the student by using 'SELF LEARNING' techniques | | | |
| Course Outcomes | On successful completion of this course the students shall be able to:<br>CO.1 Recognize the importance of Value Education through the process of self-exploration<br>CO.2 Explain the human being as the co-existence of the self and the body in harmony.<br>CO.3 Describe the role of foundational values in building harmonious relationships.<br>CO.4 Summarize the importance of a holistic perspective in developing ethical professional behavior. | | | |
| Course Content: | | | | |
| Module 1 | Introduction to Value Education | Online Assessment | MCQ Quiz | 5 Sessions |
| Topics:<br>Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations. | | | | |
| Module 2 | Harmony in the Human Being | Online Assessment | MCQ Quiz | 5 Sessions |
| Topics:<br>Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health | | | | |
| Module 3 | Harmony in the Family and Society | Online Assessment | MCQ Quiz | 5 Sessions |
| Topics:<br>Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order. | | | | |
| Module 4 | Implications of the Holistic Understanding – A Look at Professional Ethics | Online Assessment | MCQ Quiz | 5 Sessions |
| Topics:<br>Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Strategies for Transition towards Value-based Life and Profession | | | | |
| Targeted Application & Tools that can be used:<br>Application areas are Personal life, Education and Career, Workplace , Society and Environmental Responsibility | | | | |

Tools: Online Tools – NPTEL and Swayam.

Project work/Assignment:

Assessment Type

- Online exams (MCQs) will be conducted by the Department of Civil Engineering through Linways.

Online Link*:

1) UHV II - https://www.youtube.com/watch?v=NhFBzn5qKIM&list=PLWDeKF97v9SO8vvjC1KyqteziTbTjN1So&pp=0gcJCWMEOCosWNin
2) Lecture by Dr. Kumar Sambhav, NPTEL course: Universal Human Values, https://onlinecourses.swayam2.ac.in/aic22_ge23/preview
3) Lecture by Dr. Padmavati, Dr Narendran Thiruthy, NPTEL Course: Biodiversity Protection, Farmers and Breeders Rights, https://nptel.ac.in/courses/129105008, 2024.

* Other source links are available in below Resources link.

Text Book

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2019.
3. Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing, New Delhi, 2022.

Reference Books

1. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
2. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986.
3. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
4. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
5. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
6. A N Tripathy, 2003, Human Values, New Age International Publishers.
7. E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press
8. M Govindrajran, S Natrajan& V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
9. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
10. William P. Cunningham and Mary Ann Cunningham (2020), Principles of Environmental Science: Inquiry & Applications, 9th Edition, McGraw-Hill Education, USA.

Resources:

1. https://onlinecourses.swayam2.ac.in/imb25_mg195/preview
2. https://onlinecourses.nptel.ac.in/noc25_mg141/preview
3. https://onlinecourses.swayam2.ac.in/ini25_hs52/preview
4. https://onlinecourses.nptel.ac.in/noc25_hs219/preview
5. https://onlinecourses.swayam2.ac.in/cec25_mg14/preview
6. https://onlinecourses.swayam2.ac.in/imb25_mg195/preview
7. https://onlinecourses.swayam2.ac.in/imb25_mg196/preview

Topics relevant to Skill Development:

1. An attitude of enquiry.
2. Write reports

The topics related to Human values and Professional ethics:

All topics in are relevant to Human values and Professional ethics.

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| Catalog prepared by | Mrs. Divya Nair |
| Recommended by the Board of Studies on | 20th BoS dated 06 June 2025 |
| Date of Approval by the Academic Council | Academic Council no. 26 dated __ June 2025 |

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| **Course Code:** **CHE7601** | **Environmental Studies** **Type of Course: MOOC course** | **L- T- P- C** | - | - | - | - |
| | | **Contact hours** | - | - | - | - |
| **Course Pre-requisites** | NIL | | | | | |
| **Anti-requisites** | **NIL** | | | | | |
| **Course Description** | This course is designed to improve the learners' SKILL DEVELOPMENT by using PATICIPATIVE LEARNING techniques. This course aims to familiarize students with fundamental environmental concepts and their relevance to business operations, preparing them to address forthcoming sustainability challenges. It is designed to equip students with the knowledge and skills needed to make decisions that account for environmental consequences, fostering environmentally sensitive and responsible future managers.<br><br>**This course is designed to cater to Environment and Sustainability** | | | | | |
| **Course Objective** | The objective of the course is **'SKILL DEVELOPMENT'** of the student by using **'PARTICIPATIVE LEARNING'** techniques | | | | | |
| **Course Outcomes** | On successful completion of this course the students shall be able to:<br>1. Describe the issues related to natural resources, ecosystems and biodiversity<br>2. Identify environmental hazards affecting air, water and soil quality<br>3. Recognize the importance of healthy environment and finding the sustainable methods to protect the environment<br>4. Convert skills to address immediate environmental concerns through changes in environmental processes, policies, and decisions | | | | | |

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| **Course Content:** | | | | |
| **Module 1** | **Understanding Environment, Natural Resources, and Sustainability** | | | |
| **Topics:**<br>Classification of natural resources, issues related to Population growth and their overutilization, and strategies for their conservation. Water, air, soil, mineral, energy and food source. Effect of human activities on natural resources.<br>Concept of sustainability- Sustainable Development Goals (SDGs)- targets and indicators, challenges and strategies for SDGs; Sustainable practices in managing resources, including deforestation, water conservation, Desalination – types, energy security, and food security issues, Life Cycle thinking and Circular Economy. | | | | |
| **Module 2** | **Ecosystems, Biodiversity, and Sustainable Practices** | | | |
| **Topics:**<br>**Ecosystems and ecosystem services:** Various natural ecosystems, Major ecosystem types in India and their basic characteristics; forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services- classification and their significance.<br>The importance of biodiversity, Types of biodiversity, Biodiversity and Climate Change, the threats it faces, hotspots, and the methods used for its conservation. Strategies for in situ and ex situ conservation, mega diverse nation. | | | | |
| **Module 3** | **Environmental Pollution, Waste Management, and Sustainable Development** | | | |
| **Topics:**<br>Types of pollution- Chemical, - Biological, Biomedical, noise, air, water, soil, thermal, radioactive and marine pollution, and their impacts on society. Urbanization and Urban environmental problems; effects, and mitigation.<br>Causes of pollution, such as global climate change, ozone layer depletion, the greenhouse effect, and acid rain, with a particular focus on pollution episodes in India. Importance of adopting cleaner technologies; Solid waste management;<br><br>**Sustainable Materials and Technologies:** Biodegradable and compostable materials, Recycled and reclaimed materials (E-waste management), Sustainable manufacturing processes. | | | | |
| **Module 4** | **Social Issues, Legislation, and Practical Applications** | | | |
| **Topics:**<br>Overview of key environmental legislation and the judiciary's role in environmental protection, including the Water (Prevention and Control of Pollution) Act of 1974, the Environment (Protection) Act of 1986, and the Air (Prevention and Control of Pollution) Act of 1981. Hazardous waste Rule 1989, Biomedical Waste handling 1998, Fly Ash Rule 1999, Municipal Solid Waste Rule 2000, Battery Rules 2001, E- Waste Rules 2011, Plastic waste management Rules 2016, Construction Demolition waste Rules 2016 National Biodiversity Action Plan (NBAP) | | | | |

**Major International Environmental Agreements:** Convention on Biological Diversity (CBD), The Biological Diversity (Amendment) Act, 2023, United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Paris Agreement.

**Major International organisations and initiatives:** United Nations Environment Programme (UNEP), United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Panel on Climate Change (IPCC).

**Targeted Application & Tools that can be used:**

Application areas are Energy, Environment and sustainability

**Tools:** Online Tools – NPTEL and Swayam.

**Project work/Assignment:**

**Assessment Type**

- Online exams (MCQs) will be conducted by the department of Chemistry

**Online Link*:**

4) Lecure by Dr. Samik Chowdhury, Dr. Sudha Goel, NPTEL course: Environmental Science, https://nptel.ac.in/courses/109105203, 2024.
5) Lecture by Dr. Padmavati, Dr Narendran Thiruthy, NPTEL Course: Biodiversity Protection, Farmers and Breeders Rights, https://nptel.ac.in/courses/129105008, 2024.

* Other source links are available in below Resources link.

**Text Book**

4. G. Tyler Miller and Scott Spoolman (2020), Living in the Environment, 20th Edition, Cengage Learning, USA
5. Poonia, M.P. Environmental Studies (3rd ed.), Khanna Book Publishing Co.
6. Bharucha, E. Textbook of Environmental Studies (3rd ed.) Orient Blackswan Private Ltd.
7. Dave, D., & Katewa, S. S. Text Book of Environmental Studies. Cengage Learning India Pvt Ltd.
8. Rajagopalan, R. Environmental studies: from crisis to cure (4th ed.). Oxford University Press.
9. Basu, M., & Xavier Savarimuthu, S. J. Fundamentals of environmental studies. Cambridge University Press.
10. Roy, M. G. Sustainable Development: Environment, Energy and Water Resources. Ane Books.
11. Pritwani, K. Sustainability of business in the context of environmental management. CRC Press.
12. Wright, R.T. & Boorse, D.F. Environmental Science: Toward A Sustainable Future (13th ed,). Pearson.

**Reference Books**

**11.** Varghese, Anita, Oommen, Meera Anna, Paul, Mridula Mary, Nath, Snehlata (Editors) (2022), Conservation through Sustainable Use: Lessons from India. Routledge.
12. William P. Cunningham and Mary Ann Cunningham (2020), Principles of Environmental Science: Inquiry & Applications, 9th Edition, McGraw-Hill Education, USA.
13. Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.
**14.** Manahan, S.E. (2022). Environmental Chemistry (11th ed.). CRC Press. https://doi.org/10.1201/9781003096238
**15.** Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press

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| **Resources:**<br>8. https://nptel.ac.in/courses/109105203<br>9. https://archive.nptel.ac.in/courses/120/108/120108004/<br>10. https://nptel.ac.in/courses/127105018<br>11. https://onlinecourses.nptel.ac.in/noc23_lw06/preview<br>12. https://onlinecourses.swayam2.ac.in/ini25_bt02/preview<br>13. https://archive.nptel.ac.in/courses/120/108/120108002/<br>14. https://onlinecourses.swayam2.ac.in/ini25_bt02/preview<br>15. https://nptel.ac.in/courses/102104088<br>16. https://nptel.ac.in/courses/124107165<br>17. https://nptel.ac.in/courses/109106200<br>18. https://archive.nptel.ac.in/content/storage2/courses/120108004/module1/lecture1.pdf<br>19. https://onlinecourses.swayam2.ac.in/nou25_ge19/preview<br>20. https://onlinecourses.swayam2.ac.in/ini25_hs01/preview<br>21. http://kcl.digimat.in/nptel/courses/video/105105184/L32.html<br>**22.** https://nptel.ac.in/courses/105105169 |
| **Topics relevant to Skill Development:**<br>3. An attitude of enquiry.<br>4. Write reports<br>**The topics related to Environment and Sustainability :**<br>All topics in theory component are relevant to Environment and Sustainability. |

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| **Catalog prepared by** | Faculty members of the Department of Chemistry |
| **Recommended by the Board of Studies on** | |
| **Date of Approval by the Academic Council** | |

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|---|---|---|---|---|---|---|
| **Course Code:** **LAW7601** | **Indian Constitution**<br>**Type of Course: MOOC course** | **L- T- P- C** | - | - | - | **0** |
| | | **Contact hours** | - | - | - | - |
| **Course Pre-requisites** | NIL | | | | | |
| **Anti-requisites** | **NIL** | | | | | |

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| **Course Description** | This course is designed to improve the learners' SKILL DEVELOPMENT by using PATICIPATIVE LEARNING techniques. This course aims to familiarize students with fundamentals of Indian Constitution concepts and their relevance to 75+ Years of Republic of India (https://constitution75.com/) as well as **#AzaadiKaAmrutMahotsav / Azadi Ka Amrit Mahotsav** (https://amritmahotsav.nic.in). It is designed to equip students with the knowledge about the Constitution of India. This course aims to introduce the constitutional law of India to students from all walks of life and help them understand the constitutional principles as applied and understood in everyday life. The objective of making the Constitution of India, familiar to all students, and not only to law students, this course aims and objectifies legal understanding in the simplest of forms.<br><br>**This course is designed to cater to Constitutional Studies.** | | | |
| **Course Objective** | The objective of the course is **'SKILL DEVELOPMENT'** of the student by using **'PARTICIPATIVE LEARNING'** techniques | | | |
| **Course Outcomes** | On successful completion of this course the students shall be able to:<br>1. Describe the basic understanding of the Indian Constitution and the concepts and issues relevant to day-to-day life of the nation and to equip the Citizen with the zeal of capacity building. Recognizing and identify the values of the Constitution of India.<br>2. Enabling the Citizen-centric Awareness of Rights and Responsibilities of the State<br>3. Explain the role of the State actors in building India.<br>4. Understanding the Gandhian vision over the power of the LSG (Local Self-Governance) | | | |
| **Course Content:** | | | | |
| **Module 1** | **Understanding the Making of the Constitution: The Constituent Assembly & The Constitution of India** | | | |
| **Topics:**<br><br>Historical Context of Constituent Assembly - Compositions & Functions of Constituent Assembly<br><br>What is a Constitution? – Why have a Constitution? – Constitutional Change - Features of Indian Constitution – Preamble of Indian Constitution | | | | |
| **Module 2** | **Citizen's Fundamental Rights and State's Responsibilities (Directive Principles)** | | | |
| **Topics:**<br>Introduction to Fundamental Rights - Right to Equality – Facets of Right to Equality - Right to Freedom - Constitutional Position of Some Democratic Rights - Right Against Exploitation - Right to Freedom of Religion - Right to Constitutional Remedies | | | | |

Directive Principles of the State Policy

| Module 3 | Organs Of the Government | | | |
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**Topics:**

**Executive**: The President of India - Powers and Functions of President of India - Emergency Powers and the Position of the President

**Legislature**: Union Council of Ministers - Prime Minister - The Rajya Sabha - The Lok Sabha - Relation between the Lok Sabha & Rajya Sabha - Office of the Speaker – Important Parliamentary Committees

**Judiciary**: The Structure and Organization of the Judiciary & the High Court - The Supreme Court - Role of The Supreme Court - Judicial Activism in India - Basic Structure Doctrine & PIL

| Module 4 | Federalism & Decentralization | | |
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**Topics:**

What is Federalism? - Centre-State Legislative Relations - Centre-State Administrative Relations - Centre-State Financial Relations

The 5th & 6th Schedules - Municipality- (History of Indian Municipality, Organization & Functions) – Panchayat 1 (Idea of Panchayat, Organization and Powers of Panchayats in India)

**Targeted Application & Tools that can be used:**

Application areas to familiarize students with fundamentals of Indian Constitutional concepts.

**Tools:** Online Tools – NPTEL and Swayam.

**Project work/Assignment:**

**Assessment Type**

- Online end term exam will be conducted as notified by the Presidency University.

**Online Link*:**

1) Prof. Amitabha Ray, SWAYAM Course: "Constitutional Government & Democracy in India" https://onlinecourses.swayam2.ac.in/cec19_hs13/preview

* Other source links are available in below Resources link.

**Text Book**

1. Durga Das Basu --- Introduction to the Constitution of India, 23rd Edition (Gurgaon; LexisNexis, 2018).
2. MP Jain's Constitutional Law of India, Lexis Nexis
3. V.N Shukla's Indian Constitutional Law, M.P Singh 13th Edition
4. MV Pylee's Constitution of India
5. J.C.Johari -- The Constitution of India: A Politico-Legal Study (Greater Noida: Sterling Publishers Pvt. Ltd. 2013).
6. Himangshu Roy and M.P.Singh – Indian Political System, 4th Edition (Bengaluru; Pearson Education, 2018)
7. Vidya Bhushan & Vishnoo Bhagwan--- Indian Administration (S. Chand, 2011)
8. S.R.Maheswari --- Indian Administration (Orient Blackswan, 2001)
9. Dr. A.Avasthi & A.P. Avasthi --- Indian Administration (L.N. Agarwal Educational Publishing, 2017).

10. B. L. Fadia --- Indian Government and Politics (Sahitya a. Bhawan, 13th Revised Edition, 2017).
11. P.M.Bakshi – The Constitution of India (Prayagraj, UP; a. Universal Law Publishing, January, 2018)

**Reference Books**

12. HM Seervai, Constitutional Law of India, 4th Ed. Vol I, II, & III
13. Uday Raj Rai, Constitutional Law-I
14. Democracy and Constitutionalism in India, Oxford University Press 2009

**Resources:**

1. https://onlinecourses.nptel.ac.in/noc20_lw03/course?&force_user=true
2. https://onlinecourses.swayam2.ac.in/cec19_hs13/course?&force_user=true
3. https://nptel.ac.in/courses/129106003
4. https://nptel.ac.in/courses/129106411
5. https://nptel.ac.in/courses/129105608
6. https://nptel.ac.in/courses/129106002

**Topics relevant to Skill Development:**

1. An attitude of inquiry.
2. Write reports

**The topics related to Constitutional Studies and its application :**

All topics in theory component are relevant to Indian Constitution.

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| **Catalog prepared by** | Faculty members of the Department of Law. |
| **Recommended by the Board of Studies on** | |
| **Date of Approval by the Academic Council** | |

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|---|---|---|---|---|---|---|
| **Course Code: CSE7101** | **Course Title: Mini Project**<br>**Type of Course:** | **L- T-P- C** | 0 | 0 | 0 | 5 |
| **Version No.** | **1.0** | | | | | |
| **Course Pre-requisites** | **Knowledge and Skills related to all the courses studied in previous semesters.** | | | | | |
| **Anti-requisites** | **NIL** | | | | | |

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| **Course Description** | Students observe science and technology in action, develop an awareness of the method of scientific experimentation, and often get an opportunity to see, study and operate sophisticated and costly equipment. They also learn about the implementation of the principles of management they have learnt in class, when they observe multidisciplinary teams of experts from engineering, science, economics, operations research, and management deal with techno-economic problems at the micro and macro levels. Finally, it enables them to develop and refine their language, communication and inter-personal skills, both by its very nature, and by the various evaluation components, such as seminar, group discussion, project report preparation, etc. The broad-based core education, strong in mathematics and science and rich in analytical tools, provides the foundation necessary for the student to understand properly the nature of real-life problems. The students have options to pursue this course as either Project Work and Dissertation at the university, or Project Work in an Industry/ Company/ Research Laboratory, or Internship Program in an Industry/Company. |
| **Course Objectives** | The objective of the course is to familiarize the learners with the concepts of Professional Practice and attain Employability Skills through Experiential Learning techniques. |
| **Course Outcomes** | On successful completion of this course the students shall be able to:<br>1. Identify the engineering problems related to local, regional, national or global needs. (Understand)<br>2. Apply appropriate techniques or modern tools for solving the intended problem. (Apply)<br>3. Design the experiments as per the standards and specifications. (Analyze)<br>4. Interpret the events and results for meaningful conclusions. (Evaluate)<br>5. Appraise project findings and communicate effectively through scholarly publications. (Create) |

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| **Course Code: MAT2003** | **Course Title: NUMERICAL METHODS FOR ENGINEERS<br>Type of Course: School Core** | **L-T- P-C** | 1 | 0 | 2 | 2 |
| **Version No.** | 1.0 | | | | | |
| **Course Pre-requisites** | MAT1002 – Transform Techniques, Partial Differential Equations and Their Applications | | | | | |
| **Anti-requisites** | **Nil** | | | | | |

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| **Course Description** | ● The course focuses on formulating and solving problems concerning real-world engineering applications numerically as well as statistically. This course provides an introduction to basic numerical methods to deal with algebraic and transcendental equations, system of equations, interpolation, differentiation and integration. This course also deals with numerical solution of ordinary differential equations by means of Taylor's series method, modified Euler's method and Runge-Kutta methods. | | | |
| **Course Objective** | The objective of the course is to **familiarize the learners with the concepts of " NUMERICAL METHODS FOR ENGINEERS" and attain Skill Development Through Problem Solving.** | | | |
| **Course Outcomes** | On successful completion of the course the students shall be able to:<br>1] Solve algebraic and transcendental equations numerically.<br>2] Adopt numerical techniques to differentiate and integrate functions.<br>3] Apply numerical methods to solve ordinary differential equations. | | | |
| **Course Content:** | | | | |
| **Module 1** | **Numerical solution of Algebraic and Transcendental Equations** | | | **15 Classes** |
| Algebraic and Transcendental Equations, Regula - Falsi method, Bisection method (Self study), Secant method, Newton-Raphson method, and NR method for non-linear Equations, Fixed-point iteration method.<br>System of Linear Equations: Introduction, LU decomposition method, Gauss-Jacobi method, Gauss-Seidel iteration method, Largest Eigen value and corresponding Eigen vector by Power method & Jacobi Method. | | | | |
| **Module 2** | **Numerical Interpolation, differentiation and Integration** | | | **15 Classes** |
| Numerical Interpolation: Newton's forward and backward interpolation method, Newton's divided difference method, Lagrange's method, numerical differentiation. Numerical integration: Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule, Weddle's Rule.<br>Area between the two curves. | | | | |
| **Module 3** | **Numerical solution of ODEs and PDEs** | | | **15 Classes** |
| Solution of ordinary differential equations: Initial Value problems: Taylor's series method, Picard's method, Euler's Method, Modified Euler's method, Runge-Kutta method, Milne's predictor-corrector formula. Adams -Bashforth method, Boundary value problems - Finite difference methods for ODE. Numerical solution for LCR & damped forced oscillatory equations.<br>Solution of partial differential equations: Schmidt Explicit Formula for Heat Equation, Crank-Nicolson method. Numerical solution to Wave, Laplace & Heat Equation. | | | | |
| **Targeted Application & Tools that can be used:** | | | | |

The objective of the course is to familiarize students with a variety of numerical techniques and the theoretical concepts of probability and statistics so as to equip them with the necessary numerical approaches and basic statistical tools to tackle engineering and real-life problems.

**Assignment:**

Gauss-Jacobi iteration method.
Numerical differentiation.
Gaussian quadrature rule for numerical integration.
Taylor series method for ODEs.
Implicit and explicit schemes for PDEs.

**Text Books**

T1: M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computations, 6th Edition, New age Publishing House, 2015.

T2: Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley& Sons (India), 2014.

**References:**

R1: B.S. Grewal, Numerical methods in engineering and science, 10th Edition, Khanna publishers, 2016.

R2: B.S. Grewal, "Higher Engineering Mathematics", 44th edition, Khanna Publishers.

- R3: Steven C Chapra and Raymond P Canale, "Numerical Methods for Engineers," 7th Ed., McGraw-Hill Edition, 2015.

R4: C. Ray Wylie and Louis C Barrett, "Advanced Engineering Mathematics", 6th Edition, McGraw-Hill, 2012.

**Topics relevant to SKILL DEVELOPMENT:** This course focuses on formulating and solving problems concerning real-world engineering applications numerically as well as statistically. This course provides an introduction to basic numerical methods to deal with algebraic and transcendental equations, system of equations, interpolation, differentiation and integration with numerical solution of ordinary differential equations by means of Taylor's series method, modified Euler's method and Runge-Kutta methods for **Skill Development through Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.