PRESIDENCY UNIVERSITY

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PROGRAMME REGULATIONS & CURRICULUM

2023-25

PRESIDENCY SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

MASTER OF TECHNOLOGY (M.TECH.)

COMPUTER SCIENCE AND ENGINEERING
SPECIALIZATION IN DATA SCIENCE

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

2023-2025

MASTER OF TECHNOLOGY (M.Tech.) in

COMPUTER SCIENCE AND ENGINEERING

Specialization in

Data Science

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

Regulation Number: PU/AC-21/SoCSE2/ DSC /2023-2025

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

(As amended upto 24th Meeting of the Academic Council held on 3rd August 2024, and ratified by the Board of Management in its 24th Meeting held on 5th August 2024.)

September 2023

Table of Contents

PART A – PROGRAM REGULATIONS

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 Presidency School of Computer Science and Engineering, committed to developing globally competent engineers, dedicated to developing cutting-edge technology to enhance the 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 M.Tech degree.

The Curriculum is designed to take into the factors listed in the Choice Based Credit System (CBCS) with focus on Social Project Based 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 Master of Technology Degree Program Regulations and Curriculum 2023-2025.
b. These Regulations are subject to, and pursuant to the Academic Regulations.

c. These Regulations shall be applicable to the ongoing Master of Technology Degree Programs of the 2023-2025 batch, and to all other Master of Technology Degree Programs which may be introduced in future.
d. These Regulations shall supersede all the earlier Master of Technology Degree Program Regulations and Curriculum, along with all the amendments thereto.
e. These Regulations shall come into force from the Academic Year 2024-2025.

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 M.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 Master of Technology Degree Program Regulations and Curriculum, 2023-2025;*

ff. *"Program" means the Masterr of Technology (M.Tech.) Degree Program;*

gg. *"PSCS" means the Presidency School of 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 Master of Technology Degree Program Regulations and Curriculum 2023-2025 are subject to, and, pursuant to the Academic Regulations. These Program Regulations shall be applicable to the following ongoing Master of Technology (M.Tech.) Degree Programs of 2023-2025 offered by the Presidency School of Engineering (PSOE):

1. Master of Technology in Computer Science and Engineering Specialization in Artificial Intelligence.M.Tech. (AIE)
2. Master of Technology in Computer Science and Engineering Specialization in Data Science.M.Tech. (DSC)

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 Master of Technology Degree Program is a Two-Year, Full-Time Semester based program. The minimum duration of the M.Tech. Program is four (02) years and each year comprises of two academic Semesters (Odd and Even Semesters) and hence the duration of the M.Tech. program is four (04) 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 of Academic Regulations) in the prescribed maximum duration (Sub-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:

PEO 01: To prepare graduates who will be successful professionals in industry, government, academia, research, entrepreneurial pursuit and consulting firms.

PEO 02: To prepare graduates who will contribute to society as broadly educated, expressive, ethical and responsible citizens with proven expertise.

PEO 03: To prepare graduates who will achieve peer recognition as individuals or in a team through demonstration of good analytical, research, design and implementation skills.

PEO 04: To prepare graduates who will thrive to pursue life-long reflective learning to fulfil their goals.

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:

PO1:An ability to analysis, manage and supervise engineering systems and processes with the aid of appropriate advanced tools.

PO2:An ability to design a system and process within constraints of health, safety, security, economics, manufacturability to meet desired needs.

PO3:An ability to carry out research in the respective discipline and publish the findings.

PO4:An ability to effectively communicate and transfer the knowledge/ skill to stakeholders.

PO5:An ability to realize the impact of engineering solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.

8.2 Program Specific Outcomes (PSOs):

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

PSO 1:

Apply foundational and advanced data science methodologies to analyze, model, and extract meaningful insights from complex and large-scale datasets for solving real-world problems across multiple domains.

PSO 2:

Demonstrate proficiency in designing and deploying scalable, data-driven systems using appropriate tools, technologies, and platforms to support informed decision-making and innovation.

PSO 3:

Exhibit ethical and responsible data handling practices while ensuring data privacy, transparency, and fairness in analytics and machine learning applications for societal and industrial impact.

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 M.Tech. Program is listed in the following Sub-Clauses:

- Have a Bachelor's degree in engineering (B.E./B.Tech) from a recognized university.
- Have a minimum aggregate of 50% in your Bachelor's degree.
- Have a minimum aggregate of 45% in your Bachelor's degree if you belong to a reserved category.
- Have to submit score card from any state or central entrance exam or the Presidency University admission qualifying exam

10. 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)

10.1 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.

10.2 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 8.8 of academic regulations) shall be clearly defined in the Course Plan for every Course, and approved by the DAC.

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

10.4 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)

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 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.

10.5 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	Continuous Assessments	50%

L component in the L-T-P Structure is predominant (more than 1) (Examples: 3-0-0; 3-0-2; 2-1-0; 2-0-2, 2-0-4 etc.)	End Term Examination	50%
Lab/Practice-based Course P component in the L-T-P Structure is predominant (Examples: 0-0-4; 1-0-4; 1-0-2; etc.)	Continuous Assessments	50%
	End Term Examination	50%
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–P–C) [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.

10.6 Minimum Performance Criteria:

10.6.1 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.

10.6.2 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.

10.6.3 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-clause 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.

11 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:

11.1 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.

11.2 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.

11.3 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:

11.3.1 A student may complete SWAYAM/NPTEL/other approved MOOCs as mentioned in Clause 11.3 (as per 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.

11.3.2 SWAYAM/NPTEL/ other approved MOOCs as mentioned in Clause 11.3 (as per academic regulations) shall be approved by the concerned Board of Studies and placed (as Annexures) in the concerned PRC.

11.3.3 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.

11.3.4 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.

11.3.5 A student shall request for transfer of credits only from such approved Courses as mentioned in Sub-Clause 11.3.2 above.

11.3.6 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.

11.3.7 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.

11.3.8 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

11.3.9 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.

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

11.4 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 (11.0), shall not be included in the calculation of the CGPA.

PART B: PROGRAM STRUCTURE

12.0 Structure / Component with Credit Requirements Course Baskets & Minimum Basket wise Credit Requirements

The M.Tech. CSE Specialization in (Data Science) Program Structure (2023-2025) totalling 68credits. 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: Summary of mandatory courses and minimum credit contribution from various baskets

S.No	Baskets	Credit Contribution
1	SCHOOL CORE	32
2	PROGRAM CORE	15
3	DISCIPLINE ELECTIVE	15
4	OPEN ELECTIVE	06
	TOTAL CREDITS	**Min. 68**

In the entire Program, the practical and skill based course component contribute to an extent of approximately 61% out of the total credits of 68 for M.Tech. (Product Design and Development) program of twoyears' duration.

13. Minimum Total Credit Requirements of Award of Degree

As per the AICTE guidelines, a minimum of 68 credits is required for the award of a M.Tech. degree.

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

14.1 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**.**

14.2 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 5.0 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 a 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

15.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, Course Basket, 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 : List of School Core (SC)

S. No	Course Code	Course Name	L	T	P	C	Contact Hours	Type of Skills	Pre requisite
1	MAT6001	Advanced Engineering Mathematics	3	0	0	3	3	S	-
2	ENG5001	English for Employability	2	1	0	3	3	S	-
3	SEM5001	Seminar – I	-	-	-	1		S/EM	-
4	SEM5002	Seminar – II	-	-	-	1		S/EM	-
5	PIP6001	Dissertation/ Internship – I	-	-	-	10		S/EM	-
6	PIP6002	Dissertation/ Internship – II	-	-	-	14		S/EM	-
		Total No. of Credits				**32**			

Table 3.2 : List of Programme Core Courses (PC)

S.No	Course Code	Course Name	L	T	P	C	Contact Hours	Type of Skills	Pre requisite
1	CSE5009	Data Analytics and Visualization	2	0	2	3	4	S	-
2	CSE5008	Programming in Data Science	2	0	2	3	4	S	-
3	CSE5007	Machine Learning Algorithms	2	0	2	3	4	S	-
4	CSE6001	Deep Leaning	2	0	2	3	4	S	-
5	CSE6003	Big Data Tools and Techniques	2	0	2	3	4	S	-
		Total No. of Credits				**15**			

16. 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 M.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.

16.1 Internship

A student may undergo an Internship for a period of 12-14 weeks in an industry / company or academic / research institution during 3rd and 4th Semesters, subject to the following conditions:

16.1.1 The Internship shall be in conducted in accordance with the Internship Policy prescribed by the University from time to time.

16.1.2 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 Internship to a student;

16.1.3 The number of Internships available for the concerned Academic Term. Further, the available number of internships 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 Internship, as stated in Sub-Clause 16.1.2 above.

16.1.4 A student may opt for Internship 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 Internship on her / his own. Provided further, that the Industry / Company or academic / research institution offering such Internship confirms to the University that the Internship shall be conducted in accordance with the Program Regulations and Internship Policy of the University.

16.1.5 A student selected for an Internship in an industry / company or academic /

research institution shall adhere to all the rules and guidelines prescribed in the Internship Policy of the University.

16.2 Project Work

A student may opt to do a Project Work for a period of 12-15 weeks in an Industry / Company or academic / research institution or the University Department(s) as an equivalence of Internship during the 3rd and 4th Semester as applicable, subject to the following conditions:

16.2.1 The Project Work shall be approved by the concerned HOD and be carried out under the guidance of a faculty member.

16.2.2 The student may do the project work in an Industry / Company or academic / research institution of her / his choice subject to the above mentioned condition (Sub-Clause 16.2.1). Provided further, that the Industry / Company or academic / research institution offering such project work confirms to the University that the project work will be conducted in accordance with the Program Regulations and requirements of the University.

16.3 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 4th Semester as applicable, subject to the following conditions:

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

16.3.2 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;

16.3.3 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 16.3.2 above.

16.3.4 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.

16.3.5 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.

16.4 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:

16.4.1 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.

17.List of Discipline Elective Courses:

Table 3.3 DISCIPLINE ELECTIVE - Minimum of 15 Credits to be earned from this basket

Sl. No.	Course Code	Course Name	L	T	P	C	Contact Hours	Type of Skill/ Focus	Prerequisites/ Corequisites
1	CSE5009	Data Analytics and Visualization	2	0	2	3	4	S/EM	-
2	CSE5010	Robotic Process Automation	3	0	0	3	3	S/EM	-
3	CSE5011	Machine Vision	3	0	0	3	3	S/EM	-
4	CSE5012	AI in Cloud Computing	3	0	0	3	3	S/EM	-
5	CSE5013	Soft Computing Techniques	3	0	0	3	3	S/EM	-

6	CSE5014	Ontology Engineering for the Semantic Web	3	0	0	3	3	S/EM	-
7	CSE6003	Big Data Analytics Tools And Techniques	2	0	2	3	3	S/EM	-
8	CSE6004	Time Series Analysis and Forecasting	3	0	0	3	3	S/EM	CSE5007
9	CSE6005	Intelligent Information Retrieval	3	0	0	3	3	S/EM	CSE5005
10	CSE6006	AI in Internet of Things	3	0	0	3	3	S/EM	CSE5005
11	CSE5016	Essentials for Machine Learning	3	0	0	3	3	S/EM	-
12	CSE6011	Application of Probability theory in Computer Science	3	0	0	3	3	S/EM	-
13	CSE5017	NoSQL Databases	2	0	2	3	4	S/EM	-
14	CSE6012	Recommender Systems with Machine Learning and AI	3	0	0	3	3	S/EM	CSE5007

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

Table 3.4 Open Elective Courses Minimum of 6 Credits to be earned from this basket									
Civil Engineering Basket									
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Contact Hours**	Type of Skills	**Prerequisites**
1	CIV5001	Sustainable Smart Cities	3	0	0	3	3	EM	-
2	CIV5002	Systems Design for Sustainability	3	0	0	3	3	EM	-
3	CIV5003	SelfSustainable Buildings	3	0	0	3	3	EM	-

4	CIV5004	Energy and Buildings	3	0	0	3	3	EM	-
Law Basket									
1	LAW5001	International Trade Law	3	0	0	3	3	-	-
2	LAW5002	Law relating to Business Establishment	3	0	0	3	3	-	-
3	LAW5003	Data Protection Law	3	0	0	3	3	-	-
4	LAW5004	Law Relating to Consumer Protection	3	0	0	3	3	-	-
5	LAW5005	Law Relating to Infrastructure Projects	3	0	0	3	3	-	-
Computer Science and Engineering Basket									
1	CSE5001	Programming Methodologies using Java	3	0	0	3	3	-	-
2	CSE5002	Human Computer Interaction	3	0	0	3	3	-	-
3	CSE5003	IOT Applications	3	0	0	3	3	-	-
4	CSE5004	Programming Essentials in Python	3	0	0	3	3	-	-
Electronics and Communication Engineering Basket									
1	ECE5001	Wearable Computing	3	0	0	3	3	-	-
2	ECE5002	MEMS and Nanotechnology	3	0	0	3	3	-	-
3	ECE5003	Advanced Computer Networks	3	0	0	3	3	-	-
4	ECE5004	Pervasive Computing	3	0	0	3	3	-	-
Mechanical Engineering Basket									
1	MEC5001	Optimization Techniques	3	0	0	3	3	-	-

2	MEC5002	Industry 4.0	3	0	0	3	3	EM	-
3	MEC5003	Six Sigma for Engineers	3	0	0	3	3	-	-
4	MEC5004	Design for Internet of Things	3	0	0	3	3	-	-
Management Basket									
1	MBA3042	Innovation and Business Incubation	3	0	0	3	3	-	-
2	MBA3037	Personal Wealth Management	3	0	0	3	3	-	-
3	MBA3038	Team Dynamics	3	0	0	3	3	-	-
4	MBA3039	Market Research	3	0	0	3	3	-	-
5	MBA2023	Design Thinking for Business Innovation	3	0	0	3	3	-	-
6	MBA3046	Game Theory in Business	3	0	0	3	3	-	-
7	MBA3047	Data Story Telling	3	0	0	3	3	-	-
8	MBA3048	Environmental Sustainability and Value Creation	3	0	0	3	3	-	-
9	MBA3049	Industry 4.0	3	0	0	3	3	-	-
Media Studies Basket									
1	BAJ5001	Media and Entertainment Business	3	0	0	3	3	EN	-
2	BAJ5002	TV Journalism and News Management	2	0	2	3	4	EM	-
Research Basket									
1	RES5001	Research Methodology	3	0	0	3	3	S	-
2	RES3001	Research Methodology	3	0	0	3	3	S	-

Research Project (Students are required to carry out research work under the guidance of a faculty member/ research scholar and the same shall be evaluated and credit will be granted as per the academic regulations)									
1	URE7001	University Research Experience	-	-	-	3		EM	-
2	URE7002	University Research Experience	-	-	-	0		EM	-
Apart from the above list, the student is free to enroll for any course offered by any school and earn credits for Open elective provided the student has not completed an antirequisite course and the student fulfills the prerequisite if any for the course he wishes to enroll									

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

	SEM-I							
S. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Contact Hours**	**BASKET**
1	MAT6001	Advanced Engineering Mathematics	3	0	0	3	3	School Core
2	ENG5001	English for Employability	2	1	0	3	3	School Core
3	CSE5007	Machine Learning Algorithms	2	0	2	3	4	Program Core
4	CSE5008	Programming in Data Science	2	0	2	3	4	Program Core
5	CSE5009	Data Analytics and Visualization	2	0	2	3	4	Program Core
6	CSEXXXX	Discipline Elective – I	3	0	0	3	3	Discipline Elective
7	CSEXXXX	Discipline Elective – II	3	0	0	3	3	Discipline Elective
8	SEM5001	Seminar – I	-	-	-	1		School Core
		TOTAL				22		
	SEM-II							
S. No	**Course Code**	**Course Name**	L	T	P	C	Contact Hours	**BASKET**
1	CSE6001	Deep Learning	2	0	2	3	4	Program Core
2	CSE6003	Big Data Analytics Tools and Techniques	2	0	2	3	4	Program Core
3	CSEXXXX	Discipline Elective – III	**2**	0	**2**	3	4	Discipline Elective
4	CSEXXXX	Discipline Elective – IV	3	0	0	3	3	Discipline Elective

5	CSEXXXX	Discipline Elective – V	3	0	0	3	3	Discipline Elective
6	XXXXXXX	Open Elective – I	3	0	0	3	3	Open Elective
7	XXXXXXX	Open Elective – II	3	0	0	3	3	Open Elective
8	SEM 5002	Seminar – II	-	-	-	1		School Core
		TOTAL				**22**		
	SEM-III							
1	PIP6001	Dissertation/ Internship - I	-	-	-	10		School Core
		TOTAL				10		
	SEM-IV							
1	PIP6002	Dissertation/ Internship - II	-	-	-	14		School Core
		TOTAL				14		

I. Course Catalogues:

Each course shall have a course catalogue with the following details:

i) Pre –Requisites of the course
ii) Course Description
iii) Course Outcome
iv) Course Content
iv) Reference Resources.

The Course Catalogues for the Courses offered in each basket are attached below:

Course Code: CSE 5006	**Course Title: KNOWLEDGE ENGINEERING AND EXPERT SYSTEM** **Type of Course: Program Core** **Theory Only**	**L- T- P- C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	--					
Anti-requisites	**NIL**					
Course Description	Knowledge engineering is a field within artificial intelligence that develops knowledge-based systems. Such systems are computer programs that contain large amounts of knowledge, rules and reasoning mechanisms to provide solutions to real-world problems. A major form of knowledge-based system is an expert system, one designed to emulate the reasoning processes of an expert practitioner. Topics includes: Introduction to Knowledge Engineering, Knowledge based Systems, Types of Knowledge-based systems, Knowledge acquisition, Knowledge representation and reasoning: Logic rules and representations, Semantic Networks, frames, Life cycle Methodologies, Uncertain Reasoning with confidence factor, Basic Structure and Architecture of Expert System. Tools used in Expert System.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Knowledge Engineering and Expert Systems and attain **Skill Development** through **Participative Learning** techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: CO1.Explain the basic concepts in Knowledge Engineering and types of Knowledge based system. CO2.Discuss the process of acquiring the Knowledge from the human expert. CO3.Apply the logical rules, Semantic Networks and Frames for representing the knowledge. CO4.Life Cycle and Methodologies applied to support the development of Knowledge based Systems. CO5.Explain how expert system deal with uncertainty and describes architecture and tools used.					
Course Content:						
Module 1	Introduction to Knowledge Engineering and Knowledge Base	Assignment	Analysis			**10 Sessions**

	Topics: Data, Information and Knowledge Skills of a Knowledge Engineering, Engineering, software engineering and knowledge engineering, Knowledge Engineering around the world. Introduction to Knowledge-Based Systems.				
Module 2	Knowledge Acquisition	Assignment	Analysis, Data Collection		**5 Sessions**
	Topics: Knowledge Engineering life cycle, , Knowledge acquisition - knowledge acquired from a human expert - purpose and types of Interviews in obtaining knowledge.				
Module 3	Knowledge Representation and Reasoning	Problem-Solving	Data analysis task		**9 Sessions**
	Topics: Using knowledge - Logic, rules and representation- Developing rule-based systems, Conceptual Networks.				
Module 4	Life Cycle and Methodologies	Assignment	Analysis		**9 Sessions**
	Topics: Need for methodologies- Blackboard architectures- Problem Solving Methods (PSMs)- GEMINI, POLITE, - The Hybrid Methodology (HyM)- Building a well-structured application using Aion BRE.				
Module 5	Uncertain Reasoning and Expert System	Assignment	Analysis		**10 Sessions**
	Topics: Uncertainty – Confidence factor- Expert System – Basic Structure, Architecture – Tools used Constructing Expert System, Rule-based system.				
	Targeted Applications & Tools that can be used: After Completion of the course, student may get an opportunity to be a Knowledge engineer to design and develop Knowledge base with reference to Acquisition and to represent it. Expert System can be developed on real time application (To highlight a few) Medical Knowledge Automation, Chemical and Biological Synthesis, Mineral and Oil explorations, Planning and Scheduling. Space Defense, VLSI Design, Air traffic control, Equipment fault Diagnosis. Circuit Diagnosis and So on. **Tools: Programming tools for building Expert System.** • OPS 5 • EMYCIN • KAS • TEIRESIAS				
	Project work/Assignment:				
	Case Study Analysis: To Study, analyze and develop expert system on applications. **Term Assignments:**				

	• **Comparative analysis on methods in Knowledge representations.** • **A short survey on techniques used to build Knowledge base.** • **Recent trends used in developing Expert System.**
	Text Book T1. "An introduction to knowledge engineering", Simon Kendal, Malcolm creen, Springer, 2007.(with Recent version copyright) T2. "An Overview of Expert System " William B. Gevarter,Dept. of Commerce,U.S , NBS, Washignton,D.C.
	References R1. "An introduction to knowledge engineering", Peter Smith, Thomson computer press, 1996. R2. "A guide to an Expert System ", Donald Waterman, Pearson India. **Weblinks** W1.https://presiuniv.knimbus.com/user#/home W2.https://www.javatpoint.com/ai-knowledge-engineering.
	Topics relevant to "SKILL DEVELOPMENT": Converting from English to Predicate Logic, and logically prove statements using inference rules like first-order resolution, Uncertain Reasoning and Expert Systems for skill development through participative learning techniques. This is attained through the assessment components mentioned in the course handout.

Course Code: CSE 5007	**Course Title: Machine Learning Algorithms** **Type of Course: Program Core Theory and Laboratory Integrated**	**L-T-P-C**	2	0	2	3

Version No.		2.0
Course Pre-requisites		--
Anti-requisites		NIL
Course Description		This course provides a broad introduction to machine learning and statistical pattern recognition. Topics include: supervised learning (generative/discriminative learning, parametric/non-parametric learning, neural networks, support vector machines); unsupervised learning (clustering, dimensionality reduction, kernel methods); learning theory (bias/variance tradeoffs, practical advice); reinforcement learning and adaptive control.
Course Objective		The objective of the course is to familiarize the learners with the concepts of Machine Learning Algorithms and attain **Skill Development** through **Experiential Learning** techniques.
Course Out Comes		On successful completion of the course the students shall be able to: CO1: Identify the characteristics of datasets and compare the trivial data for various applications. CO2: Understand and apply scaling up machine learning techniques. CO3: To design and implement various machine learning algorithms in a range of real-world applications.
Course Content:		

Module 1	Machine Learning Model Fundamentals	Assignment	Programming		**10 Sessions**
	Topics: Data-generating process, Understanding the structure and properties of good datasets, Scaling datasets, including scalar and robust scaling, Selecting training, validation and test sets, including cross-validation, Features of a machine learning model, Learnability, Capacity, including Vapnik-Chervonenkis theory, Bias including underfitting, Variance including overfitting, Regularization with types, cross validation, Defining loss and cost functions.				
Module 2	Clustering and Unsupervised Models	Assignment	Programming		**10 Sessions**
	Topics: K-Nearest Neighbors(KNN), based on k-dimensional(k-d) trees and ball tress, K-means and K-means++, Clustering Fundamentals, Evaluation of clustering models on the ground truth, Hierarchical clustering algorithms, Spectral clustering, DBSCAN, Clustering as a Mixture of Gaussians.				
Module 3	Semi- Supervised Learning Algorithms	Assignment	Programming		**15 Sessions**
	Topics: Introduction to Semi- Supervised Learning, Semi-supervised scenario, The different approaches to semi-supervised learning, Generative Gaussian Mixture, contrastive pessimistic likelihood estimation approach, Self-Training, Co-Training, Advanced Semi-Supervised Classification, Contrastive Pessimistic Likelihood Estimation(CPLE), Semi-supervised Support Vector Machines(S3VM). Transductive Learning via regularized least squares				

Module 4	Graph-Based Semi-Supervised Learning	Assignment	Programming		**12 Sessions**

Topics: Graph-Based Semi-Supervised Learning, Label propagation, Example of label propagation, Label spreading, Label propagation based on Markov random walks, Manifold Learning. Quadratic cost criterio. Regularization with graph.

List of Laboratory Tasks:

Experiment N0 1: Programming assignment for data cleaning..

Level 1: Programming scenarios which handles missing features, data normalization, data scaling.

Level 2: Programming assignment which helps in feature filtering, selection.

Experiment No. 2: Programming assignment for unsupervised learning

Level 1: Implementation of covariance rule.
Implementationof rubner_tavan_network

Level 2: Implementation of sanger_network.

Experiment No. 3: Programming assignment for advanced unsupervised learning

Level 1: Implementation of kNN, K-means.
Implementation of fuzzy cmeans.

Level 2: Implementation of spectral clustering.

Experiment No. 4: Programming assignment for supervised learning.

Level 1: Programming assignment on label_propogation, spreading

Experiment No. 5: Programming assignment for supervised learning.

Level 1: Implementing SVM

Level 2: Implementing TSVM

Experiment No. 6: Programming assignment for Graph-Based Supervised learning.

Level 1: Estimating Gaussian mixture in ICA

Level 2: Estimating parameter using PCA.

Targeted Application & Tools that can be used:

- Data Mining
- Text Mining
- Web Mining
- Medical Industry

Tools: Anaconda for Python or Google Colab for Python.

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 dataset will be given to the student to practice the learned algorithms
On completion of Module 4, student will be asked to develop a Project for analyzing the given dataset.

Text Book

T1. Giuseppe Bonaccorso, *"Mastering Machine Learing Algorithms"*,Packt.

	T2. Giuseppe Bonaccorso, *"Machine Learning Algorithms"*,Packt.
	References **R1. Imran Ahmed, *"40 Algorithms Every Programmer Should Know",* Packt** **Weblinks** W1.https://presiuniv.knimbus.com/user#/home W2.https://www.javatpoint.com/machine-learning-algorithms
	Topics relevant to "SKILL DEVELOPMENT: Machine Learning, Clustering and Unsupervised, Graph-Based Semi-Supervised Learning for developing Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout

Course Code: CSE 6001	**Course Title: Deep Learning** **Type of Course: Program Core Theory and Laboratory Integrated**	**L-T-P-C**	2	0	2	3

Version No.		2.0
Course Pre-requisites	•	--
Anti-requisites		NIL
Course Description		The course introduces the core intuitions behind Deep Learning, an advanced branch of Machine Learning involved in the development and application of Artificial Neural Networks that function by simulating the working principle of human brain. Deep learning algorithms extract layered high-level representations of data in a way that maximizes performance on a given task. The course includes theory and lab components which emphasizes on understanding the implementation and application of deep neural networks in various prominent problem domains like speech recognition, sentiment analysis, recommendations, and computer vision etc. The course facilitates the students to interpret and appreciate the successful application of deep neural nets in various prediction and classification tasks of ML.
Course Objective		The objective of the course is to familiarize the learners with the concepts of **Deep Learning** and attain **SKILL DEVELOPMENT** through **Experiential Learning techniques**
Course Out Comes		On successful completion of the course the students shall be able to: CO1: Apply basic concepts of Deep Learning to develop feed forward models CO2: Apply Supervised and Unsupervised Deep Learning techniques to build effective models for prediction or classification tasks CO3: Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains of Machine Learning and Machine vision. CO4: Analyze performance of implemented Deep Neural models
Course Content:		

Module 1	Introduction to Deep Learning	Assignment	Programming		**10 Sessions**
	Topics: Machine Learning in a nutshell, Fundamentals of deep learning and neural networks, Deep Neural Network, Feedforward Neural Network, Perceptron, Activation Functions, Loss Functions, Gradient Descent, Back-propagation, Training Neural Networks Building your Deep Neural Network: Step by Step, Introduction to CNN				
Module 2	Improving Deep Neural Networks	Assignment	Programming		**09 Sessions**
	Topics: Hyperparameter tuning, Initialization, Overfitting and Underfitting, Regularization and Optimization, Dropout, Batch Normalization				

Module 3	Deep Supervised Learning Models	Assignment	Programming		**10 Sessions**
	Topics: Convolutional neural network with pooling flattening, Prediction of image using Convolutional Neural Networks, Deep learning in Sequential Data, RNN & LSTM, GRU,				
Module 4	Deep Unsupervised Learning	Assignment	Programming		**10 Sessions**
	Topics: Basics of Deep unsupervised learning, Auto encoders, Recommender systems, computer vision				

List of Laboratory Tasks:

Experiment No. 1: Programming assignment to implement a single layer feed forward neural network from scratch (Application: A basic neural network).

Level 1: Programming scenario to implement a basic single layer feed-forward neural network perceptron.

Level 2: Programming scenario to implement a basic single layer feed-forward neural network with a single hidden layer having ReLU activation function and sigmoid in the output layer.

Experiment No. 2: Programming assignment to build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.

Level 1: Programming scenario to use the Backpropagation algorithm to build an ANN and run it on a dataset for few epochs.

Level 2: Programming scenario to use the Backpropagation algorithm to build an ANN and run it on a dataset for few epochs and interpret the accuracy, loss and other evaluation parameters.

Experiment No. 3: Programming assignment to build a multiple layer neural network with specific model parameters and hyperparameters on a given real life dataset.

Level 1: Programming assignment to implement a MLP with

- possibility to use 2-4 layers
- ReLU for the hidden layer
- Sigmoid in the output layer
- optimization via gradient descent (GD)

Level 2: Programming assignment to implement the neural network and add some more hyperparameters in the perceptron model

- softmax output layer
- optimization via stochastic gradient descent (SGD)
- Gradient checking code (!!!)

Generate the confusion matrix

Experiment No. 4: Programming assignment to implement classification of linearly separable Data with a Deep neural network (Application: Binary classification).

Level 1: Programming scenarios to build a binary classifier with a deep ANN.

Level 2: Programming scenarios to build a binary classifier with a deep ANN

- Weight initialization with random noise (!!!) (use normal distribution with changing std. deviation for now)
- implement dropout, *l2* regularization
- implement a different optimization scheme (RPROP, RMSPROP, ADAGRAD)
- employ batch normalization

Experiment No. 5: Programming assignment to implement a basic Convolution Neural Network.

Level 1: Programming scenarios which use the concept of convolution and pooling to implement a CNN.

Level 2: Programming scenarios which use the concept of convolution and pooling to implement a CNN and also specify some parameters like number of filters, length of feature detector, stride etc.

Experiment No. 6: Programming assignment to perform image segmentation and object detection using CNNs.

Level 1: Programming assignment to instantiate a CNN (that uses FullyConnectedLayers) and train the neural network using the training data from MNIST data set.

Level 2: Programming assignment to instantiate a CNN (that uses FullyConnectedLayers) and train the neural network using the training data from MNIST data set. Choose appropriate hyper parameters for the training of the neural network. Plot the cost versus training iterations using different mini-batch sizes: 16; 64; 256; 1024. Record the test accuracy in percentage and total training time you spent in seconds. Implement Adam Optimizer. To obtain full marks, the network should be able to achieve a test accuracy of 90% or more across many different random seeds.

Experiment No. 7: Programming assignment to employ CNN in image classification from given dataset.

Level 1: Programming scenario to instantiate a CNN (with at least one convolutional layer) and train the neural network using the training data from CIFAR10 data. Choose appropriate hyperparameters for the training of the neural network. The network should be able to achieve a test accuracy of at least 50% within 10 training epochs.

Level 2: Programming scenario to build a CNN (with more than one convolutional layer) and train the neural network using the training data from CIFAR10 data. Choose appropriate hyperparameters for the training of the neural network. The network should be able to achieve a test accuracy of at least 50% within 10 training epochs. Continue to train further and examine training and testing performance. Report hyperparameters (learning rate, number of hidden layers, number of nodes in each hidden layer, batch size and number of epochs) of the Deep Neural Network. Also, explain the observations.

Experiment No. 8: Programming assignment to perform Sentence (text) Classification using Convolutional Neural Networks.

Level 1: Programming Scenarios to utilize CNN to categorize text data in given datasets like SST movie reviews.

	Level 2: Programming Scenarios to utilize CNN to categorize text data in given datasets like SST and MR movie reviews. **Experiment No. 9:** Programming assignment to apply Recurrent Neural Networks for sentiment analysis of text data. **Level 1:** Programming scenario to build a model to perform sentiment analysis of IMDB movie reviews using. Reviews are categorized into two polarities: positive and negative. **Level 2:** Programming scenario to build a model to perform sentiment analysis of IMDB movie reviews. Reviews are categorized into three polarities: positive, negative and neutral. **Experiment No. 10:** Programming assignment to create a generative model for text, character-by-character using Recurrent neural networks. **Level 1:** Programming scenario to implement a multi-layer Recurrent Neural Network like LSTM for training/sampling from character-level language models, which takes one text file as input and trains an RNN that learns to predict the next character in a sequence. The RNN can then be used to generate text character by character that will look like the original training data. **Level 2:** Programming scenario to implement a multi-layer Recurrent Neural Network utilizing both LSTM and GRU in turns for training/sampling from character-level language models, which takes one text file as input and trains an RNN that learns to predict the next character in a sequence. The RNN can then be used to generate text character by character that will look like the original training data. Train the model and use it to generate new text. **Experiment No. 11:** Programming assignment to implement RNN models for multivariate time series forecasting. **Level 1:** Programming scenario to implement a many-to-one Recurrent Neural Network for Stock Price forecasting, i.e. trained with a certain number of day's data, the model should predict the stock price of the next day. **Level 2:** Programming scenario to implement a many-to-one Recurrent Neural Network for Stock Price forecasting, i.e. trained with a certain number of day's data, the model should predict the stock price of the next day. Students are free to use RNN, GRU, or LSTM (or compare between) and any number of layers and architecture. In the testing, plot the ground truth and your predicted values for 100 days. **Experiment No. 12:** Programming assignment to implement Autoencoders and deep Boltzmann's machines. **Level 1:** Programming scenario to implement a basic recommender system using deep Boltzmann's machines. **Level 2:** Programming scenario to build a recommender system with Collaborative filtering algorithm using deep Boltzmann's machines,
	Targeted Application & Tools that can be used: Targeted employment sector is not restricted to any single domain. Today, ML and Dl have been employed for data analysis and improved business intelligence in every sector. Targeted

job profiles include Data Analyst, Data Scientist, Data Engineer, Neuroinformatician, Bioinformatician, Image Recognition, Research Analyst, Full Stack Developer for Deep Learning, Natural Language Process Engineer, Business Analyst etc. Few of the top recruiters are Amazon, NVIDIA. Microsoft, IBM, Accenture, Facebook, Intel, Samsung, Lenovo, Adobe etc., among numerous others.

Tools: Neural Designer, AutoML, AutoDL, Keras, TensorFlow, Torch, Google Colaboratory, Spider, Jupiter Notebook

Project work/Assignment:

Throughout the progression in each module, students will have to submit scenario based programming Assignments/Experiments as listed in "List of Lab Tasks". On completion of each module, students will be asked to develop a Mini Project, similar to the following:

- **Music genre classification system**
  This is one of the interesting deep learning project ideas. This is an excellent project to nurture and improve one's deep learning skills. The aim is to create a deep learning model that uses neural networks to classify the genre of music automatically. For this project, students will use an FMA (Free Music Archive) dataset. FMA is an interactive library comprising high-quality and legal audio downloads. It is an open-source and easily accessible dataset.
  However, it is noteworthy that before one can use the model to classify audio files by genre, he/she will have to extract the relevant information from the audio samples (like spectrograms, MFCC, etc.)

- **Image Caption generator**
  This is one of the trending deep learning project ideas. This is a Python-based deep learning project that leverages Convolutional Neural Networks and LTSM (a type of Recurrent Neural Network) to build a deep learning model that can generate captions for an image. An Image caption generator combines both computer vision and natural language processing techniques to analyze and identify the context of an image and describe them accordingly in natural human languages (for example, English, Spanish, Danish, etc.). This project will strengthen one's knowledge of CNN and LSTM, and one will learn how to implement them in real-world applications as this.

- **Visual tracking system**
  A visual tracking system is designed to track and locate moving object(s) in a given time frame via a camera. It is a handy tool that has numerous applications such as security and surveillance, medical imaging, augmented reality, traffic control, video editing and communication, and human-computer interaction. This system uses a deep learning algorithm to analyze sequential video frames, after which it tracks the movement of target objects between the frames. The two core components of this visual tracking system are Target representation and localization

- **Traffic Signal Classification**
  The traffic sign classification project is useful for all autonomous vehicles. Machines are able to identify traffic signs from the image. Students can use the GTSRB dataset that contains 43 different traffic sign classes. This is a good project to understand image classification.

- **Driver Drowsiness Detection**

	The driver drowsiness detection is a project which can detect whether a person is sleeping or not while driving. We can implement a model for drivers and it can also prevent accidents from happening. • **Autocolouring old Black and white images** The idea of this project is to make a model that is capable of colorizing old black and white images to colorful images. Digital artists take a few hours to color the image but now with Deep Learning, it is possible to color an image within seconds.
	Text Book T1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017
	References R1. Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classification. Wiley-Inderscience, 2nd Edition. 2013 R2. Theodoridis, S. and Koutroumbas, K. Pattern Recognition. Edition 4, Academic Press, 2015 R3. Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach. Prentice Hall Series in Artificial Intelligence, 2013 R4. Bishop, C. M. Neural Networks for Pattern Recognition, Oxford University Press, 2008. **Weblinks** W1.https://presiuniv.knimbus.com/user#/home W2.https://www.ibm.com/in-en/topics/deep-learning#:~:text=Deep%20learning%20is%20a%20subset,from%20large%20amounts%20of%20data.
	Topics relevant to development of "SKILL DEVELOPMENT": Real time Data Analysis using Deep learning. for developing **SKILL DEVELOPMENT** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout

Course Code: CSE 6002	**Course Title:** Natural Language Processing **Type of Course:** Program Core Theory and Laboratory Integrated Course	**L-T-P- C**	2	0	2	3

Version No.		2.0
Course Pre-requisites		--
Anti-requisites		**NIL**
Course Description		This course introduces a basics of Natural Language Processing methods with specific emphasis on modern applications. The course will cover pre-processing techniques of textual data like stemming, lemmatization, tokenization etc. Different word Vectorization Techniques like Bag of Words, TF-iDF etc. followed by basics of Probability for building language models. Basics of Neural Network, LSTM Recurrent Neural Network, Applications of NLP like Information Extraction, Emotion Extraction from text, sentiment analysis etc.
Course Objective		The objective of the course is to familiarize the learners with the concepts of **Natural Language Processing** and attain **SKILL DEVELOPMENT** through **Experiential Learning** techniques
Course Outcomes		**On successful completion of this course the students shall be able to:** CO1: Understanding the fundamentals of NLP techniques. CO2: Apply Language modelling techniques for predictions. CO3: Apply Deep learning Techniques to build NLP Model CO4: Outline the application of NLP Techniques.
Course Content:		

Module 1	**pre-processing techniques**	Assignment		**Apply all the pre-processing techniques to the corpus of your choice.**	**14 Sessions**
	Topics: Introduction to Natural Language Processing, terminologies, empirical rules, why NLP is hard, why NLP is useful, Natural Language generation, NLP Processing pipeline, Corpus Cleaning techniques – word tokenization, sentence tokenization, word frequency distribution, stemming, lemmatization, dictionary, Part of Speech Tagging, optical character recognition, Textual Pre-Processing techniques – Stop words removal, regular expression, lower case, text standardization. Punctuation Mark Removal.				
Module 2	**Language Model**	**Assignment**		**Build n-gram language model for future word predictions.**	**11 Sessions**
	Topics: Word Embeddings techniques- bag of words, Tf-iDF, Word2Vec and optimization. Hidden Markov Models Simple N-gram models. Estimating parameters and smoothing. Negative Sampling Evaluating language models. (Forward and Viterbi algorithms and EM training), Maximum Entropy Models, N-gram and unigram.				
Module 3	**Deep Learning techniques for NLP models**	**Assignment**		**Build model for spam detection using mail subject as Corpus**	**11 Sessions**

	Topics: **Introduction to Neural Network, Perceptron, back Propa**gation, Recurrent Neural network, LSTM, Attention Models, BERT (Bidirectional **E**ncoder **R**epresentation from **T**ransformer), Reformer, speech recognition. Document summarization				
Module 4	**Application of NLP**	**Assignment**		**Paper Review of State-of-the-ArtNLP Technique**	**11 Sessions**
	Topics: Application of NLP- Lexical semantics and word-sense disambiguation. Named entity recognition and relation extraction. IE using sequence labeling, Emotion Extraction. tExt Summarization**.**				
	Targeted Application & Tools that can be used: 1. **Application Area Sentiment Analysis , Text Classification , Chatbots & Virtual Assistants , Text Extraction , Machine Translation , Text Summarization , Market Intelligence , Auto-Correct , Intent Classification , Urgency Detection , Speech Recognition** **Professionally Used Software: Anaconda Navigator, Python Packages, NLP toolkit** **List of Laboratory Task** 1. **Experiment No. 1: Apply all preprocessing technique to corpus of choice and plot word frequency.** 2. **Experiment No. 2: Word Embedding using Bag of words** 3. **Experiment No. 3: Word Embedding using TF-iDF** 4. **Experiment No. 4: Word Embedding using Word2Vec Continuous Bag of words** 5. **Experiment No. 5: Word Embedding using Word2Vec Skip gram Model** 6. **Experiment No. 6: Build language Model using n- gram.** 7. **Experiment No. 7: Build NLP model using LSTM** 8. **Experiment No. 8: Build NLP model using BERT** 9. **Experiment No. 9: Build NLP model using Reformer to show optimization.**				
	Project work/Assignment:				
	Project Assignment: NIL **Assignment 1: Paper Review of the state of the art NLP Technique**				
	Text Books T1. Daniel Jurafsky, James H. MartinSpeech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014. T2. Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Pythonll, First Edition, OReilly Media, 2009.				
	References **R1. Breck Baldwin, Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.**				

	R2. Richard M Reese, Natural Language Processing with Javall, OReilly Media, 2015. **R3. Nitin Indurkhya and Fred J. Damerau, Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.** **R4. Tanveer Siddiqui, U.S. Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press, 2008.** **Weblinks** W1.https://presiuniv.knimbus.com/user#/home W2.https://www.ibm.com/in-en/topics/natural-language-processing
	Topics relevant to development of "SKILL DEVELOPMENT": Information retrieval of Search Engines Information Retrieval. for developing **SKILL DEVELOPMENT** through **Experiential Learning techniques**. This is attained through assessment component mentioned in course handout.

Course Code: **CSE 5009**	**Course Title: Data Analytics and Visualization** **Type of Course: Program Core** **Theory and Laboratory Integrated Course**	**L-T-P-C**	2	0	2	3
Version No.	2.0					
Course Pre-requisites	--					
Anti-requisites	NIL					
Course Description	The Course consists of two parts where first Part covers advanced analytics that covers topics necessary to give businesses greater insight into their data than they could ordinarily, and the Second Part covers data visualization concepts. Primary concepts include machine learning, data mining, predictive analytics, location analytics, big data analytics, and location intelligence. Visualization for Time series, Geolocated data, Correlations, connections, Hierarchies, networks, and interactivity.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Data Analytics and Visualization** and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING techniques					
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Analyze data by performing Exploratory Data Analysis. CO2: Apply techniques of Machine Learning to build Generalized Predictive Models. CO3: Explain basic concepts of Data Visualization. CO4: Apply principles of Data Visualizations to provide insights from data.					
Course Content:						

Module 1	Data Analytics	Assignment	Analysis, Data Collection		**11 Sessions**
	Topics: Characteristics and types of data, Types of Analytics, Location Analytics, Working with Geospatial Data, Feature Engineering and Selection, Dimensionality Reduction Techniques, Common challenges faced during analysis				

Module 2	Advanced Analytics	Case Study	Analysis, Data Collection, Programming		**13 Sessions**
	Topics: Statistical methods for Data Analytics, Advance topics in Supervised and Unsupervised Machine Learning: Cluster Analysis, Hyper-Parameter Tuning, Measuring Performance of the Models, Model Selection, Data Mining techniques.				
Module 3	Introduction to Data Visualization	Assignment	Analysis, Data Collection		**9 Sessions**
	Topics: Importance of analysis and visualization in the era of data abundance, Fundamentals of Data Visualization, Human Perception, Basic plotting techniques, Interaction concepts, Visualization techniques for Time Oriented data, Introduction to Data Visualization Tools				
Module 4	Application - Data Visualization	Case Study	Analysis, Data Collection, Programming		**14 Sessions**
	Topics: Designing effective Visualizations, Advanced Visualization Tools, Visualizing Geospatial Data, Document Visualization, Visualization Systems, Evaluating Visualizations, Visualization Benchmarking. Use cases of data visualization.				
	List of Laboratory Tasks: **Experiment No 1: Exploratory Data analysis** **Level 1:** Demonstration of Tools to implement EDA **Level 2:** Use the Dataset to analyze and summarize data, analyze anomalies, analyze Outliers, and Missing Value Treatment **Experiment No. 2: Dimensionality Reduction Techniques** **Level 1:** Implement DR Technique(s) **Experiment No. 3: Machine Learning Methods** **Level 1:** Implement Supervised Learning Techniques for the given dataset **Level 2:** Implement Un-Supervised Learning Techniques for the given dataset and Cluster Analysis **Experiment No. 4: Measure the Performance of the Models** **Level 1**: Perform Model Selection **Level 2**: Regularize the model **Experiment No. 5: Introduction to Data Visualization Tools** **Level 1**: Implement Basic plotting techniques **Experiment No. 6: Time Oriented data** **Level 1:** Visualization techniques for Time Oriented data **Experiment No. 7: Trees, Graphs, Networks**				

	Level 1: Visualization techniques for Trees, Graphs, Networks **Experiment No. 8: Advanced Visualization Tools** **Level 1:** Design effective Visualizations for the given scenario **Level 2**: Implement Visualizing of Geospatial Data and Document Visualization **Experiment No. 9: Analyze Visualization Systems** **Level 1:** Analyze Visualization Systems
	Targeted Application & Tools that can be used: Data visualization is the graphical representation of information and data. By using visual elements like charts, graphs, and maps, data visualization tools provide an accessible way to see and understand trends, outliers, and patterns in data. In the world of Big Data, data visualization tools and technologies are essential to analyze massive amounts of information and make data-driven decisions. **Tools**: 1. R Programming 2. Python 3. Tableau 4. SAS 5. Excel 6. RapidMiner 7. IBM Cognos Analytics 8. Microsoft Power BI
	Project work:
	After completion of each module a Data analysis or programming based Assignment/Assessment will be conducted. **Mini Project:** Perform exploratory data analysis on a given dataset and provide insights on the same. **1. Crunchbase** – Find business information about private and public companies. You can look up how many investments they had, who the founding members are, and if they had any mergers or acquisitions. **2. Glassdoor Research** – Glassdoor offers data related to employment. You can, for example, figure out how much you can save by retaining employees. **3. Open Corporates** – Open Corporates is the largest open database of companies and company data in the world. Used by banks and governments, they pride themselves on having the most accurate data. 4. **FBI Uniform Crime Reporting –** The Uniform Crime Reporting compiles statistical crime reports, publications, and data points from thousands of cities, universities, states, and federal law enforcement agencies. 5. **Uppsala Conflict Data Program** – The Uppsala Conflict Data Program (UCDP) provides data on organized crime and civil war around the world. 6. **National Institute on Drug Abuse** – The National Institute on Drug Abuse (NIDA) monitors the prevalence and trends regarding drug abuse in the United States. 7. **DBpedia** – DBpedia aims to make Wikipedia's information easily searchable via SPARQL queries or by downloading their information directly. For instance, you can search for NBA players born in the 80s, in cities with more than 1M inhabitants. 8. **Google Trends** – Google Trends allows you to look at what's going on in the world. It gives you data about what's becoming popular, and how much people are searching for a particular term.

	9. **Instagram API** – Facebook allows you to use Instagram's API to quickly access comments, metadata, and metrics. 10. **Comtrade** – Official trade in goods and services data sets managed by the UN COMTRADE database. There are data visualization tools and an API and other extraction tools available. 11. **Datahub – Stock Market** – From gold prices, NASDAQ listings, to S&P 500 companies, you'll find it all on datahub.io 12. **Global Financial Data** – Global Financial Data gives you exactly what it says on the tin; data about the finances of the world. Ranges from real estate, global macro data, to market data. 13. **IMF Data** – The IMF, or International Monetary Fund, is an organization that aims to foster monetary collaboration between countries. You can find data on trade, government finance, and financial development. 14. **The Atlas of Economic Complexity** – The Atlas of Economic Complexity provides data about global trade dynamics over time. Want to know the quantity of textiles China exported to South Korea? Easy. 15. **World Bank** – Not only does the World Bank provide financial data about countries, but it also provides data on education and health. 16. **Financial Times Data** – Here you'll find cold, hard numbers about the different markets in the world. Data include fluctuations in currency, yield rates of bonds, and commodity prices.
	Text Book T1. Wilke, Claus O. Fundamentals of data visualization: a primer on making informative and compelling figures. O'Reilly Media, 2019. T2. Ward, Grinsten, Keim. Interactive Data Visualization: Foundations, Techniques, and Applications, A K Peters/CRC Press,2nd Edition, 2015
	References **R1.** Mohammed J. Zaki, and Wagner Meira Jr., "Data Mining and Analysis: Fundamental Concepts and Algorithms", Cambridge University Press, 2016 R2. I.H. Witten and E. Frank, Data Mining: Practical Machine learning tools and techniques Morgan Kaufmann publishers; 3rd Edition, 2011 **Weblinks** W1.https://presiuniv.knimbus.com/user#/home W2. https://www.geeksforgeeks.org/short-note-on-data-visualization/
	Topics relevant to "EMPLOYABILITY SKILLS": Real time decision-making application development using Data visualization tools for EMPLOYABILITY SKILLS through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 5010	**Course Title: Robotic Process Automation** **Type of Course: Discipline Elective** **Theory only**	**L- T-P-C**	3	0	0	3

Version No.	2.0
Course Pre-requisites	--
Anti-requisites	**NIL**
Course Description	The purpose of this course is to enable the students to appreciate the need for Robotic Process Automation and the course offers comprehensive knowledge and professional-level skills focused on developing and deploying software robots using UiPath Platforms. The course is both conceptual and Practical in nature and needs basic knowledge of Computer Programming. The course assumes no prior knowledge of RPA. It begins by refreshing basic programming skills and introducing basic RPA concepts. The course develops skills to identify task which can be automated and develop it with UiPath Studio. The course also enhances the programming abilities through assignments.
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Robotic Process Automation** and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING techniques
Course Outcomes	On successful completion of the course, the students shall be able to: CO1.Explain the concept of automation. CO2.Describe various programming constructs in RPA. CO3.Identify and understand different simulation drive robots. CO4.Apply automation to various concepts related to AI and ML algorithms.
Course Content:	

Module 1	Introduction to Programming Concepts and RPA Basics	Assignment	Data Analysis		**10 Sessions**
	Topics: **Programming Concepts Basics-1**: Software applications, Introduction to Programming, Data and data structure, Algorithms, Sequence, and Flow, and Software Development Guidelines. **Programming Concepts Basics-2:** Compiler and execution, Scripting and Macro, Frameworks and Languages, Information Sharing Mechanism, Variables and Arguments, Files and File Types, Access Control. **RPA Basics:** Automation and RPA, Programming Constructs in RPA, Robots in RPA, RPA in Business and Technology.				
Module 2	RPA Advanced Concepts	Assignment	Build own bots		**10 Sessions**
	Topics: **RPA Advanced Concepts:** Setting up the Center of Excellence, RPA Project Methodology, The RPA Journey, RPA in the Emerging Ecosystem**.** **Introduction to UiPath:** The Basics of UiPath Studio Installation, The User Interface, the various steps involved in the automation projects, The installation of UiPath extensions. **Variables:** Variables, Types of Variables, Variables in UiPath, Arguments, Namespaces. **Control Flow:** Control Flow & Universal Statements, Control Flow Statements in UiPath, Practical Exercise				
Module 3	Simulation of differential drive robots	Assignment	Differential robots		**10 Sessions**

	Introduction to Gazebo, Installation, Testing Gazebo with ROS interface, Simulation of differential drive robot using ROS technical requirements: Getting Started with Gazebo Simulator, Working with TurtleBot2 simulation, Creating a simulation of Chefbot.

Module 4	Advanced Automation and Orchestrator	Case Study	Data Collection and Team Project		**10 Sessions**

	Topics: **Email Automation:** Introduction to Email Automation, Email Automation in UiPath Studio, Practice retrieving and sending emails **Debugging and Exception Handling:** Exception Handling, Debugging Tools, Workflow Designs, Catching errors **Project Organization:** Project Organization, Process, Library, Robotic Enterprise Framework **Orchestrator:** Introduction to Orchestrator, Processes, Robots in Orchestrator, Working with Orchestrator **Future Trends:** Artificial Intelligence, Autonomous things, Digital Assistant, Computing
	Targeted Application & Tools that can be used: Targeted employment sector is service provider and control monitor like GE, Siemens, TCS etc. Targeted job profiles include digital domain and Service based indusrty etc. **Tools:** • UiPath Studio/StudioX
	Project work:
	Project 1: Sales order entry Robot **Project 2: E-Mail auto responder Robot** **Project 3: Disk Monitoring Robot**
	Text Book T1. "Robotic Process Automation using UiPath StudioX", Adeel Javed, Anum Sundrani, Nadia Malik, Sidney Madison Prescott, Apress, 2021
	References R1. "Learning Robotic Process Automation", Alok Mani Tripathi, Packetz, 2018. R2. https:// academy.uipath.com/ **Weblinks** W1.https://presiuniv.knimbus.com/user#/home W2.https://www.geeksforgeeks.org/robotics-introduction/.
	Topics relevant to development of "EMPLOYABILITY SKILLS": Get introduced to RPA Studio and RPA developer Tools for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 5011	**Course Title: Data Science with Cloud Computing** **Type of Course: Discipline Elective** **Theory Only**		**L- T-P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	--					
Anti-requisites	**NIL**					
Course Description	This course introduces a new Transformative, more collaborative way of doing Data Science. It helps in understanding End to End Data pipelines, Ingesting Data in a serverless way and working our way through Data Exploration, Dashboards, and Streaming Data all the way to training and making an operational Machine Learning Model.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Data Science with Cloud Computing** and attain **EMPLOYABILITY SKILLS** through **PARTICIPATIVE LEARNING** techniques					
Course Outcomes	On successful completion of the course the students shall be able to: CO1.Define Data Science and its fundamentals and the process in Data Science. CO2.Explain the process of Ingesting Data into the Cloud Platform. CO3.Analyze real-world problems with Accuracy. CO4.Demonstrate the overall organization of Data and Storage.					
Course Content:						
Module 1	**Making Better Decisions Based on Data**	**Assignment**	**Case Study**		**10 Sessions**	
Topics: Many Similar Decisions, Role of Data Engineers, The Cloud Makes Data Engineers Possible, The NaN value, Series CRUD, Series Indexing, The Cloud Turbocharges Data science, Airline on Time Performance Data, Scheduling Monthly Downloads.						
Module 2	**Creating Compelling Dashboards**	**Assignment**	**Case Study**		**10 Sessions**	
Topics: Explain your Model with Dashboards, Loading Data into google Cloud SQL, Creating Google cloud Instance, Interacting with Google cloud Platform, Maximum Likelihood Estimation (MLE)						
Module 3	**Streaming Data: Publication and Ingest**	**Assignment**	**Case Study**		**10 Sessions**	
Topics: Designing the Event Feed, Time Correction, Apache Beam/Cloud Dataflow, Publishing an Event Stream to Cloud Pub/Sub, Real Time Stream processing, Interactive Data Exploration, Exploratory Data Analysis, Loading Flights Data into Big Query, Arrival Delay conditioned on Departure Delay, Evaluating the Model. Time Series Analysis						
Module 4	**Cloud Dataproc**	**Assignment**	**Case Study**		**10 Sessions**	

Topics:
Bayes Classifier on Cloud Dataproc, Map Reduce and Hadoop Eco System, Quantization using Spark SQL, Bayes Classification using Pig

Targeted Applications & Tools that can be used:

Targeted Industries like Banking, Transport, e-commerce, healthcare and many more are using data science to make optimal Decisions. The usage of data science helps in rising sales. It can explore historic data, make comparisons and analyses of the market and provide recommendations.
Target Jobs Data Scientist, Data Architect, Data Engineer, Statistician.

Tools:

- Apache Spark
- Jupyter
- Weka

Project work/Assignment:

Mini Project:

Walmart Sales Forecasting in Cloud

- Predict the sales across various departments in each store.
- Predict the effect of markdowns on the sales during the holiday seasons.

Term Assignments:

Consider a Dataset on Bird communities that needs to be analyzed. The data has three columns, a date, a common name, and a count of the number of individuals.

- Count the total number of individuals of each species that were seen in each data file.
- Sort based on the total number of individuals.

Text Book

T1. "Data Science on the Google Cloud Platform: Implementing End-to-End Real-Time Data Pipelines: From Ingest to Machine Learning"-Valiappa Lakshmanan,1st Edition, January 2018.
T2. "Data Analysis in The Cloud"- Domenico Talia ,1st Edition, September 2015

References

R1. Doing Data Science, Straight Talk from the Frontline. O'Reilly. 2014.

Weblinks

W1.https://presiuniv.knimbus.com/user#/home
W2.https://www.geeksforgeeks.org/why-cloud-computing-is-important-in-data-science/

Topics relevant to " EMPLOYABILITY SKILLS ": Data Extraction, Data wrangling for developing **Employability Skills** through **Participative Learning techniques**. This is attained through assessment component as mentioned in course handout.

Course Code: **CSE 5012**	**Course Title: Artificial Intelligence in Cloud Computing** **Type of Course: Discipline Elective** **Theory Only**		**L-T- P-C**	3	0	0	3
Version No.	2.0						
Course Pre-requisites	--						
Anti-requisites	**NIL**						
Course Description	This Course is designed to acquire the ability to deliver intelligent solutions to problems in a variety of domains and business applications such as natural language processing, text mining, robotics, reasoning and problem-solving in AI. The inclusion of AI in the cloud can lead to a more effective synthesis of data systems for identifying valuable information. This information can then be applied practically in business operations. AI in cloud computing can provide users with seamless data access. AI uses data to get things done, which makes it well-suited to cloud environments as they can hold large amounts of data. Topics Includes: AI Cloud Services, Applications of AI, AI Chatbots , Types of Chatbots, Applications of Chatbot, Cloud platforms –Google cloud, Microsoft Azure, AWS, Developing AI Application using AWS sage maker						
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Artificial Intelligence in Cloud Computing** and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING techniques						
Course Outcomes	On successful completion of the course the students shall be able to: CO1. Gain the knowledge on AI Cloud services. CO2. Understand the various applications of AI CO3. Explain the factors that lead to the growing popularity of chatbots. CO4. Develop the cloud AI application using AWS Sage Maker						
Course Content:							
Module 1	AI Cloud Services	Assignment	Cloud API			**10 Sessions**	
	Topics: Introduction to AI cloud, The AI Hub, AI platform, AI building blocks, why AI cloud, Technologies that support AI platform for business like IBM Watson, Microsoft Cognitive Services or Natural Language application programming interfaces allow abstract complex AI capabilities via simple API calls.						
Module 2	AI applications	Use case study	Speech Recognition			**10 Sessions**	
	Topics: Language Models – Information Retrieval- Information Extraction – Machine Translation – Speech Recognition - Image Analysis and Recognition on the Cloud– Robot – Hardware –Perception – Planning – Moving						
Module 3	AI chatbot	Assignment	Applications of chatbots			**8 Sessions**	

	Topics: Explaining what a chatbot is, Describe common applications of chatbots, Identifying factors that drive the growing popularity of chatbots, two main systems in use that bots use to recognize intent and extract entities, Designing a chatbot conversation, Building Chatbots with Python, Developing Goal-Oriented Chatbots with Dialogflow, Building Text Transformers, Training Conversational Chatbots.				
Module 4	Cloud-native AI application development	use case study	Create and deploy AI Application using AWS cloud platform		**10 Sessions**
	Topics: MLOps: Train, test, and deploy Deep Learning models using containers on a cloud server - Hands-on end-to-end cloud AI applications development and deployment using AWS Sage Maker, Training the AI Fashionista to Discern Fashions, Improving Fashionista AI 2.0 - Hands-on AI application development with APIs provided by the main cloud platforms, Object Detection and the Object Detection Hub API				
	Targeted Application & Tools that can be used: • Google Vertex AI is an integrated suite of machine learning tools and services for building and using ML models with AutoML or custom code. It offers both novices and experts the best workbench for the entire machine learning development lifecycle.				
	Project work:				
	Mini Project: Build a dynamic mobile chatbot powered with AI 1. Create Watson services with IBM Cloud. 2. Update the details in the back-end application. 3. Deploy the back-end application. 4. Set up IBM Cloud Functions. 5. Set up Watson Assistant. 6. Set up IBM Mobile Foundation Server and CLI. 7. Set up Google Cloud Anchors. 8. Configure the Android mobile app. 9. Build and run the Android mobile app.				
	Text Book T1. Micheal Lanham "Practical AI on the Google Cloud Platform", O'Reilly Media, 2020 E.Book-**Practical AI on the Google Cloud Platform (21h.io)** 2. Anand Deshpande, Manish Kumar, Vikram Chaudhari , "Hands-On Artificial Intelligence on Google Cloud Platform: Build intelligent applications powered by TensorFlow, Cloud AutoML, BigQuery, and Dialogflow" , Kindle Edition, 2020				
	References R1. "Cloud Computing: Principles and Paradigms" by Rajkumar Buyya (Editor), James Broberg (Editor), Andrzej M. Goscinski (Editor), WILEY, First Edition, March 29, 2011 R2. Deepak Khemani "Artificial Intelligence", Tata Mc Graw Hill Education 2013. R3. Stuart Russel and Peter Norvig "AI – A Modern Approach", 2nd Edition, Pearson Education 2007. **Weblinks** W1.https://presiuniv.knimbus.com/user#/home.				

	W2.https://www.geeksforgeeks.org/cloud-computing/.
	Topics relevant to development of " EMPLOYABILITY SKILLS ": Data Scientist using the Cloud - Data Scientists have to work with a variety of data (structured, semi-structured, unstructured), analytics tools, and programming languages by leveraging the cloud platform for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout

Course Code: CSE 5013	**Course Title:** Soft Computing **Type of Course:** Discipline Elective Theory Only	**L- T-P- C**	3	0	0	3

Version No.	2.0
Course Pre-requisites	--
Anti-requisites	**NIL**
Course Description	Soft computing is an emerging approach in computing that mimics the human mind's remarkable ability to reason and learn in an environment of uncertainty and imprecision. Soft computing is based on biologically inspired methodologies such as genetics, evolution, ant behaviors, particle swarming, human nervous systems, etc. Soft computing is the only solution when we don't have any mathematical modeling of problem-solving (i.e., algorithm), needs a solution to a complex problem in real-time, and easily adapts with changing scenarios and is implemented with parallel computing. It has enormous applications in many application areas such as medical diagnosis, computer vision, handwritten character reconditions, pattern recognition, machine intelligence, weather forecasting, network optimization, VLSI design, etc.
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Soft Computing** and attain **EMPLOYABILITY SKILLS** through **Problem Solving Methodologies**.
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Define the concept and applications of Soft Computing. CO2: Discuss Fuzzy logic concepts and its applications. CO3: Demonstrate Artificial Neural Networks concepts and its applications. CO4: Apply Evolutionary algorithms and hybrid soft computing techniques.
Course Content:	

Module 1	Introduction Soft Computing	Assignment	Analysis		**9 Sessions**

Topics:
Introduction to Soft Computing: Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing, Applications of Soft computing techniques, Elements of soft Computing.

Module 2	Fuzzy Logic	Assignment	Analysis, Data Collection		**12 Sessions**

Topics:
Fuzzy Logic: Introduction to Fuzzy logic. Fuzzy sets and membership functions. Operations on Fuzzy sets. Fuzzy relations, rules, propositions, implications and inferences. Defuzzification techniques. Fuzzy logic controller design, Predicate logic, Fuzzy decision making.

Module 3	Neural Networks	Case Study	Analysis, Data Collection		**10 Sessions**

Topics:
Neural Network: Neural Networks, Supervised and Unsupervised Learning. Single Layer Perceptron, Multilayer Perceptron, Backpropagation Learning, Network rules and various learning activation

functions, Introduction to Associative memory, Adaptive resonance theory and self-organizing map, Recent Applications.
Neural Networks as Associative Memories: Hopfield Networks, Bidirectional Associative Memory. Topologically Organized Neural Networks: Competitive Learning, Kohonen Maps.

Module 4	Evolutionary Computing	Assignment	Analysis, Data Collection	**10 Sessions**

Topics:
Evolutionary Computing: "History of Genetic Algorithm and Optimization working principle, The Schema Theorem, GA operators: Encoding, Crossover, Selection, Mutation, bit wise operation in GA etc. Introduction to ant colony optimization and particle swarm optimization. Integration of genetic algorithm with neural network and fuzzy logic.

Targeted Application & Tools that can be used:

In recent times, engineers have very well accepted soft computing tools such as Fuzzy Computing, ANN, Neuro-Computing and Evolutionary Computing, etc., for carrying out various numerical simulation studies. In the last two decades, these tools independently and in hybrid forms have been successfully applied to varieties of problems. The main objective is to introduce students to the latest soft computing tools. The training of these tools will be helpful to develop rigorous applications in the engineering domain.

Tools:

- MATLAB
- PYTHON
- C

Project work/Assignment:

Mini Project:

- Training of known/classified datasets representing some objects/pattern using various ANN learning methods including Perceptron, BPN, Adaline, Associative memory networks, Hopfield, kohenen networks.
- Classification of new input feature set/pattern based on training & learning
- Applying GA search to optimize the solutions. Implementation of the GA procedure.

Text Book

T1. Principles of Soft computing, Shivanandam, Deepa S. N Wiley India, 3rd Edition 2019
T2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Third Edition, Wiley.

References

R1. Kumar S., "Neural Networks - A Classroom Approach", Tata McGraw Hill, 2nd Edition 2017.
R2. Eiben A. E. and Smith J. E., "Introduction to Evolutionary Computing", Second Edition, Springer, Natural Computing Series, 2nd Edition, 2015.
R3. Fakhreddine O. Karray, and Clarence W. De Silva. Soft computing and intelligent systems design: theory, tools, and applications. Pearson Education, 2009.

Weblinks

W1.https://presiuniv.knimbus.com/user#/home
W2.https://www.geeksforgeeks.org/fuzzy-logic-introduction/

Topics relevant to " EMPLOYABILITY SKILLS ": Solving real world problems with uncertainty using Nature Inspired Algorithms for developing **Employability Skills** through **Problem Solving Methodologies** . This is attained through assessment component mentioned in course handout

Course Code: CSE 5014	**Course Title:** Ontology Engineering for the Semantic Web **Type of Course:** Discipline Elective **Theory Only**		**L- T-P- C**	3	0	0	3
Version No.	2.0						
Course Pre-requisites	--						
Anti-requisites	**NIL**						
Course Description	This course presents the basics of semantic web and Ontology engineering. This course consist of the detailed description RDF frameworks. This course is designed with theoretical material on ontology design, Description Logics, and developing ontologies using OWL. The course uses the Protege-OWL environment.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Ontology Engineering for the Semantic Web** and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING techniques						
Course Outcomes	On successful completion of the course the students shall be able to: CO1. Understand the semantic web basics, architecture and technologies. CO2. Describe the semantic relationships among the data elements using Resource Description Framework (RDF) CO3. Analyze the conventional web with semantic web. CO4. Able to design and implement real-world applications that "discovers" the data and/or other web services via the semantic web						
Course Content:							
Module 1	Introduction	Assignment	Analysis, Data Collection			**9 Sessions**	
	Topics: Introduction to the Syntactic web and Semantic Web, Evolution of the Web, The visual and syntactic web, Levels of Semantics, Metadata for web information, The semantic web architecture and technologies, A Layered Approach, Semantic Modeling -Potential of semantic web solutions and challenges of adoption.						
Module 2	Ontological Engineering	Assignment	Analysis, Data Collection			**9 Sessions**	
	Topics: Ontologies, Taxonomies, Topic Maps, Classifying Ontologies, Terminological aspects: concepts, terms, relations between them, Complex Objects, Subclasses and Sub properties, definitions, Upper Ontologies, Quality, Uses, Types of terminological resources for ontology building, Methods and methodologies for building ontologies, Multilingual Ontologies, methods for Ontology Learning, Constructing Ontologies Manually, Reusing Existing Ontologies, Ontology Evolution, Versioning.						
Module 3	Describing the Web Resources	Assignment	Data analysis task			**9 Sessions**	
	Topics: RDF Overview, The basic elements of RDF, RDF triples, Fundamental rules of RDF Aggregation and distributed information, RDF tools, RDF and RDF Schema in RDF Schema, RDFS, , Need for RDFS, Core elements of RDFS, RDF Schema: Basic Ideas.						
Module 4	Web Ontology Language and Real-world examples	Case Study	Analysis, Data Collection			**11 Sessions**	

Topics:
Requirements for Ontology Languages, OWL Sub languages, Description of the OWL Language, Layering of OWL, Examples for OWL, OWL in OWL, Future Extensions, Building Classes from Other Classes, Restricting Properties of Classes.

SWOOGLE and FOAF: basics, architecture, usage and examples.

Targeted Application & Tools that can be used:

Enterprise applications. A more concrete example is SAPPHIRE (Health care) or Situational Awareness and Preparedness for Public Health Incidences and Reasoning Engines which is a semantics-based health information system capable of tracking and evaluating situations and occurrences that may affect public health.

Geographic information systems bring together data from different sources and benefit therefore from ontological metadata which helps to connect the semantics of the data.

Domain-specific ontologies are extremely important in biomedical research, which requires named entity disambiguation of various biomedical terms and abbreviations that have the same string of characters but represent different biomedical concepts.

Tools:

- **Protégé**
- **Neon Toolkit**
- **SWOOP**
- **Vitro**

Project work:

Mini Project:

- Ontology-Based Model for the "Ward-round" Process in Healthcare
  To design an ontology-based model that can fix information flow problems in the ward-round process of hospital unit. This can used to provide relevant information to the domain users according to their needs and demands. The domain users profiling and describes their roles, information demands with competencies: skills, qualifications and experiences. The ontology based model will be implemented in OWL language that can be used in an application to support ward-round activities for achieving effective patient's treatment process.

Text Book/

1. Grigoris Antoniou, Frank Van, "Semantic Web Primer", MIT Press, 2008
2. Karin K. Breitman, Marco Antonio Casanova and Walter Truszowski, "Semantic Web Concepts: Technologies and Applications", Springer, 2007

References Books

1. LiyangYu , "Introduction to the Semantic Web and Semantic web services" Chapman & Hall/CRC, Taylor & Francis group, 2007
2. Peter Mika, "Social networks and the Semantic Web", Springer, 1st edition 2007
3. Robert M. Colomb, "Ontology and the Semantic Web", Volume 156 ,Frontier in Artificial Intelligence and Applications, IOS Press, 2007
4. Michael C. Daconta, Leo J. Obrst, and Kevin T. Smith, "The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management", Fourth Edition, Wiley Publishing, 2003.

Weblinks

W1.https://presiuniv.knimbus.com/user#/home.
W2. https://en.wikipedia.org/wiki/Ontology_engineering.

	Topics relevant to "ONTOLOGY ENGINEERING and " SEMANTIC WEB": Syntactic web and Semantic Web, Multilingual Ontologies, Ontology Development process and Life cycle, RDF triples, Fundamental rules of RDF Aggregation and distributed information, OWL Sub languages for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 6003	Course Title: Big Data Analytics Tools and Techniques Type of Course: Program Core Theory and Lab Integrated Course	L- T-P-C	2	0	2	3

Version No.	2.0
Course Pre-requisites	--
Anti-requisites	NIL
Course Description	This course is designed to provide the fundamental knowledge to equip students being able to handle real-world big data problems including the three key resources of Big Data: people, organizations and sensor. With the advancement of IT storage, processing, computation and sensing technologies. It helps the students to interpret the operational concepts of computer technology as well as performance enhancement.
Course Objective	The objective of the course is to familiarize the learners with the concepts of Big Data Analytics Tools and Techniques and attain **EMPLOYABILITY SKILLS** through **EXPERIENTIAL LEARNING** techniques
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Understand managing big data using Hadoop analytical tools and technologies CO2: Understand map-reduce analytics using Hadoop and related tools CO3: Preparing for data summarization, query, and analysis. CO4: Applying data modeling techniques to large data sets CO5: Building a complete business data analytic solution
Course Content:	

Module 1	Introduction to Hadoop and HDFS	Assignment	Data Collection and Analysis		8 Sessions

Topics:

Meet Hadoop: Data, Data Storage and Analysis, Comparison with Other Systems: Relational Database Management Systems, Grid Computing, Volunteer Computing Hadoop Fundamentals Map Reduce A Weather Dataset: Data Format, Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop: Map and Reduce, Java Map Reduce, Scaling Out: Data Flow, Combiner Functions, Running a Distributed Map Reduce Job, Hadoop Streaming , Characteristics of big data, Challenges in processing big data, Limitations of classical algorithms on big data

The Hadoop Distributed File system: The Design of HDFS, HDFS Concepts: Blocks, Name nodes and Data nodes, HDFS Federation, HDFS High-Availability, The Command-Line Interface, Basic File system Operations, Hadoop File systems Interfaces, The Java Interface, Reading Data from a Hadoop URL, Reading Data Using the File System API, Writing Data, Directories, Querying the File system, Deleting Data, Data Flow: Anatomy of a File Read, Anatomy of a File Write, Using Hadoop archives, limitations.

Module 2	YARN and Hadoop I/O	Assignment	Data Collection and Analysis		8 Sessions

Topics:

YARN Anatomy of a YARN Application Run: Resource Requests, Application Lifespan, Building YARN Applications, YARN Compared to Map Reduce, Scheduling in YARN: The FIFO Scheduler, The Capacity Scheduler, The Fair Scheduler, Delay Scheduling, Dominant Resource Fairness

Hadoop I/O: Data Integrity in HDFS, Local File System, Checksum File System, Compression and Input Splits, Using Compression in Map Reduce, Serialization, The Writable Interface, Writable Classes,

	Implementing a Custom Writable, Serialization Frameworks, File-Based Data Structures: Sequence File				
Module 3	Map Reduce Applications	Case Study	Data analysis		**8 Sessions**
	Topics: **Developing a Map Reduce Application:** The Configuration API, Combining Resources, Variable Expansion, Setting Up the Development Environment, Managing Configuration, Generic Options Parser, Tool, and Tool Runner, Writing a Unit Test with MR Unit: Mapper, Reducer, Running Locally on Test Data, Running a Job in a Local Job Runner, Testing the Driver, Running on a Cluster, Packaging a Job, Launching a Job, The Map Reduce Web UI, Retrieving the Results, Debugging a Job, Hadoop Logs, Tuning a Job, Profiling Tasks, Map Reduce Workflows: Decomposing a Problem into Map Reduce Jobs, Job Control, Apache Oozie **How Map Reduce Works:** Anatomy of a Map Reduce Job Run, Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion, Failures: Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure, Shuffle and Sort: The Map Side, The Reduce Side, Configuration Tuning, Task Execution: The Task Execution Environment, Speculative Execution, Output Committers				
Module 4	Map Reduce Types and Formats, Flume	Case Study	Data analysis		**10 Sessions**
	Topics: **Map Reduce Types, Input Formats**: Input Splits and Records Text Input, Binary Input, Multiple Inputs, Database Input (and Output) Output Formats: Text Output, Binary Output, Multiple Outputs, Lazy Output, Database Output **Flume** Installing Flume, An Example, Transactions and Reliability, Batching, The HDFS Sink, Partitioning and Interceptors, File Formats, Distribution: Agent Tiers, Delivery Guarantees, Sink Groups, Integrating Flume with Applications, Component Catalog				
Module 5	**Hive, Pig, Spark Analytical Tools**	Case Study	Data analysis		**10 Sessions**
	Topics: **Hive** Apache Hive with Hive Installation, Hive Data Types, Hive Table partitioning, Hive DDL commands, Hive DML commands, Hive sort by vs order by, Hive Joining tables **Pig** Installing and Running Pig, Execution Types, Running Pig Programs, Grunt, Pig Latin Editors, An Example: Generating Examples, Comparison with Databases, Pig Latin: Structure, Statements, Expressions, Types, Data Processing Operators: Loading and Storing Data, Filtering Data, Grouping and Joining Data, Sorting Data, Combining and Splitting Data. **Spark** An Example: Spark Applications, Jobs, Stages and Tasks, A Java Example, A Python Example, 20082020 / 31 Resilient Distributed Datasets: Creation, Transformations and Actions, Persistence, Serialization, Shared Variables, Broadcast Variables, Accumulators, Anatomy of a Spark Job Run, Job Submission, DAG Construction, Task Scheduling, Task Execution, Executors and Cluster Managers: Spark on YARN				
	List of Laboratory Tasks: 1. (i) Perform setting up and Installing Hadoop in its two operating modes: • Pseudo distributed, • Fully distributed. (ii) Use web based tools to monitor your Hadoop setup. **Level 1:** Programming assignment to install the Hadoop environment tools. 2. (i) Implement the following file management tasks in Hadoop:				

- Adding files and directories
- Retrieving files
- Deleting files

(ii) Benchmark and stress test an Apache Hadoop cluster

Level 1: Programming assignment to maintain the Hadoop Distributed File System.

3. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.

- Find the number of occurrence of each word appearing in the input file(s)
- Performing a Map Reduce Job for word search count (look for specific keywords in a file)

Level 1: Programming scenario to use map reduce programming to perform the analysis.
Level 2: Programming assignment to analyze the data for any given data file.

4. Stop word elimination problem:

Input:
- A large textual file containing one sentence per line
- A small file containing a set of stop words (One stop word per line)

Output:
A textual file containing the same sentences of the large input file without the words appearing in the small file.

5. 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 semi structured and record-oriented. Data available at: https://github.com/tomwhite/hadoopbook/tree/master/input/ncdc/all.

- Find average, max and min temperature for each year in NCDC data set?
- Filter the readings of a set based on value of the measurement, Output the line of input files associated with a temperature value greater than 30.0 and store it in a separate file.

Level 2: Programming assignment to analyze the social media data for business analytics.

6. For Purchases.txt Dataset , instead of breaking the sales down by store, give us a sales breakdown by product category across all of our stores.

- What is the value of total sales for the following categories?

  i.Toys
  ii.Consumer Electronics

- Find the monetary value for the highest individual sale for each separate store
  What are the values for the following stores?
  i.Reno
  ii.Toledo
  iii. Chandler
- Find the total sales value across all the stores, and the total number of sales.

Level 2: Programming assignment to analyze and find the maximum sales, minimum sales and average sales in each store.

7. Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data.

Level 1: Programming scenarios to perform the grouping, filtering and Joining.

	8. Write a Pig Latin scripts for finding TF-IDF value for book dataset (A corpus of eBooks available at: Project Gutenberg) **Level 2:** Programming Assignment to analyze the data from the given text file using Pig latin script. 9. Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes. **Level 1:** Programming scenario to analyze the data from the given text file to perform SQL operations. 10. Install, Deploy & configure Apache Spark Cluster. Run apache spark applications using Scala. **Level 1:** Programming scenario to analyze a dataset using spark. 11. 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. **Level 2:** Programming assignment to analyze the data using spark.
	Targeted Application & Tools that can be used: • **Business Analytical Applications** • **Social media Data Analysis** • **Predictive Analytics** • **Government Sector for analyzing the data** • **Improve the business through analytics** **Tools: Hadoop Framework tools like map reduce, Hive, Hbase, Spark, Pig, Flume.**
	Project work/Assignment:
	After completion of each module a programming based Assignment/Assessment will be conducted. A scenario will be given to the student to be developed as a data analysis application. On completion of Module 5, student will be asked to develop a project for Data Analysis.
	Text Book T1. Hadoop: The Definitive Guide Tom White O'Reilley Third Edition, 2012
	References R1.SPARK: The Definitive Guide MateiZaharia and Bill Chambers Oreilly 2018 R2.Apache Flume: Distributed Log Collection for Hadoop . D'Souza and Steve Hoffman Oreilly 2014 **Weblinks** W1.https://presiuniv.knimbus.com/user#/home W2. Data Analytics: What It Is, How It's Used, and 4 Basic Techniques (investopedia.com)
	Topics relevant to "EMPLOYABILITY SKILLS": Real time application development using Hadoop Ecosystem tools. for developing **EMPLOYABILITY SKILLS** through **EXPERIENTIAL LEARNING** techniques. This is attained through assessment component mentioned in course handout

Course Code: CSE 6004	**Course Title: Time Series Analysis and Forecasting** **Type of Course: Discipline Elective Theory Only**			**L- T-P-C**	3	0	0	3
Version No.	2.0							
Course Pre-requisites	CSE5007							
Anti-requisites	**NIL**							
Course Description	The course will provide a basic introduction to time series analysis. This theory based course covers topics in time series analysis and some statistical techniques on forecasting. Time series regression, exploratory data analysis, AR models, Seasonal Models, GARCH Models and Box-Jenkins approach are the major topics covering in this course. R and RStudio will be required for this class.							
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Time Series Analysis and Forecasting** and attain EMPLOYABILITY SKILLS through PROBLEM SOLVING techniques							
Course Outcomes	On successful completion of the course the students shall be able to CO1.Select appropriate model, to fit parameter values and make concise decisions based on forecasts obtained CO2.Demonstrate an understanding of the principles behind modern forecasting techniques. CO3.Apply concepts to real time series data using packages.							
Course Content:								
Module 1	Introduction	Assignment	Data Analysis task			**9 Sessions**		
	Topics: Background for time series analysis, Examples of Time Series, Objectives of Time Series Analysis, Characteristics of Time Series, Time Series Techniques, Approaches used for time series forecasting, ETS (Error, Trend, Seasonality) models to make forecasts, Decomposition method, Case study on decomposition method, Model forecast theory, Model forecast hands-on, stochastic process.							
Module 2	Time Series Regression and Exploratory Data Analysis	Assignment	Data analysis			**10 Sessions**		
	Topics: Time series pipeline, Classical Regression in the Time Series Context, Exploratory Data Analysis, Stationary Models and the Autocorrelation Function, Detrending and De-seasonalizing Smoothing, Introduction to Time Series Analysis with R,							
Module 3	AR models	Assignment	Data analysis			**10 Sessions**		
	Topics: Models for Stationary Time Series, Models for Non-Stationary Time Series, Identification, Forecasting, ARIMA (Autoregressive, Integrated, Moving Average) models, AR model, and MA model.							
Module 4	Additional models, Spectral Analysis and packages	Case Study	Data analysis			**10 Sessions**		
	Topics: Seasonal Models, Time Series Regression Models, GARCH Models, Seabird Model. Preparing model using ITSM, Time series using astsa, ARIMA models is to use sarima from astsa Preparing model using LSTM for weather forecasting using ARIMA.							
	Targeted Application & Tools that can be used:							

	Targeted Applications: Time series analysis on economics, finance, natural sciences, health care and more **Tools:** • R package astsa (Applied Statistical Time Series Analysis) • The package ITSM2000 (https://extras.springer.com/)
	Project work:
	Mini Project: **Choose any suitable real time dataset and build time series forecast models.** **Example:** In the Air Passengers dataset set, go back 12 months in time and build the ARIMA forecast for the next 12 month. Investigate following questions Is the series stationary? If not what sort of differencing is required? What is the order of your best model? What is the AIC of your model? What is the order of the best model predicted by auto_arima() method?
	Text Book T1.Montgomery DC, Jennings CL, Kulahci M. Introduction to time series analysis and forecasting. John Wiley & Sons; 2015 Apr 21. T2.Brockwell & Davis (2016) Introduction to Time Series and Forecasting, 3rd edition, Springer. T3.Shumway & Stoffer (2011) Time Series Analysis and its applications, with examples in R , 3rd edition, Springer.
	References R1.Box GE, Jenkins GM, Reinsel GC, Ljung GM (2015) Time series analysis: forecasting and control. John Wiley & Sons R2.Cryer & Chan (2008) Time Series Analysis with Applications in R, Springer R3.Prado & West (2010) Time Series: Modeling, Computation, and Inference Chapman & Hall **Weblinks** W1.https://www.coursera.org/courses?query=time%20series%20analysis W2. https://www.tableau.com/learn/articles/time-series-forecasting W3.https://presiuniv.knimbus.com/user#/home
	Topics relevant to development of "EMPLOYABILITY SKILLS": Information retrieval of Search Engines Information Retrieval for developing Employability Skills through PROBLEM SOLVING techniques. This is attained through assessment component mentioned in course handout

Course Code: CSE 6005	**Course Title: Intelligent Information Retrieval** **Type of Course: Discipline Elective** **Theory Only**		**L-T- P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	CSE5005					
Anti-requisites	**NIL**					
Course Description	This Course studies the theory, design, implementation and evaluation of information retrieval systems. The focus is on the core concepts of Text- based information systems, statistical characteristics of text, representation of information needs and documents. Several important retrieval models, algorithms, and Recommender System. Also examined is how an effective information search and retrieval is interrelated with the organization and description of information to be retrieved. Throughout the course, current literature from the viewpoints of both research and practical retrieval technologies on the World Wide Web will be examined.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Intelligent Information Retrieval** and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING techniques					
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Define basic concepts of information Retrieval and Recommender System CO2: Evaluate the effectiveness and efficiency of different information retrieval methods CO3: Explain the standard methods for Web indexing and retrieval CO4: Develop Methods for implementing a recommender system					
Course Content:						
Module 1	INTRODUCTION	Assignment	Term Paper		**8 Sessions**	
	Topics: Information Retrieval – Early Developments – The IR Problem -Components of IR Model–User Interaction with IR model- The Users Task – Information versus Data Retrieval – The IR System – The Software Architecture of the IR System – The Retrieval and Ranking Processes – The Web – The e-Publishing Era – How the web changed Search – Practical Issues on the Web – How People Search.					
Module 2	MODELING AND RETRIEVAL EVALUATION	Assignment	Term Paper		**12 Sessions**	
	Topics: Basic IR Models – Boolean Model – TF-IDF (Term Frequency/Inverse Document Frequency) Weighting – Vector Model – Probabilistic Model – Latent Semantic Indexing Model – Neural Network Model –Set Theoretic-Fuzzy, Extended Boolean, Retrieval Evaluation – Retrieval Metrics – Precision and Recall – Reference Collection – User-based Evaluation.					
Module 3	WEB RETRIEVAL AND WEB CRAWLING	Assignment	Term Paper		**10 Sessions**	
	Topics:					

	The Web – Search Engine Architectures – Cluster based Architecture – Distributed Architectures – Search Engine Ranking – Link based Ranking – Simple Ranking Functions – Learning to Rank – Evaluations — Search Engine Ranking – Search Engine User Interaction – Browsing – Applications of a Web Crawler – Taxonomy – Architecture and Implementation – Difference between web scraping and web crawling.

Module 4	RECOMMENDER SYSTEM	Assignment	Term Paper		**10 Sessions**

	Topics: Recommender Systems Functions – Data and Knowledge Sources – Recommendation Techniques – Basics of Content-based Recommender Systems – High-Level Architecture – Advantages and Drawbacks of Content-based Filtering – Collaborative Filtering – Matrix factorization models – Introduction to user-based recommender systems.
	Targeted Application & Tools that can be used: • Information Retrieval Applications • Machine Learning Applications **Tools:** • Bow Toolkit • GATE • Lemur • MG • Smart (System for the Mechanical Analysis and Retrieval of Text) Information Retrieval System is an information retrieval system **developed at Cornell University** in the 1960s.
	Text Book T1.Ricardo Baeza-Yates and Berthier Ribeiro-Neto, —Modern Information Retrieval: The Concepts and Technology behind Search, Second Edition, ACM Press Books, 2011. Link: https://people.ischool.berkeley.edu/~hearst/irbook/ T2.Ricci, F, Rokach, L. Shapira, B.Kantor, —Recommender Systems Handbook, First Edition, 2011. T3.C. Manning, P. Raghavan, and H. Schütze, —Introduction to Information Retrieval, Cambridge University Press, 2008. Link: https://nlp.stanford.edu/IR-book/
	References R1.Mikhail Klassen, Matthew A. Russell, Mining the Social Web,O'Reilly Media, Inc., 3rd Edition (2019) R2.Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, —Information Retrieval: Implementing and Evaluating Search Engines, The MIT Press, 2010. R3.Ceri, S., Bozzon, A., Brambilla, M., Della Valle, E., Fraternali, P. and Quarteroni, S., 2013. Web information retrieval. Springer Science & Business Media. **Weblinks** W1.https://presiuniv.knimbus.com/user#/home W2.https://www.geeksforgeeks.org/what-is-information-retrieval/.
	Topics relevant to development of "EMPLOYABILITY SKILLS": Software Development Engineer(Flipkart), Architect, Information Retrieval Officer, Research Scientist – IBM Research, Machine Learning Application Developer and Lead Engineer / Module Lead – Java / Python for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout

Course Code: CSE 6006	Course Title: AI in Internet of Things Type of Course: Discipline Elective Theory Only	L-T- P- C	3	0	0	3

Version No.	2.0
Course Pre-requisites	CSE5005
Anti-requisites	**NIL**
Course Description	This course introduces the core principles of the Internet of things and Artificial Intelligence from the basic to intermediate level. This theory-based course emphasizes on understanding the application of AI in IoT. The course will focus on the creative thinking of AI & IoT concepts & technologies.
Course Objective	The objective of the course is to familiarize the learners with the concepts of **AI in Internet of Things** and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING techniques
Course Outcomes	On successful completion of the course the students shall be able to: CO1.Understand building blocks of Internet of Things and characteristics. CO2.Describe IoT Protocols CO3.Compare and contrast from a range of AI techniques when implementing smart systems. CO4.Identify and Apply techniques in areas of AIIoT.
Course Content:	

Module 1	Introduction to AI	Assignment	Data Analysis task		**10 Sessions**

Topics:
Introduction to Artificial Intelligence, Basics of Python, Example programs in Python, Introduction to Machine Learning, Types of Machine Learning Algorithms, Introduction to Linear Algorithm, Introduction to deep learning, Genetic Algorithms, Adversarial Search, Constraint Satisfaction, Propositional Logic & Satisfiability, Uncertainty in AI.

Module 2	Introduction to IOT	Assignment	Data Collection		**10 Sessions**

Topics:
Introduction to Internet of Things, What is Microcontrollers?, Difference between Microprocessor and Microcontroller, Introduction to Arduino Boards, Types of Arduino Boards, Installation of Arduino IDE, Usage of Tinker Cad, Types of Sensors, Working Principle, Pin Configuration of Sensors, Demonstrating of Ultrasonic Sensor, IR Sensor, Gas Sensor, and PIR Sensor. Structure of Coding – Embedded C, Demonstrating - the intensity of LED using a potentiometer, Traffic Signal, Tinker cad demonstration for object detection.

Module 3	AI algorithms for sensors	Assignment	Data Collection		**10 Sessions**

Topics: How algorithms are used in sensors, Algorithms of Artificial Intelligence in Sensors-Classification algorithms, Data clustering, Evolutionary algorithms in sensing, Data pattern recognition, Maintenance, and production scheduling, Artificial intelligence in predictive and proactive scheduling, Energy efficient scheduling, Stochastic models in artificial intelligence, Queuing theory-based approach, Project scheduling, Artificial intelligence in assembly line balancing, Disassembly line balancing.

Module 4	IOT Protocols and Applications of AI in IOT	Case Study	Data Collection		**10 Sessions**

Topics:
Connectivity Protocols: 6LoWPAN, IEEE 802.15.4, Zigbee, Wireless, NFC, RFID. **Communication/Transport Protocols:** Bluetooth. **Data Protocols:** Message Queue Telemetry Transport (MQTT), Constrained Application Protocol (CoAP), Advanced Message Queuing Protocol (AMQP),Data Distribution service.**Applications of AI in IOT- Case Study: Smart Retail, Drone Traffic Monitoring , Office Buildings.**

Targeted Application & Tools that can be used:

Targeted employment sector is service provider and control monitor like GE, Siemens, TCS etc. Targeted job profiles include digital domain and Physical system design engineer, IOT engineer etc.

Tools:

- Arduino IDE
- TinkerCad
- NodeMCU
- Tensor Flow and Keras

Text Book

T1."Artificial Intelligence: A Modern Approach", Stuart Russell & Peter Norvig, Prentice-Hall, Third Edition (2009).
T2."Internet of Things: A hands on approach", Arshdeep Bagha & Vijay Madisetti, Universities Press 2015.
T3.https://www.tinkercad.com/

References

R1."The internet of Things: Connecting Objects to web", Hakima Chaouchi, Wiley 2017.
R2."Prolog: Programming for Artificial Intelligence", I. Bratko, Fourth edition, AddisonWesley Educational Publishers Inc, 2011.
R3.WE. RICH, K. KNIGHT, S. B. NAIR (2017), Artificial Intelligence, McGraw Hill Education, 3rd Edition

Weblinks

W1.https://presiuniv.knimbus.com/user#/home
W2.https://techvidvan.com/tutorials/iot-protocols/.
W3.https://www.javatpoint.com/iot-internet-of-things.

Topics relevant to development of "EMPLOYABILITY SKILLS ": Get introduced to AI programming and Interfacing of IOT devices. for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE5016	**Course Title: Essentials for Machine Learning (ML)** **Type of Course: Discipline Elective** **Theory Only**	**L- T-P- C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	**NIL**					
Anti-requisites	**NIL**					
Course Description	**Machine learning has been emerged as a promising paradigm in the field of Computer science having applications in a wide variety of fields such as communication networks, bioinformatics, image processing, antenna design etc. Now a day's people from multiple discipline are interested in Machine learning due to its applicability in predicting behaviors of highly complex systems, which is otherwise difficult based on traditional optimization techniques in a time bound fashion. The goal of this course is to provide the mathematical prerequisite for starting any Machine learning course to the students coming from various engineering disciplines. This course does not require any prerequisite. The goal of the course is:** 1. **To introduce basic probability and statistics concepts.** 2. **To introduce basic Linear Algebra concepts.** 3. **To enable the students to understand Machine Learning/Deep learning concepts in future.**					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Essentials for Machine Learning (ML)** and attain **EMPLOYABILITY SKILLS** through **PARTICIPATIVE LEARNING** techniques					
Course Outcomes	**On successful completion of this course the students shall be able to:** **CO1: Understand the basic concepts of Probability and Statistics.** **CO2: Understand the basic concepts of Linear Algebra.** **CO3: Peruse courses on Machine learning/Deep learning in future.**					
Course Content:						
Module 1	Probability	Assignment		Sample space and Events, Interpretation and axioms of Probability, Conditional Probability, Multiplication and total Probability rules, Independence, Bayes' theorem	**08 Sessions**	
	Topics: Sample space and Events, Interpretation and axioms of Probability, Conditional Probability, Multiplication and total Probability rules, Independence, Bayes' theorem.					
Module 2	Random variables	Assignment		Probability distribution, Probability mass function, Probability density function, Cumulative distribution function, Mean and variance of a random variable, Binomial,	**08 Sessions**	

				Poisson and Normal random variables, relation between them.	
	Topics: Probability distribution, Probability mass function, Probability density function, Cumulative distribution function, Mean and variance of a random variable, Binomial, Poisson and Normal random variables, relation between them.				
Module 3	Introduction to Statistics	Assignment		Pie Chart, Bar chart, Box and whisker plot, Mean, Median, Mode, AM, GM, HM, Quartiles, Deciles, Percentiles, Moments, Skewness, Kurtosis, Measures of Central tendency, Software demonstration.	**08 Sessions**
	Topics: Pie Chart, Bar chart, Box and whisker plot, Mean, Median, Mode, AM, GM, HM, Box Plots, time sequences plots, Measures of Central tendency, Software demonstration.				
Module-4	Estimation of Parameters	Assignment		Point estimation, Sampling distribution, Central Limit Theorem, Unbiased estimators, Method of point estimation, Method of moments, method of maximum likelihood, confidence interval estimates of population parameter, student's t distribution, Testing of hypothesis, Chi square distribution, Degrees of freedom	**06 Sessions**
	Topics: Point estimation, Sampling distribution, Central Limit Theorem, Unbiased estimators, Residual Analysis and model checking,method of maximum likelihood, confidence interval estimates of population parameter, student's t distribution, Testing of hypothesis, Chi square distribution, Degrees of freedom				
Module-5	Linear Algebra	Assignment		Scalar, Vector, Matrices and Tensors, Norms, Span, Eigen Value, Eigen Vector, The trace operator, Determinant, Proximity measure, Example: Principal Component Analysis.	**06 Sessions**
	Topics: Scalar, Vector, Matrices and Tensors, Norms, Span, Eigen Value, Eigen Vector, The trace operator, Determinant, Example: Principal Component Analysis.				
	Project work/Assignment:				
	Software demonstration, Probability mass function, Independence, Bayes' theorem, Span, Eigen Value for developing **Employability Skills** through **Participative**				

	Learning techniques. This is attained through assessment component mentioned in course handout.
	REFERENCE MATERIALS: **Text Book(s):** T1. Douglas C. Montgomery and George C. Runger, "Applied Statistics and Probability for Engineers", Sixth Edition, Wiley, 2016 T2. Dimitri P. Bertsekas and John N. Tsitsiklis, "Introduction to probability", MIT press, FALL 2000. T3. Murry R Spiegel and Larry J Stephens, "STATISTICS", Fourth Edition, Schaum's outlines, 2008. T4. Narsingh Deo, "System simulation with digital computer", PHI. T5. G. Strang, "Introduction to Linear Algebra", Fifth Edition, 2016, Wellesley-Cambridge Press, ISBN: 978-09802327-7-6. **Reference Books:** R1. Nils J. Nilsson, "Introduction to Machine Learning" (online Lecture notes on Stanford AI) R2. Shai Shalev-Shwartz, and Shai Ben-David, "Understanding Machine Learning", Cambridge University Press, 2017. **Weblinks** W1.https://presiuniv.knimbus.com/user#/home W2.https://www.javatpoint.com/machine-learning
	Topics relevant to " EMPLOYABILITY SKILLS ": Software demonstration, Probability mass function, Independence, Bayes' theorem, Span, Eigen Value for developing **Employability Skills** through **Participative Learning techniques**. This is attained through assessment component as mentioned in course handout

Course Code: CSE6011	**Course Title: Application of Probability theory in Computer Science** **Type of Course: Theory Course**		**L- T-P- C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	--					
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. In this course, our objective is to give an idea regarding the application of probability theory in the modeling and analyzing different kinds of computer systems. We particularly focus on time complexity analysis of different algorithms, reliability analysis of networks, physical layer security as well as resource allocation in 5G and beyond. The target audience for this course is Masters and Ph.D., students. The student should have basic Probability concepts as a pre-requisite. With a good knowledge of different techniques of applying Probability theory in modeling/analyzing computer systems, the students will be able to develop efficient solutions for complex and challenging real-life problems.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Application of Probability theory in Computer Science** and attain EMPLOYABILITY SKILLS through PROBLEM SOLVING techniques					
Course Outcomes	**On successful completion of this course the students shall be able to:** CO1: Develop mathematical models for various computer systems. CO2: Apply an appropriate probability concept to analyze the system. CO3: Apply appropriate Reinforcement learning techniques to solve complex real-life problems. CO4: Apply statistical Inference concepts to estimate parameters which are unknown to the model.					
Course Content:						
Module 1	Review on Basic Concepts	Assignment		Basic Probability Concepts		**12 Sessions**
	Topics: Basic probability concepts, Conditional probability, Expectation, random variables, Law of Large Numbers, well-known distributions, order statistics, and a basic idea of hypothesis testing, Central Limit Theorem. Applications in reliability analysis of VLSI chips, performance analysis of telephone network and binary communication channels, and application in the cognitive radio network.					
Module 2	Stochastic processes	Assignment		Markov process		**12 Sessions**
	Topics: Markov chain, Random Walks, Generating Functions, Birth-death process, application in modeling the behavior of wireless channels, memory interference problem, performance analysis of medium access protocols, analyzing the time complexity in the implementation of two stacks using a single array.					
Module 3	Reinforcement learning	Assignment		Understanding different Reinforcement learning techniques		**12 Sessions**

	Topics: Simple Applications of Decision Theory, Model Comparison, Markov decision process, value and policy iteration, off-policy and on-policy learning techniques (e.g., SARSA, Q-learning), Multi-arm Bandit problem (MAB), modeling resource allocation in 5G as MAB, Hidden Markov model (HMM), application of HMM in physical layer security.
	Targeted Applications & Tools that can be used: Markov's inequality Chernoff bound
	Project work
	-Performance analysis of the LRU stack model -Modeling multiprocessor systems and analyzing the reliability -Modeling handovers in wireless networks and performance analysis of handover algorithms. -A short survey on Monte Carlo simulation techniques.
	REFERENCE **MATERIALS: Text** **Book(s):** T1. Kishore S. Trivedi, "Probability and Statistics with Reliability, Queuing, and Computer Science Applications", PHI. T2. Dimitri P. Bertsekas and John N. Tsitsiklis, "Introduction to Probability", MIT Press, FALL 2000. T3. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", MIT press. T4. Narsingh Deo, "System simulation with digital computer", PHI **Reference links:** R1. https://open.umn.edu/opentextbooks/textbooks/21 **Weblinks** W1.https://presiuniv.knimbus.com/user#/home. W2.https://www.cuemath.com/data/probability/.
	Topics relevant to the development of "EMPLOYABILITY SKILLS": Information retrieval of Search Engines Information Retrieval for developing EMPLOYABILITY SKILLS through PROBLEM SOLVING techniques. This is attained through assessment component mentioned in course handout

Course Code: CSE 5017	**Course Title: Machine Vision** **Type of Course: Discipline Elective** **Theory Only**	**L-T-P- C**	3	0	0	3

Version No.		1.0
Course Pre-requisites		--
Anti-requisites		**NIL**
Course Description		This course provides an introduction to computer vision including fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, image classification and scene understanding. We'll explore methods for depth recovery from stereo images, camera calibration, automated alignment, tracking, boundary detection, and recognition. We'll use both classical machine learning and deep learning to approach these problems. The focus of the course is to develop the intuitions and mathematics of the methods in lecture, and then to learn about the difference between theory and practice in the projects.
Course Objective		The objective of the course is to familiarize the learners with the concepts of **Machine Vision** and attain EMPLOYABILITY SKILLS through PROBLEM SOLVING techniques
Course Outcomes		On successful completion of the course the students shall be able to: 1. Describe Image formation and Camera Models [Knowledge] 2. Classify techniques for Local feature extraction and tracking [Comprehension] 3. Apply the different category of calibration methods and dimension reconstruction approach for computer vision[Application]
Course Content:		

Module 1	Basic Concept of Image Processing	Mini Project	Mapping Facial Features		**12 Classes**
	Introduction to Image Processing-Basic mathematical concepts: Image enhancement: Grey level transforms, Spatial filtering. Extraction of special features: edge and corner detection. Morphological processing, Image transforms, Discrete Fourier Transform, Fast Fourier Transform. Frequency domain enhancement.				
Module 2	Image Segmentation	Mini Project	Hand gesture recognition		**14 Classes**
	Image Segmentation Algorithms: contextual, non-contextual segmentation, texture segmentation. Feature Detectors and Descriptors, Feature Matching-Object Recognition, The Use of Motion in Segmentation Optical Flow & Tracking Algorithms, Face detection (Viola Jones), Face Recognition.				
Module 3	Image Dimensions	Mini Project	Surveillance		**14 Classes**
	2D and 3D feature-based alignment, Pose estimation, Geometric intrinsic calibration, - Camera Models and Calibration: Camera Projection Models – orthographic, affine, perspective, projective models.				

	Projective Geometry, transformation of 2D and 3D, Internal Parameters, Lens Distortion Models, Calibration Methods – linear, direct, indirect and multi plane methods. Visual servo. Stereo correspondence-Epipolar geometry, Fundamental matrix, Introduction to SLAM (Simultaneous Localization and Mapping).
	Targeted Application & Tools that can be used: Computer Vision applications are **used for traffic sign detection, surveillance and recognition**. Vision techniques are applied to segment traffic signs from different traffic scenes (using image segmentation) and algorithms to recognize and classify traffic signs. **Tools:** • MAT Lab/Open CV
	Project work/Assignment:
	Project Work: **1. Detect the faces of humans by mapping facial features from a video or an image. There are several steps involved in these projects, such as mapping features.** **2. Hand gesture recognition is one of the critical topics for human-computer interaction. In this project, there are several tasks which are needed to be performed. This includes the hand region, which is to be extracted from the background, followed by segmenting the palms and fingers to detect finger movements.** **3. Count the number of people passing through a specific scene. The applications of this project include civilian surveillance, pedestrian tracking, pedestrian counting, etc.** **4. Design, implement and test on several regions on a set of images based on the segmentation algorithms.**
	Text Book 1. R. C. Gonzalez, R. E. Woods, 'Digital Image Processing', Pearson,2017 2. Introduction to Computer Vision and its Application, Richard Szelinski,2021
	References 1 . Emanuele Trucco and Alessandro Verri, "*Introductory Techniques for 3-D Computer Vision*", Prentice Hall, 1998. 2 Olivier Faugeras, "*Three Dimensional Computer Vision*", MIT Press, 1993. 3 Richard Szeliski, "*Computer Vision: Algorithms and Applications*", Springer, 2011. 4 Milan Sonka, Vaclav Hlavac and Roger Boyle, "*Image Processing, Analysis and Machine Vision*", Third Edition, CL Engineering, 2013. 5.Marco Treiber, "An Introduction to Object Recognition Selected Algorithms for a Wide Variety of Applications", Springer, 2010. 6.Forsyth and Ponce, "Computer Vision – A Modern Approach", Second Edition, Prentice Hall, 2011.
	Topics relevant to development of " EMPLOYABILITY SKILLS ", " IMAGE SEGEMENTATION and DIMENSIONS of Image Processing- We compare IMAGE PROCESSING/ COMPUTER VISION jobs with Information Technology service oriented jobs then obviously there is relatively limited scope. But things are changing very fast as time is changing. Scope of image processing/computer vision jobs is increasing day to day.

Course Code: CSE 6012	**Course Title:** Recommender Systems with Machine Learning and AI **Type of Course:** Discipline Elective **Theory Only**		**L- T-P- C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	CSE5007					
Anti-requisites	NIL					
Course Description	This course helps us understand from the early days of collaborative filtering to bleeding-edge applications of deep neural networks and modern machine learning techniques for recommending the best items to every individual user.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Recommender Systems with Machine Learning and AI** and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING techniques					
Course Outcomes	**On successful completion of this course, the students shall be able to:** CO1. Define recommender systems CO2. Use content-based filtering using item attributes CO3.Build model-based methods including matrix factorization, SVD. CO4.Apply deep learning, AI, artificial and recursive neural networks, for session based recommendations. CO5. Analyse recommendation algorithms using various case studies.					
Course Content:						
Module 1	Introduction to Recommendation System	Assignment	Seminar		**12 Sessions**	
	Topics: Introduction to Recommendation systems, Architecture of Recommendation systems, Basic models o Recommendation systems, Implicit Ratings, Explicit Ratings, Collaborative Filtering, Content-base Recommendation, Advantages and Disadvantages of Content-based recommendations. Knowledge Based Recommender Systems, Hybrid Recommendation systems, Demographic Recommendatio Systems, Applications of Recommendation systems, Advantages and Disadvantages of recommendatio systems.					
Module 2	Content-Based Recommender Systems	Assignment	Mini Project		**12 Sessions**	
	Topics: Introduction, Architecture of content-based recommendation, Basic components of Content-base systems, Learning User profiles and Filtering- KNN, case-based recommendation, Bayes Classifiers Rule-based Classifiers, Decision tree classifier.					
Module 3	Model-Based Collaborative Filtering	Assignment	Mini project		**12 Sessions**	
	Topics: Introduction to collaborative filtering, Decision and Regression Trees, Rule-based collaborative Filtering Item-wise vs User-wise models, Item-based collaborative filtering, Naive Bayes Collaborative filtering Basic matrix Factorization principle, and Singular Value Decomposition.					
Module 4	Hybrid Recommendation Systems	Assignment	Mini project		**12 Sessions**	
	Topics:					

Introduction to Hybrid Recommendation systems, Losses faced by recommendation systems: Bayesia personalized rating (BPR), Weighted approximation rank-pairwise(WARP). Weighted Hybrids Switching Hybrids, Cascade Hybrids, Meta-Level Hybrids, Mixed hybrids, Advantages an disadvantages of Hybrid Recommendation systems.

Module 5	Application and Evaluation of RS	Assignment	Seminar	**12 Sessions**

Topics:

Case study on YouTube Recommendation, case study on Netflix Recommendation system, Case study o an restaurant ratings given by the customer, Offline Evaluation, Online Evaluation, Goals of Evaluatio design- Accuracy, Coverage, Confidence and Trust, Diversity, Robustness and Stability, Scalability Training and testing of Ratings, RMSE, MAE, Evaluating Ranking via Correlation, Utility, Receive Operating Characteristics.

Targeted Applications & Tools that can be used:

Targeted Application: Web application development, AI, Operating systems

Tools: Python IDLE, ANACONDA

Application Areas:

- E-Commerce Application
- E-Learning Applications
- E-Business Services
- Artificial Intelligence and Machine Learning
- Enterprise-level/Business Applications

Professionally Used Software: Python, Spyder, Jupyter Notebook, Tensorflow (TFRS), Amazon Personalize.

Project work

- A scenario will be given to the students to be developed as a series of Program/ Application.

On completion of Module 3 and Module 4, students will be asked to develop a Mini Project using Python

Textbooks

T1.Frank Kane - Building Recommender Systems with Machine Learning and AI, First Edition,2018

T2. Charu C.Aggarwal – Recommender Systems, Springer Publishing Company,2016.

References

R1. Katarzyna Tarnowska,Lynn Daniel – Recommender System for improving custome Loyalty,Springer,1st edition,2020.

R2. EthemAlpaydin, —Introduction to Machine Learning 3e (Adaptive Computation and Machin Learning Series)‖, Third Edition, MIT Press, 2014.

Weblinks

W1.Whttps://presiuniv.knimbus.com/user#/home

W2.https://www.geeksforgeeks.org/recommendation-system-in-python/

Topics relevant to the development of "EMPLOYABILITY SKILLS": Information retrieval of Searc Engines Information Retrieval for developing Employability Skills through **Participative Learnin** techniques. This is attained through assessment component mentioned in course handout

Course Code: CSE 5001	**Course Title: Programming Methodologies using Java** **Type of Course: Open Elective Theory Only**	**L-T-P-C**	3	0	0	3

Version No.		2.0
Course Pre-requisites		--
Anti-requisites		Object Oriented Programming, Java
Course Description		This course introduces the engineering of computer applications emphasizing modern software engineering principles: object-oriented design, decomposition, encapsulation, abstraction and testing by using Java Programming. This course has theory and lab component which emphasizes on understanding the implementation and application of object-oriented programming paradigm. All along the course, we discuss how OOP allows software engineers to develop complex software by making high-level abstractions starting from very general classes down to more concrete classes. The Programming methodology emphasizes on software engineering principles, following best practices in software development, which enables the student to build real time applications with industry standards.
Course Objective		The objective of the course is to familiarize the learners with the concepts of **Programming Methodologies using Java** and attain SKILL DEVELOPMENT through PROBLEM SOLVING techniques
Course Out Comes		On successful completion of the course the students shall be able to: CO1.Identify and model the objects and their relationship. CO2.Apply the concept of arrays, strings, polymorphism & inheritance for real world scenarios. CO3.Implement interface & packages for building applications CO4.Apply the error handling and multithreading concepts appropriately. CO5.Use collections and generics to create desktop applications. CO6. Create GUI and web-based application.
Course Content:		

Module 1	INTRODUCTION	Assignment		Programming	**8 Sessions**
	Introduction to Object Oriented Programming, TOKENS: Data types, Variables, Operators, Control Statements, Command Line Arguments. Common Errors, Comments, Difference between JDK,JRE and JVM, Data types in Java, Pre-conditions and Post-conditions, Decomposition, Importance of Software Engineering. CLASSES, OBJECTS, AND METHODS: Defining a class, access specifiers, instantiating objects, reference variable, accessing class members and methods, constructors, method overloading, static members, static methods, inner class, Wrapper class.				
Module 2	Arrays, Strings, Inheritance, and Package	Assignment		Programming	**6 Sessions**
	Array, Strings, Inheritance, Interface: extending an interface, Implementing interfaces, Package: Package as Access Protection, Defining a Package, Library Packages, Java polymorphism,				
Module 3	Exception Handling &MultiThreading	Assignment		Programming	**8 Sessions**

	Exception handling: Introduction to Exceptions, Difference between Exceptions & Errors, Types of Exception. Handling Exceptions: Use of try, catch, finally, throw, throws. User Defined Exceptions and Exception handling with method overriding. Introduction to threads, life cycle of a thread, creating threads, extending the Thread Class, Implementing the "runnable" interface. Thread Priority, Thread synchronization, Intercommunication of Threads				
Module 4	Generics, Collection Framework, JAR File	Assignment		Programming	**8Sessions**
	Generics: Introduction, using wildcard, generic method, generic class hierarchies, erasure. Collections: Introduction to Collections, Classification of Collection, Interfaces that extends the collection interface.				
Module 5	Graphic Programming & Java Bean, Servlet, JDBC	Assignment		Mini Project	**10Sessions**
	Swings: Introduction, Swing GUI Components and Layout Managers, Swing Menus. Java Bean: Introduction, Introspection, Persistence, JavaBeans API. Servlet: Lifecycle, Simple Servlet, Java Applets: Basics of applets, Graphics in applets, Displaying image in the applet, Event handling in the applet, Animation in the applet.				
	List of Laboratory Tasks: **Experiment N0 1:** Programming assignment with class, objects and basic control structures. (Application: Build a basic menu driven application). RandomGenerator Program, The RollDice Program. **Level 1:** Programming scenarios which use control structures to solve simple case scenarios. **Level 2:** Programming assignment which will build menu driven application by identifying the class and its relevant methods. **Experiment No. 2:** Programming assignment using Arrays and Strings. **Level 1:** Programming scenarios which build single dimensional and multidimensional array, apply the different methods to operate on strings. **Level 2:** Programming assignment which will manipulate the data stored in matrices and identify the appropriate usage String methods. **Experiment No. 3:** Programming assignment using acm.graphics Package, GCanvas, Methods Common to All GObjects, Interfaces and Methods Defined by Them, The Bouncing Ball Program Example, The Geometry of the GLabel Class, The GArc Class. **Level 1:** Programming scenarios which use the concept the Package and usage of Packages **Level 2:** Programming assignment which build application which have Packages for different scenarios. **Experiment No. 4:** Programming assignment using Exception Handling **Level 1**: Programming assignment on building applications using built in Exceptions. **Level 2**: Programming assignment on building application using user defined Exceptions. **Experiment No. 5:** Programming assignment using Multithreading. (E.g.: Building an application which performs different arithmetic operations and sharing the resources using threads) **Level 1**: Programming scenarios to build a thread, assign priority and use the thread methods to perform operations **Level 2:** Programming scenarios for building synchronized applications.				

	Experiment No. 6: Programming assignment using Collections, Generics. Music store case study: Managing Large Amounts of Data, Principles of Design, Defining the Song Class, Defining the Album Class, Considering the Data Structures Needed, Reusing Data - Shallow Copy vs. Deep Copy. Jar File: Creating a Jar file. **Level 1:** Programming scenarios which build applications Using Collections and Generics. **Level 2:** Programming scenarios which help in understanding the need and scenarios to use Collections **Experiment No. 7:** Programming assignment to build GUI Applications. Building Online Music Store. **Level 1:** Programming Scenarios to build GUI for a given scenario using Swings concepts. **Level 2:** Understanding and application of Swing and Graphics Concepts to build an Application
	Targeted Application & Tools that can be used: Targeted Employment sector is Software application,product development Companies in IT sector and Non IT Sector. The skills include • Platform independent Application Development • Secure Application Development • Data Mining • Operating Systems. • Database Management Systems • Banking software • Automobiles • Mobile Applications **Tools**: JDK (Java Development Tool kit), Integrated Development Environment (IDE), Apache NetBeans, Eclipse.
	Project work: Mention the Type of Project
	A scenario will be given to the student to be developed as a Java Application.
	Text Book T1.Cay S Horstmann and Cary Gornell, *"CORE JAVA volume I-Fundamentals"*, Pearson. T2.Cay S Horstmann and Cary Gornell, *"CORE JAVA volume II-Advanced Features"*, Pearson.
	References R1.Herbert Schildt, *"The Complete Reference Java 2",* Tata McGraw Hill Education. R2.James W. Cooper, *"Java TM Design Patterns – A Tutorial"*, Addison-Wesley Publishers. R3.Jim Keogh, "J2EE Complete reference", Tata McgrawHill. R4. Timothy C. Lethbridge and Robert Laganiere, "Object Oriented Software Engineering : Practical Software Development using UML and Java", Tata McgrawHill. R5.Sarcar, Vaskaran, "Java Design Patterns – A hands on experience with real world examples", Apress. **Weblinks** W1.https://presiuniv.knimbus.com/user#/home W2.https://www.w3schools.com/java/java_intro.asp.
	Topics relevant to the development of "SKILL DEVELOPMENT**":** Tokens**,** Arrays, Strings, Inheritance and Package, Exception Handling & Multithreading, Generics, Collection Framework, JAR File, Graphic Programming & Java Bean, Servlet, JDBC, JavaBeans API. Servlet: Lifecycle, Simple Servlet for developing SKILL DEVELOPMENT

	through PROBLEM SOLVING techniques. This is attained through assessment component mentioned in course handout

Course Code: **CSE 5002**	**Course Title: Human-Computer Interaction** **Type of Course: Open Elective** **Theory Only**	**L- T-P- C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	--					
Anti-requisites	**NIL**					
Course Description	The Course is intended to introduce students about the key concepts of User Interface Design. It will cover the theory and methods that exist in the field. User Interface Design is an interdisciplinary field that integrates theories and methodologies from computer science, cognitive psychology, design, and many other areas. It stresses the importance of good interfaces and the relationship of interface design to effective human interaction with computers. It helps in categorizing the interfaces based on the processes, methods and programming used. It focuses on applications of emerging fields in user Interface Design.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Human-Computer Interaction** and attain SKILL DEVELOPMENT through Experiential Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: CO1.Identify the factors influencing user interfaces; CO2.Apply guidelines, principles, theories, and methodologies for designing interfaces; CO3.Explain various user interface evaluation methods. CO4.Identify the applications of emerging fields in human-computer interaction					
Course Content:						
Module 1	Importance of User Interface Design	Assignment	Basics			**10 Sessions**
	Topics: Introduction: Importance of user Interface – definition, the importance of good design. Benefits of good design, Types of user interface design, GUI design, and A brief history of Screen design. Human Perception –Human Thinking, Emotion, Psychology and the design of interactive systems – Cognitive frameworks – Models of interaction, Frameworks, and HCI					
Module 2	Interface Design	Assignment	Designing			**10 Sessions**
	Topics: **Interface design:** The software life cycle Usability engineering Iterative design and prototyping, UI design principles-Interaction design – Guidelines – Principles – Theories – The process of design – Prototyping and Construction - Conceptual design – Physical design – The four pillars of design – Development methodologies – Participatory design – Scenarios development – Social impact statement for early design review					
Module 3	Evaluation of interface design	Case Study	Evaluation			**8 Sessions**
	Topics: **Evaluating interface design** Evaluating interface design – Evaluation, Goals of evaluation, Expert Reviews, Usability testing and Laboratories,Acceptance Tests, Evaluating during Active Use, Controlled Psychologically Oriented Experiments, Choosing an evaluation method, Different challenges faced during evaluation.					
Module 4	Information Presentation	Assignment	Applications			**10 Sessions**

	Topics: **Information presentation:** Information presentation – Data type by task taxonomy, Challenges for Information Visualization -Information display factors–Analog vs digital presentation-Ubiquitous computing and augmented realities Ubiquitous computing applications research Design Focus: Ambient Wood – augmenting the physical Virtual and augmented reality Design Focus: Shared experience Design Focus: Applications of augmented reality Information and data visualization Design Focus: Getting the size right. Groupware – Goals of collaboration and participation, Design for Diversity
	Targeted Applications & Tools that can be used: Targeted employment sector is Developing Mobile Apps and web Applications vendors like Amazon, Flip kart, Snap Deal, Byjus, eBay etc. Targeted job profiles include HCI Specialist, UX Design etc. **Tools:** • Xampp Server • Any Text Editor like notepad++
	Case Study Analysis
	Case Study Analysis: • Students have to choose any of the Application it can be Mobile App or web Applications and they should relate with User Interface Design concepts in term of Guidelines and Principles of Interface Design etc. to evaluate design with respect to user perspective.
	Text Book T1.Ben Shneiderman and Catherine Plaisant, "Designing the User Interface". Addison Wesley. T2.Dix A. et al. "Human-Computer Interaction", Prentice Hall T3.The essential guide to user interface design, Wilbert O Galitz, Wiley Dream Tech.
	References R1.Yvonne Rogers, Helen sharp, Jenny Preece, "Interaction Design: Beyond Human Computer Interaction", Wiley. R2.The Essentials of Interaction Design, Fourth Edition by Cooper, Reimann, Cronin, & Noessel (2014). R3.Human–Computer Interaction. Alan Dix, Janet Fincay, Gre Goryd, Abowd, Russell Bealg, Pearson Education **Weblinks** W1.https://presiuniv.knimbus.com/user#/home W2.https://www.javatpoint.com/software-engineering-coding. W3.https://www.javatpoint.com/gui-testing.
	Topics relevant to the " SKILL DEVELOPMENT": Identifying factors which influences User Interface Topics relevant to "Human Values and Professional ethics": Guidelines for User Interface Design and Data collection for Term Assignments and case studies for developing SKILL DEVELOPMENT through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 5003	**Course Title:** IOT Applications **Type of Course:** Open Elective Theory Only		**L- T-P- C**	3	0	0	3

Version No.	2.0
Course Pre-requisites	--
Anti-requisites	**NIL**
Course Description	This course introduces the core principles of Internet of things. This theory based course emphasizes on understanding the applications areas of IOT. The course will focus on creative thinking of IoT concepts & technologies.
Course Objective	The objective of the course is to familiarize the learners with the concepts of **IOT Applications** and attain SKILL DEVELOPMENT through Experiential Learning techniques.
Course Outcomes	On successful completion of the course the students shall be able to: CO1.Understand general concepts of Internet of Things (IoT) CO2.Recognize various devices, sensors and applications CO3.Apply design concept to IoT solutions CO4.Evaluate design issues in IoT applications CO5. Create IoT solutions using sensors, actuators and Devices
Course Content:	

Module 1	Introduction to IoT	Assignment	Fundamentals		**10 Sessions**

Topics:
Introduction, Definition & Characteristics of IOT, Physical Design of IoT- Things in IoT, IoT Protocols, Logical design of IoT- IoT functional blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies- Wireless sensor networks,Big data Analytics, Embedded Devices and System, Advantages and disadvantages of IoT.

Module 2	IoT Protocols	Assignment	Protocols		**10 Sessions**

Topics:
Connectivity Protocols: 6LoWPAN, IEEE 802.15.4, Zigbee, Wireless HART, Z-Wave, ISA 100, NFC, RFID. **Communication/Transport Protocols:** Bluetooth. Data Protocols: Message Queue Telemetry Transport (MQTT), Constrained Application Protocol (CoAP), Advanced Message Queuing Protocol (AMQP), XMPP – Extensible Messaging and Presence Protocol, Data Distribution Service(DDS).

Module 3	IoT Application building tools	Assignment	Tools		**10 Sessions**

Topics:
Introduction to Arduino Boards, Types of Arduino Boards, Installation of Arduino IDE, Usage of Tinker Cad, Structure of Coding – Embedded C, Hands-on session in Serial Monitor, Hands-on session in Traffic Signal, Hands-on session in Arduino UNO Board, Hands-on session on gas detector using Arduino, Introduction to WiFi Module (ESP8266), Introduction to Node MCU, Pin Configuration of Node MCU, Installation of Node MCU and Blynk Library files, Introduction to Blynk App Open Source Cloud Environment, demonstrate session in connecting Node MCU with Blynk, demonstrate session in Blinking Inbuilt LED in Node MCU, demonstrate session in Blinking of LED. Sensors and its applications.

Module 4	Applications of IoT	Assignment	Analysis, Data Collection		**10 Sessions**

	Topics: **Overview of IoT applications:** Automotive and Transport, Smart factories, Smart buildings, Smart cities, Smart Utilities, Security and Surveillance, Retail, and Healthcare with suitable examples, Wearables. **Building IoT Application:** Enabling and facilitating the students to take up existing problems and building the solution.				
	Targeted Applications & Tools that can be used: The targeted employment sector is service providers and control monitors like GE, Siemens, TCS etc. Targeted job profiles include digital domain and Physical system design engineer, IOT engineer, etc. **Tools:** • Arduino IDE • TinkerCad • NodeMCU Tensor Flow and Keras				
	Project work				
	Mini Project: • A mini project to demonstrate use of IOT tools, techniques and protocols to build and smart real time application.				
	Text Book T1. "Internet of Things (A Hands-on-Approach)", by Vijay Madisetti and Arshdeep Bahga, 1st Edition, VPT, 2014 T2. "Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress)				
	References R1. "Industrial Internet of Things: Cyber manufacturing Systems" by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer) **Weblinks** W1.https://www.udemy.com/internet-of-things-iot-for-beginners-getting-started/ W2.http://playground.arduino.cc/Projects/Ideas W3.http://runtimeprojects.com W4.https://presiuniv.knimbus.com/user#/home				
	Topics relevant to development of "SKILL DEVELOPMENT ": Get introduced to AI programming and Interfacing of IOT devices for developing SKILL DEVELOPMENT through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.				

Course Code: CSE 5004	**Course Title:** Programming Essentials in Python **Type of Course:** Open Elective **Theory Based Course**	**L- T-P-C**	3	0	0	3

Version No.		2.0
Course Pre-requisites		--
Anti-requisites		Python programming
Course Description		This course introduces the core concepts of programming using Python. This course has theory component which emphasizes on understanding and programming right from basics to Visualization in Python. It helps the student to explore data by applying these concepts and also for effective problem solving, visualizing and analyzing.
Course Objective		The objective of the course is to familiarize the learners with the concepts of Programming Essentials in Python and attain **SKILL DEVELOPMENT** through **Participative Learning** techniques.
Course Outcomes		**On successful completion of this course the students shall be able to:** CO1.Illustrate the python programming constructs. CO2.Explore Data using Python Numpy and Pandas CO3.Demonstrate Data Visualization using Matplotlib. CO4.Analyze the data using scikit.
Course Content:		

Module 1	Basics of Python programming	Assignment	Programming		**8 Sessions**
	Topics: Data types, Operators and expressions, I/O statements, Control structures- Sequential, selective and Iteration logic, Functions- user defined and builtin functions.				
Module 2	Data Exploration using Numpy and Pandas	Assignment	Programming		**10 Classes**
	Topics: Installation of **Numpy**, Numpy Basics, Placeholders, Datatypes, Arrays, Basic Statistics, Copying, Slicing & Subsetting, Indexing, Flattening, Reshaping, Resizing, Sorting, Swapping, Dealing with Missing values. **PANDAS** - the PYTHON Data Analysis Library, Motivation, Installation of PANDAS, PANDAS Data Structure, Series, Dataframe, Loading the Data, Descriptive Statistics, Indexing & ReIndexing, Renaming, Iteration, Sorting, Statistical functions, loc & iloc Groupby Operations, Merging/Joining, Concatenation, Time Series, Working with Categorical Data and Text Data. Pivot table				
Module 3	I/O Tools and Visualization	Assignment	Mini project		**10 Sessions**
	Topics: **I/O API Tools**, CSV and Textual files, Reading data in CSV or text files, Using RegExp to parse txt files, Reading txt files into parts, Writing data in CSV, Reading and Writing HTML files, Reading data from XML, Reading and Writing data from excel file, JSON Data, The format HDF5, Pickle-PYTHON Object Serialization, Serialize a PYTHON object with cpickle				

	The **Matplotlib library**, Installation, A simple interactive chart, Adding elements to the chart, Adding a grid, Adding a legend, Converting the session to an html file, Saving your chart directly as an image, Handling date values, Chart typology, Line charts, Histograms, Bar charts, Horizontal Bar Charts, Multiseries bar charts, Multiseries stacked bar chart, Pie chart.

Module 4	Sci-kit	Assignment	Mini project		**8 Sessions**

	Topics: **The Scikit learn library**, Machine learning, Supervised and Unsupervised learning, Supervised learning with Scikit learn, The iris flower dataset, KNN Classifier, Diabetes dataset, Linear Regression-the least square regression, SVMs, SVC, Non linear SVC, Plotting different SVM classifier using iris dataset.
	Targeted Application & Tools that can be used: **Targeted Application : Web application development, AI, Operating systems** **Tools: Python IDLE, ANACONDA** • **Application Areas:** • Web Development • Game Development • Scientific and Numeric Applications • Artificial Intelligence and Machine Learning • Software Development • Enterprise-level/Business Applications • Education programs and training courses • Operating Systems • Web Scrapping Applications • Image Processing and Graphic Design Applications **Professionally Used Software: Python IDLE, Spyder, Jupyter Notebook, Google Colab**
	Project work/Assignment:
	• 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 3 and Module 4, students will be asked to develop a Mini Project using Python.
	Text Book T1. Charles Dierbach, "Introduction to Computer Science Using Python", Wiley India Edition,2015.
	References R1. E. Balagurusamy, "Introduction to Computing and Problem-Solving Using Python", Tata McGraw-Hill, 2016 R2. Y. Daniel Liang, "Introduction to Programming Using Python", Pearson, 2017 R3. Python Tutor - Visualize Python, Java, C, C++, JavaScript, TypeScript, and Ruby code execution **Weblinks** W1. https://presiuniv.knimbus.com/user#/home W2.https://practice.geeksforgeeks.org/courses/Python-Foundation

	Topics relevant to "SKILL DEVELOPMENT": Classification, Clustering and visualization of Charts for developing **SKILL DEVELOPMENT** through **Participative Learning Techniques**. This is attained through assessment component mentioned in course handout.

Course Code: CSE 5008	Course Title: Programming in Data Science Type of Course: Program Core Theory and Laboratory Integrated	L-T-P-C	2	0	2	3
Version No.	2.0					
Course Pre-requisites	--					
Anti-requisites	Python, R Programming Language					
Course Description	This course introduces the core concepts of Data Science followed by programming using Python and R. This course has theory and lab component which emphasizes on understanding and programming right from Basics to Visualization in Python and R. It helps the student to explore data by applying these concepts and also for effective problem solving, visualizing and analyzing.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Programming in Data Science and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques					
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Discuss about the process involved in Data Science CO2: Explore Data using Python Numpy and Pandas CO3: Demonstrate Data Visualization using Matplotlib CO4: Explore Data using R and Visualize using R Graphics					
Course Content:						

Module 1	Introduction to Data Science	Assignment	Case Studies		10 Sessions

Topics:
Introduction to Data Science –- The field of Data Science – The various Data Science Disciplines, Connecting the Data Science Disciplines, Features of R, Data Science Techniques and Tools – Types of Data – Measures and Metrics – Descriptive Statistics – Inferential Statistics.
Data Science Methodology - From Problem to Approach and From Requirements to Collection, From Understanding to Preparation and From Modeling to Evaluation, From Deployment to Feedback.
Data Preprocessing - Data Quality Assessment, Feature Aggregation, Dimensionality Reduction, Feature Encoding. Predictive and descriptive analytics.

Module 2	Data Exploration using Numpy and Pandas	Assignment	Programming		8 Sessions

Topics:
Introduction to Python World, Motivation, Installation of **NUMPY**, Numpy Basics, Placeholders, Datatypes, Arrays, Basic Statistics, Copying, Slicing & Subsetting, Indexing, Flattening, Reshaping, Resizing, Sorting, Swapping, Dealing with Missing values.
PANDAS - the PYTHON Data Analysis Library, Motivation, Installation of PANDAS, PANDAS Data Structure, Series, Dataframe, Loading the Data, Descriptive Statistics, Indexing & ReIndexing, Renaming, Iteration, Sorting, Statistical functions, for and while loop in R, Window functions, Aggregations. Number of Missing values in single variable. Groupby Operations, Merging/Joining, Concatenation, Time Series, Working with Categorical Data and Text Data.

Module 3	I/O Tools and Visualization	Assignment	Mini Project		8 Sessions

Topics:
I/O API Tools, CSV and Textual files, Reading data in CSV or text files, Using RegExp to parse txt files, Reading txt files into parts, Writing data in CSV, Reading and Writing HTML files, Reading data from XML, Reading and Writing data from excel file, JSON Data, Data inspection
The **Matplotlib library**, Installation, A simple interactive chart, Adding elements to the chart, Adding a grid, Adding a legend, Converting the session to an html file, Saving your chart directly as an image, Handling date values, Chart typology, Line charts, Histograms, Bar charts, Horizontal Bar Charts, Multiseries bar charts, Pie chart. Preparing time series data.

Module 4	Introduction to R	Assignment	Programming		10 Sessions

Topics:

R Environment, Using R Studio, Vectors, List, Matrices, Arrays, Data Frames, Factors. Functions - Conditional Functions, User Defined Functions. Reading Data from files, Handling Missing Data, Installing Packages,

R Graphics – Plot, Line, Scatter Plot, Pie Charts, Bars, Histogram, Box Plots, 3D Pie Charts, 3D Scatter Plot, Visualization with GG Plot.

R Statistics – Dataset, Max & Min, Mean Median Mode, Subgroup Analyses, Probability Distributions, Pipes in R.

List of Laboratory Tasks:

Experiment No 1: Create a Numpy array and perform the following operations on it

Level 1: Basic Statistics, Copying, Slicing & Subsetting, Indexing, Flattening, Reshaping, Resizing,

Level 2: Sorting, Swapping, Dealing with Missing values

Experiment No. 2: Create a PANDAS 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 a PANDAS 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: Demonstrate Reading and Writing using IO API tools

Level 1: CSV and EXCEL files, HTML and XML files,

Level 2: HDF5 CPickle

Experiment No. 5: Using Matplotlib, Visualize the Data

Level 1: Visualize the data using Line Chart, Bar Charts, Pie Chart, Histograms, Bar chart, Horizontal Bar Chart

Level 2: Visualize the data using Multiseries Bar Chart, Multiseries Stacked Bar Chart

Experiment No. 6: Install R Studio and perform basic operations

Level 1: Vectors, List, Matrices, Arrays, Data Frames, Factors,

Level 2: Functions and handling Missing Data

Experiment No. 7: 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. 8: Using R Statistics perform the following

Level 1: Max & Min, Mean Median Mode, Subgroup Analyses,

Level 2: Probability Distributions and Pipes

Targeted Application & Tools that can be used:

- Data Exploration
- Data Visualization
- Data Analysis

Tools:

- Google Colab
- Anaconda
- R Studio

Project work

- 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 and R.

Text Book

	T1. The essentials of Data Science, Knowledge Discovery Using R, Graham J Williams, CRC Press, 2017 T2. PYTHON Data Analysis, APRESS Publications, Fabio Nelli, 2015
	References R1. Comparative Approaches to using R and PYTHON for Statistical Data Analysis, Information Series Reference, 2018 R2. Practical Data Science CookBook, APRESS Publications, 2018 **Weblinks** W1.https://presiuniv.knimbus.com/user#/home W2.https://www.simplilearn.com/data-science-free-course-for-beginners-skillup
	Topics relevant to "SKILL DEVELOPMENT": Data Exploration, Data Analysis and Visualization using Python and R Programming. for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 5015	**Course Title:** Data Security and Access Control **Type of Course:** Discipline Elective Theory Only			**L- T-P- C**	3	0	0	3
Version No.	2.0							
Course Pre-requisites	--							
Anti-requisites	**NIL**							
Course Description	This course describes fundamental issues and problems in data security and provides technical solutions or facets to the problem of achieving data security. The course also deals with the security of statistical databases, discusses authorization systems, and covers the fundamental ideas of cryptography.							
Course Objective	The objective of the course is to familiarize the learners with the concepts of Data Security and Access Control and attain **EMPLOYABILITY SKILLS** through **Participative Learning** techniques.							
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Describe the basic concepts of a Data Security CO2: Apply appropriate techniques for security Algorithms CO3: Explain the Access Controls mechanisms CO4: Simulate data security algorithms for achieving access control							
Course Content:								
Module 1	Fundamentals of Data Security	Assignment	Algorithms		**8 Sessions**			
	Topics: Introduction to Data Security, Confidentiality, Integrity, Availability, Visibility, Automation, Monitoring, Models and Methodology, and The Security Problem in Computing. The Data Encryption Standard							
Module 2	Data Security Techniques	Assignment/ Case Study	Presentation		**10 Sessions**			
	Topics: Introduction, data masking, data erasure, and backup storage, Anti-malware protection, viruses and other malicious code, Security in Key specified model, Security in Characteristic specified model, File Protection Mechanisms							
Module 3	Authorization Mechanisms in Data Security	Assignment/ Case Study	Coding		**12 Sessions**			
	Topics: Introduction, concept of Un-decidability, Authorization Systems with Tractable Safety Problem, Authorization Systems with Tractable Safety Problem, Grammatical Authorization Systems, Threats in Network, Network Security Controls							
Module 4	An Overview of Data Security Tools, Data Security Policies	Assignment/ Case Study	Simulation of DS tools		**8 Sessions**			
	Topics: Introduction to tools available for Data Security, Demonstration of Security features in Linux platform, simulation using more than two computers, demonstration of data leakage during							

	transmission, GDPR (General Data Protection Regulation), Comparative study with India regulation, Data Privacy Act, Role Based Access Control, Organizational Security policies.
	Targeted Applications & Tools that can be used: Anomaly Deduction, Inclusion Prevention Systems, Firewall, Email Security **Tools:** SAGE Mathematical Library package, VPN
	Assignment:
	Term Assignments: 1. Implement Cryptographic algorithms using SAGE 2. Comparative Study on Various Data Security Tools 3. Case Study on GDPR - General Data Protection Regulation 4. Identify Data Leakage in LINUX environment using Authorization Mechanisms
	Text Book T1. Data Privacy and Security, David Solomon, Springer, T2. Principles of Data Security, Ernst L. Leiss, Plenum Press. New York And London
	References R1. Intelligence and Security Informatics for International Security, Chen, Hsinchun, Springer Publication 2006 R2. Certified Information Security Professional (CSIP) web portal **Weblinks** W1.https://presiuniv.knimbus.com/user#/home W2. https://www.datasunrise.com/professional-info/what-is-access-control/
	Topics relevant to "EMPLOYABILITY SKILLS": **":** Email Security, Web Security, GDPR (General Data Protection Regulation), Grammatical Authorization Systems for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 6007	**Course Title: IOT Data Analytics** **Type of Course: Discipline Elective Theory Only**		**L- T-P- C**	3	0	0	3
Version No.	2.0						
Course Pre-requisites	--						
Anti-requisites	**NIL**						
Course Description	This course helps in understanding the context of analytics in IoT data. Strategies to collect IoT data in order to enable analytics. Skills learnt will enable to understand the tradeoffs in streaming and batch processing. Data science techniques such as machine learning, deep learning, and forecasting are applied on IoT data. This course also teaches how to implement machine learning methods and ARIMA forecasting on IoT data. Deep learning will be described along with a way to get started experimenting with it on AWS.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of IoT Data Analytics and attain **EMPLOYABILITY SKILLS** through **Problem Solving** Methodologies.						
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Discuss the challenges of IoT Analytics. CO2: Apply strategies and techniques to collect IoT data. CO3: Apply data science techniques on IoT data						
Course Content:							
Module 1	IoT analytics, challenges, devices and networking protocols	Assignment	Data Analysis task			**12 Sessions**	
	Topics: Defining IoT Analytics and Challenges Defining IoT Analytics. IoT analytics challenges, Core IoT Functional Stack, Functional blocks of an IoT ecosystem IoT Devices and Networking Protocols IoT devices Networking basics IoT networking connectivity protocols IoT networking data messaging protocols Message Queue Telemetry Transport (MQTT) Hyper-Text Transport Protocol (HTTP) Data Distribution Service (DDS)						
Module 2	Data – Strategies, Techniques and Exploring IoT Data	Assignment	Analysis, Data Collection			**12 Sessions**	
	Topics: Collecting All That Data - Strategies and Techniques Designing data processing for analytics Applying big data technology to storage Apache Spark for data processing Exploring IoT Data Exploring. Data analytics tools						
Module 3	Data Science for IoT Analytics	Case Study	Data analysis task			**13 Sessions**	
	Topics: Feature engineering with IoT data Validation methods Understanding the bias–variance trade off Comparing different models to find the best fit Random Forest models Gradient Boosting Machines Anomaly detection, Forecasting, scaling issues.						

	Targeted Application & Tools that can be used: Employment opportunities are available in Companies like Hexaware, Episteme, Randstad. Siemens, Accenture etc. as IoT Data Engineer Tools R Python Microsoft Azure Stream Analytics. AWS IoT Analytics. SAP Analytics Cloud. Oracle Stream Analytics and Oracle Edge Analytics.
	Project work
	Mini Project: Develop a IoT application for real time data analysis of manufacturing sector. The automated IoT Analytics should aid in using real time data to watch out for certain patterns and send alerts to the concerned departments. It should enable smart manufacturing.
	Text Book T1."Analytics for the Internet of things (IoT)", Andrew Minteer, Packt, 2017
	References R1.WInternet of Things and Big Data Analytics for Smart Generation, Valentina E Balas, Springer **Weblinks** W1.https://presiuniv.knimbus.com/user#/home W2.https://www.orientsoftware.com/blog/iot-data-analytics/
	Topics relevant to "EMPLOYABILITY SKILLS": Processing geospatial IoT Data, protocols Message Queue Telemetry Transport (MQTT) Hyper-Text Transport Protocol (HTTP) Constrained Application Protocol (CoAP) Data Distribution Service (DDS), Random Forest models Gradient Boosting Machines Anomaly detection for developing Employability Skills through Problem Solving methodologies. This is attained through assessment component mentioned in course handout.

Course Code: CSE 6008	**Course Title: Probabilistic graph Models** **Type of Course: Discipline Elective Theory Only**	**L- T-P- C**	3	0	0	3

Version No.		2.0
Course Pre-requisites		--
Anti-requisites		**NIL**
Course Description		Probabilistic graphical models are used to model stochasticity (uncertainty) in the world and are extremely popular in AI and machine learning. The course will cover two classes of graphical models: Bayesian belief networks (also called directed graphical models) and Markov Random Fields (undirected models). After introducing the two frameworks the course will focus on recent advances in inferences and learning with graphical models, including topics such as loopy belief propagation, variational approximations, conditional Markov random fields and others.
Course Objective		The objective of the course is to familiarize the learners with the concepts of **Probabilistic graph Models** and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING techniques
Course Outcomes		On successful completion of the course the students shall be able to: CO1: Apply key concepts of Statistics to solve problems. CO2: Analyze the properties of distributions encoded by graphs CO3: Illustrate Inference in graphic models CO4: Illustrate Learning in graphic models
Course Content:		

Module 1	Fundamentals of Probability and Graph Theory	Assignment	Understanding all standard probability distributions		**9 Sessions**
	Topics: Fundamentals of Statistics and Probability, Conditional Probability, Conditional Independence, Joint Distributions, Baye's Theorem, Gaussians rule, Probability Distributions, Fundamentals of Graph Theory - Paths, Cliques, Sub-graphs, Cycles and Loops.				
Module 2	Graphical Models	Assignment	Construction of Markov chain model for real time problems		**9 Sessions**
	Topics: Directed Models: Bayesian Network; Undirected Models: Markov Random Fields; Parameterization of MRFs, Independencies, Duality and optimality, Non parametric Bayes hierarchical models.				
Module 3	Inference in Graphical Models	Assignment	Study about some problems based on Monte Carlo method		**9 Sessions**
	Topics: Inference in Graph Models, Variable Elimination; Belief Propagation, Sampling Methods: Markov Chain Monte Carlo, Convexity and optimization, Hidden Markov Model, Viterbi Algorithm.				
Module 4	Learning in Graphical Models	Assignment	Applications of Naïve Bayes Classifier		**10 Sessions**

Topics:
Learning in Graph Models, Maximum Likelihood Estimation, Naïve Bayes Classifier, Conditional Random Fields, constrained optimization problem

Targeted Application & Tools that can be used:

Targeted employment sector is to acquire knowledge to analyze the given problem to frame Probabilistic graphical models which are a powerful framework for representing complex domains using probability distributions, with numerous applications in machine learning, computer vision, natural language processing and computational biology.

Tools:

- Python
- HUGIN Tool for Learning Bayesian Networks
- MATLAB Toolbox for Bayesian net

Assignment:

Term Assignments:

- **Analysis and Application of Bayesian Network to real time problems**

  Understanding the given problem, analyze accordingly to apply Bayesian network and convert the problem in a Bayesian Network. The answering the required queries.

- **A short survey of the Monte Carlo Method**

  Study and analyze few realistic problems to apply Monte Carlo Technique to answer the solution of the problem.

- **A short survey of the Markov Chain & Hidden Markov Method**

  Study and analyze few realistic problems to convert into Markov chain & Hidden Markov to answer the required problem.

Text books(s)

T1. S. Lauritzen. Graphical Models. Oxford University Press, 1996.
T2. David J.C. Mackay. Information theory, inference, and learning algorithms. Cambridge, UK: Cambridge University Press 2003.

References(s)

R1.https://towardsdatascience.com/introduction-to-probabilistic-graphical-models-b8e0bf459812.

Weblinks

W1.https://presiuniv.knimbus.com/user#/home
W2.https://home.cs.colorado.edu/~mozer/Teaching/syllabi/ProbabilisticModels//

Topics relevant to development of "EMPLOYABILITY SKILLS": Conditional Independence , Markov Random Fields; Parameterization of MRFs, Independencies,, Metropolis Hastings Algorithm, Hidden Markov Model, Viterbi Algorithm for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout

Course Code: CSE 6009	**Course Title: ARTIFICIAL NEURAL NETWORK** **Type of Course: Discipline Elective** **Theory only**		**L-T-P-C**	3	0	0	3
Version No.	2.0						
Course Pre-requisites	--						
Anti-requisites	**NIL**						
Course Description	The objective of this course is to provide students with a basic understanding of the fundamentals and applications of artificial neural networks. The course will cover techniques in Single layer perceptron classifier and feed forwards network for single layer and multilayer. Along with basic concepts of Associative network and Self organizing map.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of **ARTIFICIAL NEURAL NETWORK** and attain EMPLOYABILITY SKILLS through PROBLEM SOLVING techniques						
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Understand the mathematical foundations of neural network models. CO2: Solve real world problems using neural network systems. CO3: Explain feed forward network for Single layer and multiple layers. CO4: Describe the Knowledge of Associative memories and Self organizing maps.						
Course Content:							
Module 1	Fundamental Concepts of ANN	Assignment		Numerical to observe performance of different learning rule.	09 Sessions		
	Topics: Structure of biological neurons relevant to ANNs. Models of ANNs; Feedforward & feedback networks; learning rules; Hebbian learning rule, perception learning rule, delta learning rule, Widrow-Hoff learning rule, Directed Graph , knowledge representation.						
Module 2	Single layer Perception Classifier	Assignment		Build classifier using discrete perceptron algorithm.	12 Sessions		
	Topics: Classification model, training & classification using discrete perceptron, algorithm, single layer continuous perceptron networks for linearly separable classifications, back propogation algorithm						
Module 3	Feed forward Networks	Assignment		STEP BY STEP SOLVE BACK PROPAATION	12 Sessions		
	Topics: MULTI LAYER FEED FORWARD NETWORK: Linearly non-separable pattern classification, Delta learning rule for multi-perceptron layer, generalized delta learning rule, error back-propagation training, learning factors, Examples, output representation and decision rule. Single LAYER FEED FORWARDS NETWORK: Basic Concepts, Training & Examples.						
Module 4	ASSOCIATIVE MEMORIES AND SOM	Assignment		Paper Review of State of the Art OPT	10 Sessions		
	Topics: Linear Association, Basic Concepts of recurrent Auto associative memory: retrieval algorithm, storage algorithm; By directional associative memory, Architecture, Association encoding &						

	decoding, Stability. UN supervised learning of clusters, winner-take-all learning, separability limitations, two basic feature mapping models, SOM algorithm , properties of feature mapping.
	Targeted Application & Tools that can be used: **Application Area:** Resource Allocation, Finance and Economics (Risk Analysis and Consumption Assessment), Fraud Detection, Image Segmentation, Dimensionality Reduction, Gene Expression Analysis, Recommender System, Image reconstruction, Large Scale Surveillance. **Tools:** Anaconda Navigator Python Packages
	Text Books T1. Machine Learning by Tom Mitchell, McGraw-Hill Press T2. Pattern Recognition and Machine Learning by Christopher M. Bishop, Springer, 2006
	References R1. Neural Networks A Classroom Approach– Satish Kumar, McGraw Hill Education (India) Pvt. Ltd, Second Edition. R2. Iintroduction to Artificial Neural Systems-J.M. Zurada, Jaico Publications 1994. R3. Artificial Neural Networks-B. Yegnanarayana, PHI, New Delhi 1998. **Weblinks** W1.https://presiuniv.knimbus.com/user#/home W2.https://www.javatpoint.com/artificial-neural-network
	Topics relevant to development of "EMPLOYABILITY SKILLS": Concept of feed forward network, Hopfield network, self-organizing map for developing Employability Skills through PROBLEM SOLVING techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 6010	**Course Title:** Social Network Analysis **Type of Course:** Discipline Elective **Theory Only**	**L- T-P-C**	3	0	0	3

Version No.		2.0
Course Pre-requisites		--
Anti-requisites		**NIL**
Course Description		The rapid growth of social media has given the mass consumers a powerful tool to create knowledge and propagate opinions. At the same time, social media has created an unprecedented opportunity for companies to engage real-time interactions with consumers. In addition, the size and richness of social media data has provided companies an unusually deep reservoir of consumer insights to transform the business and marketing operations. The social media analytics course will enable students to grasp the analytics tools to leverage social media data. The course will introduce tools such as engagement analytics, sentiment analysis, topic modeling, social network analysis, identification of influencers and evaluation of social media strategy.
Course Objective		The objective of the course is to familiarize the learners with the concepts of **Social Network Analysis** and attain EMPLOYABILITY SKILLS through PROBLEM SOLVING techniques
Course Outcomes		**On successful completion of this course the students shall be able to:** CO1: Interpret the social network landscape and appreciate the importance of analytics in business. CO2: Apply appropriate native analytics and measurement tools to analyze data in different social platforms CO3: Use Natural Language Processing for efficient mining of web data CO4: Demonstrate meaningful insights with actionable and strategic recommendations.
Course Content:		

Module 1	**Network Science**	Quiz/Assignment	Analysis		**9 Sessions**
	Topics: Introduction to semantic web, limitation of current web, Central Measures, Community Analysis, CPM, Homophily and Triadic Closure, Affiliation Networks, Schelling model of Segregation, Current Social Media landscape, working environment, Getting analyzing and visualizing the data, Getting started with the toolset, Need for SMA, Applications of SMA in different areas. Connecting, Capturing and cleaning of Social Data. Social network analysis of social and behavioral sciences APIs in nutshell, Introduction to authenticate techniques, Parsing API outputs, Basic cleaning techniques. Exploring GitHub's API, Analyzing GitHub Interest Graphs, Computing Graph Centrality Measures.				
Module 2	**Analyzing Social graphs and Sentiment**	Quiz	Project Development		**10 Sessions**
	Topics: Modeling and aggregating social network data, Exploring Facebook's Social Graph API, Open Graph Protocol, Analyzing Social Graph Connections, Mining your posts, Facebook Pages. Exploring Twitter's API, Analyzing Twitter using sentiment analysis, Frequency Analysis, Examining Patterns in Retweets.				

Module 3	**Mining web pages**	Assignment	Project Development		**11 Sessions**
	Topics: Scraping, Parsing and Crawling the Web: BFS in Web Crawling, Discovering Semantics by Decoding Syntax: NLP Illustrated Step-by-Step, Sentence Detection in Human Language Data, Document Summarization, Entity-Centric Analysis: A Paradigm Shift, Summarizing Human Language Data, Quality of Analytics for Processing Human Language Data, trust models based on subjective logic Campaigns and Consumer Reaction Analytics on YouTube: Structured and Unstructured, Scope and Process, Getting the data, Data pull, Data processing and Data analysis, Attack spectrum and counter measures.				
Module 4	**Recommender Systems and SEO**	Quiz	Group Discussion		**8 Sessions**
	Topics: Content-Based Recommendation and Collaborative Filtering, introduction to SEO, Keyword research Process, avoid negative SEO, Search Engines, Google PageRank, IBM HITS,				
	Targeted Application & Tools that can be used: The applications of Social Media Analytics have been seen in industrial sector, sports and games, local governments services, tourism and hospitality services, politics, social issues, disaster management, community development issues, commerce and business applications, fashion industry, agricultural activities, online media, medical and health related services as well as supplier chain services. **Tools**: Google Colab or Jupyter Notebook(Anaconda).				
	Project work				
	On completion of all Modules, students will be given a Mini Project to build a deep learning model for a given application. Sample mini projects include: **Twitter Summaries** Twitter is famous for its character-limited posts. We can use this social media platform for an innovative summary-writing project. Consolidate the takeaways from a topic or reading discussed. Students should be able to understand the text, coherently organize the points and capture the central idea with 280 words, which is the character limit on Twitter. **Hashtag activism** Information and communication technologies provide a tremendous tool for spreading awareness and highlighting issues that may not be adequately represented in the mainstream media. Hashtag activism, in particular is concerned with driving social media traffic to oft-neglected topics. We can devise a project-based activity to teach our students about social justice, human rights, equality etc.				
	Text Book(s): **T1.Mathew A. Russell, "*Mining the Social Web*", O'Reilly, 3rd Edition, 2019.**				
	Reference(s): **R1.Marco Bonzanini, "*Mastering Social Media Mining with Python*", PacktPub, 2016.** **Weblinks** W1.https://presiuniv.knimbus.com/user#/home W2.https://onlinecourses.nptel.ac.in/noc22_cs117/preview				
	Topics relevant to "EMPLOYABILITY SKILLS: **Recommender Systems and SEO** for developing Employability Skills through PROBLEM SOLVING techniques. This is attained through assessment component mentioned in course handout				

Course Code: CSE 6001	**Course Title: Deep Learning** **Type of Course: Program Core Theory and Laboratory Integrated**	**L-T-P-C**	2	0	2	3

Version No.		2.0
Course Pre-requisites	•	-
Anti-requisites		NIL
Course Description		The course introduces the core intuitions behind Deep Learning, an advanced branch of Machine Learning involved in the development and application of Artificial Neural Networks that function by simulating the working principle of human brain. Deep learning algorithms extract layered high-level representations of data in a way that maximizes performance on a given task. The course includes theory and lab components which emphasizes on understanding the implementation and application of deep neural networks in various prominent problem domains like speech recognition, sentiment analysis, recommendations, and computer vision etc. The course facilitates the students to interpret and appreciate the successful application of deep neural nets in various prediction and classification tasks of ML.
Course Objective		The objective of the course is to familiarize the learners with the concepts of **Deep Learning** and attain **SKILL DEVELOPMENT** through **Experiential Learning techniques**
Course Out Comes		On successful completion of the course the students shall be able to: CO1: Apply basic concepts of Deep Learning to develop feed forward models CO2: Apply Supervised and Unsupervised Deep Learning techniques to build effective models for prediction or classification tasks CO3: Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains of Machine Learning and Machine vision. CO4: Analyze performance of implemented Deep Neural models
Course Content:		

Module 1	Introduction to Deep Learning	Assignment	Programming		**10 Sessions**
	Topics: Machine Learning in a nutshell, Fundamentals of deep learning and neural networks, Deep Neural Network, Feedforward Neural Network, Perceptron, Activation Functions, Loss Functions, Gradient Descent, Back-propagation, Training Neural Networks Building your Deep Neural Network: Step by Step, Introduction to CNN				
Module 2	Improving Deep Neural Networks	Assignment	Programming		**09 Sessions**

	Topics: Hyperparameter tuning, Initialization, Overfitting and Underfitting, Regularization and Optimization, Dropout, Batch Normalization				
Module 3	Deep Supervised Learning Models	Assignment	Programming		**10 Sessions**
	Topics: Convolutional neural network with pooling flattening, Prediction of image using Convolutional Neural Networks, Deep learning in Sequential Data, RNN & LSTM, GRU,				
Module 4	Deep Unsupervised Learning	Assignment	Programming		**10 Sessions**
	Topics: Basics of Deep unsupervised learning, Auto encoders, Recommender systems, computer vision				
	List of Laboratory Tasks: **Experiment No. 1:** Programming assignment to implement a single layer feed forward neural network from scratch (Application: A basic neural network). **Level 1:** Programming scenario to implement a basic single layer feed-forward neural network perceptron. **Level 2:** Programming scenario to implement a basic single layer feed-forward neural network with a single hidden layer having ReLU activation function and sigmoid in the output layer. **Experiment No. 2:** Programming assignment to build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets. **Level 1:** Programming scenario to use the Backpropagation algorithm to build an ANN and run it on a dataset for few epochs. **Level 2:** Programming scenario to use the Backpropagation algorithm to build an ANN and run it on a dataset for few epochs and interpret the accuracy, loss and other evaluation parameters. **Experiment No. 3:** Programming assignment to build a multiple layer neural network with specific model parameters and hyperparameters on a given real life dataset. **Level 1:** Programming assignment to implement a MLP with o possibility to use 2-4 layers o ReLU for the hidden layer o Sigmoid in the output layer o optimization via gradient descent (GD) **Level 2:** Programming assignment to implement the neural network and add some more hyperparameters in the perceptron model o softmax output layer o optimization via stochastic gradient descent (SGD) o Gradient checking code (!!!) Generate the confusion matrix				

Experiment No. 4: Programming assignment to implement classification of linearly separable Data with a Deep neural network (Application: Binary classification).

Level 1: Programming scenarios to build a binary classifier with a deep ANN.

Level 2: Programming scenarios to build a binary classifier with a deep ANN

- Weight initialization with random noise (!!!) (use normal distribution with changing std. deviation for now)
- implement dropout, *l2* regularization
- implement a different optimization scheme (RPROP, RMSPROP, ADAGRAD)
- employ batch normalization

Experiment No. 5: Programming assignment to implement a basic Convolution Neural Network.

Level 1: Programming scenarios which use the concept of convolution and pooling to implement a CNN.

Level 2: Programming scenarios which use the concept of convolution and pooling to implement a CNN and also specify some parameters like number of filters, length of feature detector, stride etc.

Experiment No. 6: Programming assignment to perform image segmentation and object detection using CNNs.

Level 1: Programming assignment to instantiate a CNN (that uses FullyConnectedLayers) and train the neural network using the training data from MNIST data set.

Level 2: Programming assignment to instantiate a CNN (that uses FullyConnectedLayers) and train the neural network using the training data from MNIST data set. Choose appropriate hyper parameters for the training of the neural network. Plot the cost versus training iterations using different mini-batch sizes: 16; 64; 256; 1024. Record the test accuracy in percentage and total training time you spent in seconds. Implement Adam Optimizer. To obtain full marks, the network should be able to achieve a test accuracy of 90% or more across many different random seeds.

Experiment No. 7: Programming assignment to employ CNN in image classification from given dataset.

Level 1: Programming scenario to instantiate a CNN (with at least one convolutional layer) and train the neural network using the training data from CIFAR10 data. Choose appropriate hyperparameters for the training of the neural network. The network should be able to achieve a test accuracy of at least 50% within 10 training epochs.

Level 2: Programming scenario to build a CNN (with more than one convolutional layer) and train the neural network using the training data from CIFAR10 data. Choose appropriate hyperparameters for the training of the neural network. The network should be able to achieve a test accuracy of at least 50% within 10 training epochs. Continue to train further and examine training and testing performance. Report hyperparameters (learning rate, number of hidden layers, number of nodes in each hidden layer, batch size and number of epochs) of the Deep Neural Network. Also, explain the observations.

Experiment No. 8: Programming assignment to perform Sentence (text) Classification using Convolutional Neural Networks.

Level 1: Programming Scenarios to utilize CNN to categorize text data in given datasets like SST movie reviews.

Level 2: Programming Scenarios to utilize CNN to categorize text data in given datasets like SST and MR movie reviews.

Experiment No. 9: Programming assignment to apply Recurrent Neural Networks for sentiment analysis of text data.

Level 1: Programming scenario to build a model to perform sentiment analysis of IMDB movie reviews using. Reviews are categorized into two polarities: positive and negative.

Level 2: Programming scenario to build a model to perform sentiment analysis of IMDB movie reviews. Reviews are categorized into three polarities: positive, negative and neutral.

Experiment No. 10: Programming assignment to create a generative model for text, character-by-character using Recurrent neural networks.

Level 1: Programming scenario to implement a multi-layer Recurrent Neural Network like LSTM for training/sampling from character-level language models, which takes one text file as input and trains an RNN that learns to predict the next character in a sequence. The RNN can then be used to generate text character by character that will look like the original training data.

Level 2: Programming scenario to implement a multi-layer Recurrent Neural Network utilizing both LSTM and GRU in turns for training/sampling from character-level language models, which takes one text file as input and trains an RNN that learns to predict the next character in a sequence. The RNN can then be used to generate text character by character that will look like the original training data. Train the model and use it to generate new text.

Experiment No. 11: Programming assignment to implement RNN models for multivariate time series forecasting.

Level 1: Programming scenario to implement a many-to-one Recurrent Neural Network for Stock Price forecasting, i.e. trained with a certain number of day's data, the model should predict the stock price of the next day.

Level 2: Programming scenario to implement a many-to-one Recurrent Neural Network for Stock Price forecasting, i.e. trained with a certain number of day's data, the model should predict the stock price of the next day. Students are free to use RNN, GRU, or LSTM (or compare between) and any number of layers and architecture. In the testing, plot the ground truth and your predicted values for 100 days.

Experiment No. 12: Programming assignment to implement Autoencoders and deep Boltzmann's machines.

Level 1: Programming scenario to implement a basic recommender system using deep Boltzmann's machines.

	Level 2: Programming scenario to build a recommender system with Collaborative filtering algorithm using deep Boltzmann's machines,
	Targeted Application & Tools that can be used: Targeted employment sector is not restricted to any single domain. Today, ML and Dl have been employed for data analysis and improved business intelligence in every sector. Targeted job profiles include Data Analyst, Data Scientist, Data Engineer, Neuroinformatician, Bioinformatician, Image Recognition, Research Analyst, Full Stack Developer for Deep Learning, Natural Language Process Engineer, Business Analyst etc. Few of the top recruiters are Amazon, NVIDIA. Microsoft, IBM, Accenture, Facebook, Intel, Samsung, Lenovo, Adobe etc., among numerous others. **Tools**: Neural Designer, AutoML, AutoDL, Keras, TensorFlow, Torch, Google Colaboratory, Spider, Jupiter Notebook
	Project work/Assignment:
	Throughout the progression in each module, students will have to submit scenario based programming Assignments/Experiments as listed in "List of Lab Tasks". On completion of each module, students will be asked to develop a Mini Project, similar to the following: • **Music genre classification system** This is one of the interesting deep learning project ideas. This is an excellent project to nurture and improve one's deep learning skills. The aim is to create a deep learning model that uses neural networks to classify the genre of music automatically. For this project, students will use an FMA (Free Music Archive) dataset. FMA is an interactive library comprising high-quality and legal audio downloads. It is an open-source and easily accessible dataset. However, it is noteworthy that before one can use the model to classify audio files by genre, he/she will have to extract the relevant information from the audio samples (like spectrograms, MFCC, etc.) • **Image Caption generator** This is one of the trending deep learning project ideas. This is a Python-based deep learning project that leverages Convolutional Neural Networks and LTSM (a type of Recurrent Neural Network) to build a deep learning model that can generate captions for an image. An Image caption generator combines both computer vision and natural language processing techniques to analyze and identify the context of an image and describe them accordingly in natural human languages (for example, English, Spanish, Danish, etc.). This project will strengthen one's knowledge of CNN and LSTM, and one will learn how to implement them in real-world applications as this. • **Visual tracking system** A visual tracking system is designed to track and locate moving object(s) in a given time frame via a camera. It is a handy tool that has numerous applications such as security and surveillance, medical imaging, augmented reality, traffic control, video editing and communication, and human-computer interaction. This system uses a deep learning algorithm to analyze sequential video frames, after which it tracks the movement of target objects between the frames. The two core components of this visual tracking system are Target representation and localization

	• **Traffic Signal Classification** The traffic sign classification project is useful for all autonomous vehicles. Machines are able to identify traffic signs from the image. Students can use the GTSRB dataset that contains 43 different traffic sign classes. This is a good project to understand image classification. • **Driver Drowsiness Detection** The driver drowsiness detection is a project which can detect whether a person is sleeping or not while driving. We can implement a model for drivers and it can also prevent accidents from happening. • **Autocolouring old Black and white images** The idea of this project is to make a model that is capable of colorizing old black and white images to colorful images. Digital artists take a few hours to color the image but now with Deep Learning, it is possible to color an image within seconds.
	Text Book T1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017
	References R1. Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classification. Wiley-Inderscience, 2nd Edition. 2013 R2. Theodoridis, S. and Koutroumbas, K. Pattern Recognition. Edition 4, Academic Press, 2015 R3. Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach. Prentice Hall Series in Artificial Intelligence, 2013 R4. Bishop, C. M. Neural Networks for Pattern Recognition, Oxford University Press, 2008. **Weblinks** W1.https://presiuniv.knimbus.com/user#/home W2.https://www.ibm.com/in-en/topics/deep-learning#:~:text=Deep%20learning%20is%20a%20subset,from%20large%20amounts%20of%20data.
	Topics relevant to development of "SKILL DEVELOPMENT": Real time Data Analysis using Deep learning. for developing **SKILL DEVELOPMENT** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout

Course Code: CSE 6002	**Course Title:** Natural Language Processing **Type of Course:** Program Core Theory and Laboratory Integrated Course	**L-T-P- C**	2	0	2	3

Version No.		2.0
Course Pre-requisites		-
Anti-requisites		**NIL**
Course Description		This course introduces a basics of Natural Language Processing methods with specific emphasis on modern applications. The course will cover pre-processing techniques of textual data like stemming, lemmatization, tokenization etc. Different word Vectorization Techniques like Bag of Words, TF-iDF etc. followed by basics of Probability for building language models. Basics of Neural Network, LSTM Recurrent Neural Network, Applications of NLP like Information Extraction, Emotion Extraction from text, sentiment analysis etc.
Course Objective		The objective of the course is to familiarize the learners with the concepts of **Natural Language Processing** and attain **SKILL DEVELOPMENT** through **Experiential Learning** techniques
Course Outcomes		**On successful completion of this course the students shall be able to:** CO1: Understanding the fundamentals of NLP techniques. CO2: Apply Language modelling techniques for predictions. CO3: Apply Deep learning Techniques to build NLP Model CO4: Outline the application of NLP Techniques.
Course Content:		

Module 1	**pre-processing techniques**	Assignment		**Apply all the pre-processing techniques to the corpus of your choice.**	**14 Sessions**
	Topics: Introduction to Natural Language Processing, terminologies, empirical rules, why NLP is hard, why NLP is useful, Natural Language generation, NLP Processing pipeline, Corpus Cleaning techniques – word tokenization, sentence tokenization, word frequency distribution, stemming, lemmatization, dictionary, Part of Speech Tagging, optical character recognition, Textual Pre-Processing techniques – Stop words removal, regular expression, lower case, text standardization. Punctuation Mark Removal.				
Module 2	**Language Model**	**Assignment**		**Build n-gram language model for future word predictions.**	**11 Sessions**
	Topics: Word Embeddings techniques- bag of words, Tf-iDF, Word2Vec and optimization. Hidden Markov Models Simple N-gram models. Estimating parameters and smoothing. Negative Sampling Evaluating language models. (Forward and Viterbi algorithms and EM training), Maximum Entropy Models, N-gram and unigram.				
Module 3	**Deep Learning techniques for NLP models**	**Assignment**		**Build model for spam detection using mail subject as Corpus**	**11 Sessions**

	Topics: **Introduction to Neural Network, Perceptron, back Propa**gation, Recurrent Neural network, LSTM, Attention Models, BERT (Bidirectional **E**ncoder **R**epresentation from **T**ransformer), Reformer, speech recognition. Document summarization				
Module 4	**Application of NLP**	**Assignment**		**Paper Review of State-of-the-ArtNLP Technique**	**11 Sessions**
	Topics: Application of NLP- Lexical semantics and word-sense disambiguation. Named entity recognition and relation extraction. IE using sequence labeling, Emotion Extraction. tExt Summarization**.**				
	Targeted Application & Tools that can be used: 2. **Application Area Sentiment Analysis , Text Classification , Chatbots & Virtual Assistants , Text Extraction , Machine Translation , Text Summarization , Market Intelligence , Auto-Correct , Intent Classification , Urgency Detection , Speech Recognition** **Professionally Used Software: Anaconda Navigator, Python Packages, NLP toolkit** **List of Laboratory Task** 2. **Experiment No. 1: Apply all preprocessing technique to corpus of choice and plot word frequency.** 3. **Experiment No. 2: Word Embedding using Bag of words** 4. **Experiment No. 3: Word Embedding using TF-iDF** 5. **Experiment No. 4: Word Embedding using Word2Vec Continuous Bag of words** 6. **Experiment No. 5: Word Embedding using Word2Vec Skip gram Model** 7. **Experiment No. 6: Build language Model using n- gram.** 8. **Experiment No. 7: Build NLP model using LSTM** 9. **Experiment No. 8: Build NLP model using BERT** 10. **Experiment No. 9: Build NLP model using Reformer to show optimization.**				
	Project work/Assignment:				
	Project Assignment: NIL **Assignment 1: Paper Review of the state of the art NLP Technique**				
	Text Books T1. Daniel Jurafsky, James H. MartinSpeech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014. T2. Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Pythonll, First Edition, OReilly Media, 2009.				
	References **R1. Breck Baldwin, Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.**				

	R2. Richard M Reese, Natural Language Processing with Javall, OReilly Media, 2015. **R3. Nitin Indurkhya and Fred J. Damerau, Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.** **R4. Tanveer Siddiqui, U.S. Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press, 2008.** **Weblinks** W1.https://presiuniv.knimbus.com/user#/home W2.https://www.ibm.com/in-en/topics/natural-language-processing
	Topics relevant to development of "SKILL DEVELOPMENT": Information retrieval of Search Engines Information Retrieval. for developing **SKILL DEVELOPMENT** through **Experiential Learning techniques**. This is attained through assessment component mentioned in course handout.

Course Code: CSE 5009	**Course Title: Data Analytics and Visualization** **Type of Course: Program Core** **Theory and Laboratory Integrated Course**	**L-T-P-C**	2	0	2	3

Version No.		2.0
Course Pre-requisites		--
Anti-requisites		NIL
Course Description		The Course consists of two parts where first Part covers advanced analytics that covers topics necessary to give businesses greater insight into their data than they could ordinarily, and the Second Part covers data visualization concepts. Primary concepts include machine learning, data mining, predictive analytics, location analytics, big data analytics, and location intelligence. Visualization for Time series, Geolocated data, Correlations, connections, Hierarchies, networks, and interactivity.
Course Objective		The objective of the course is to familiarize the learners with the concepts of **Data Analytics and Visualization** and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING techniques
Course Out Comes		On successful completion of the course the students shall be able to: CO1: Analyze data by performing Exploratory Data Analysis. CO2: Apply techniques of Machine Learning to build Generalized Predictive Models. CO3: Explain basic concepts of Data Visualization. CO4: Apply principles of Data Visualizations to provide insights from data.
Course Content:		

Module 1	Data Analytics	Assignment	Analysis, Data Collection		**11 Sessions**
	Topics: Characteristics and types of data, Types of Analytics, Location Analytics, Working with Geospatial Data, Feature Engineering and Selection, Dimensionality Reduction Techniques, Common challenges faced during analysis				

Module 2	Advanced Analytics	Case Study	Analysis, Data Collection, Programming		**13 Sessions**
	Topics: Statistical methods for Data Analytics, Advance topics in Supervised and Unsupervised Machine Learning: Cluster Analysis, Hyper-Parameter Tuning, Measuring Performance of the Models, Model Selection, Data Mining techniques.				
Module 3	Introduction to Data Visualization	Assignment	Analysis, Data Collection		**9 Sessions**
	Topics: Importance of analysis and visualization in the era of data abundance, Fundamentals of Data Visualization, Human Perception, Basic plotting techniques, Interaction concepts, Visualization techniques for Time Oriented data, Introduction to Data Visualization Tools				
Module 4	Application - Data Visualization	Case Study	Analysis, Data Collection, Programming		**14 Sessions**
	Topics: Designing effective Visualizations, Advanced Visualization Tools, Visualizing Geospatial Data, Document Visualization, Visualization Systems, Evaluating Visualizations, Visualization Benchmarking. Use cases of data visualization.				
	List of Laboratory Tasks: **Experiment No 1: Exploratory Data analysis** **Level 1:** Demonstration of Tools to implement EDA **Level 2:** Use the Dataset to analyze and summarize data, analyze anomalies, analyze Outliers, and Missing Value Treatment **Experiment No. 2: Dimensionality Reduction Techniques** **Level 1:** Implement DR Technique(s) **Experiment No. 3: Machine Learning Methods** **Level 1:** Implement Supervised Learning Techniques for the given dataset **Level 2:** Implement Un-Supervised Learning Techniques for the given dataset and Cluster Analysis **Experiment No. 4: Measure the Performance of the Models** **Level 1**: Perform Model Selection **Level 2**: Regularize the model **Experiment No. 5: Introduction to Data Visualization Tools** **Level 1**: Implement Basic plotting techniques **Experiment No. 6: Time Oriented data** **Level 1:** Visualization techniques for Time Oriented data **Experiment No. 7: Trees, Graphs, Networks**				

	Level 1: Visualization techniques for Trees, Graphs, Networks **Experiment No. 8: Advanced Visualization Tools** **Level 1:** Design effective Visualizations for the given scenario **Level 2**: Implement Visualizing of Geospatial Data and Document Visualization **Experiment No. 9: Analyze Visualization Systems** **Level 1:** Analyze Visualization Systems
	Targeted Application & Tools that can be used: Data visualization is the graphical representation of information and data. By using visual elements like charts, graphs, and maps, data visualization tools provide an accessible way to see and understand trends, outliers, and patterns in data. In the world of Big Data, data visualization tools and technologies are essential to analyze massive amounts of information and make data-driven decisions. **Tools**: 2. R Programming 3. Python 4. Tableau 5. SAS 6. Excel 7. RapidMiner 8. IBM Cognos Analytics 9. Microsoft Power BI
	Project work:
	After completion of each module a Data analysis or programming based Assignment/Assessment will be conducted. **Mini Project:** Perform exploratory data analysis on a given dataset and provide insights on the same. **1. Crunchbase** – Find business information about private and public companies. You can look up how many investments they had, who the founding members are, and if they had any mergers or acquisitions. **2. Glassdoor Research** – Glassdoor offers data related to employment. You can, for example, figure out how much you can save by retaining employees. **3. Open Corporates** – Open Corporates is the largest open database of companies and company data in the world. Used by banks and governments, they pride themselves on having the most accurate data. 4. **FBI Uniform Crime Reporting –** The Uniform Crime Reporting compiles statistical crime reports, publications, and data points from thousands of cities, universities, states, and federal law enforcement agencies. 5. **Uppsala Conflict Data Program** – The Uppsala Conflict Data Program (UCDP) provides data on organized crime and civil war around the world. 6. **National Institute on Drug Abuse** – The National Institute on Drug Abuse (NIDA) monitors the prevalence and trends regarding drug abuse in the United States. 7. **DBpedia** – DBpedia aims to make Wikipedia's information easily searchable via SPARQL queries or by downloading their information directly. For instance, you can search for NBA players born in the 80s, in cities with more than 1M inhabitants. 8. **Google Trends** – Google Trends allows you to look at what's going on in the world. It gives you data about what's becoming popular, and how much people are searching for a particular term.

	9. **Instagram API** – Facebook allows you to use Instagram's API to quickly access comments, metadata, and metrics. 10. **Comtrade** – Official trade in goods and services data sets managed by the UN COMTRADE database. There are data visualization tools and an API and other extraction tools available. 11. **Datahub – Stock Market** – From gold prices, NASDAQ listings, to S&P 500 companies, you'll find it all on datahub.io 12. **Global Financial Data** – Global Financial Data gives you exactly what it says on the tin; data about the finances of the world. Ranges from real estate, global macro data, to market data. 13. **IMF Data** – The IMF, or International Monetary Fund, is an organization that aims to foster monetary collaboration between countries. You can find data on trade, government finance, and financial development. 14. **The Atlas of Economic Complexity** – The Atlas of Economic Complexity provides data about global trade dynamics over time. Want to know the quantity of textiles China exported to South Korea? Easy. 15. **World Bank** – Not only does the World Bank provide financial data about countries, but it also provides data on education and health. 16. **Financial Times Data** – Here you'll find cold, hard numbers about the different markets in the world. Data include fluctuations in currency, yield rates of bonds, and commodity prices.
	Text Book T1. Wilke, Claus O. Fundamentals of data visualization: a primer on making informative and compelling figures. O'Reilly Media, 2019. T2. Ward, Grinsten, Keim. Interactive Data Visualization: Foundations, Techniques, and Applications, A K Peters/CRC Press,2nd Edition, 2015
	References **R1.** Mohammed J. Zaki, and Wagner Meira Jr., "Data Mining and Analysis: Fundamental Concepts and Algorithms", Cambridge University Press, 2016 R2. I.H. Witten and E. Frank, Data Mining: Practical Machine learning tools and techniques Morgan Kaufmann publishers; 3rd Edition, 2011 **Weblinks** W1.https://presiuniv.knimbus.com/user#/home W2. https://www.geeksforgeeks.org/short-note-on-data-visualization/
	Topics relevant to "EMPLOYABILITY SKILLS": Real time decision-making application development using Data visualization tools for EMPLOYABILITY SKILLS through Participative Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 5008	**Course Title: Programming in Data Science** **Type of Course: Program Core** **Theory and Laboratory Integrated**	**L-T-P-C**	2	0	2	3
Version No.	2.0					
Course Pre-requisites	--					
Anti-requisites	Python, R Programming Language					
Course Description	This course introduces the core concepts of Data Science followed by programming using Python and R. This course has theory and lab component which emphasizes on understanding and programming right from Basics to Visualization in Python and R. It helps the student to explore data by applying these concepts and also for effective problem solving, visualizing and analyzing.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Programming in Data Science and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques					
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Discuss about the process involved in Data Science CO2: Explore Data using Python Numpy and Pandas CO3: Demonstrate Data Visualization using Matplotlib CO4: Explore Data using R and Visualize using R Graphics					
Course Content:						
Module 1	Introduction to Data Science	Assignment	Case Studies		**10 Sessions**	
Topics: **Introduction to Data Science** –- The field of Data Science – The various Data Science Disciplines, Connecting the Data Science Disciplines, Features of R, Data Science Techniques and Tools – Types of Data – Measures and Metrics – Descriptive Statistics – Inferential Statistics. **Data Science Methodology** - From Problem to Approach and From Requirements to Collection, From Understanding to Preparation and From Modeling to Evaluation, From Deployment to Feedback. **Data Preprocessing** - Data Quality Assessment, Feature Aggregation, Dimensionality Reduction, Feature Encoding. Predictive and descriptive analytics.						
Module 2	Data Exploration using Numpy and Pandas	Assignment	Programming		**8 Sessions**	
Topics: Introduction to Python World, Motivation, Installation of **NUMPY**, Numpy Basics, Placeholders, Datatypes, Arrays, Basic Statistics, Copying, Slicing & Subsetting, Indexing, Flattening, Reshaping, Resizing, Sorting, Swapping, Dealing with Missing values. **PANDAS** - the PYTHON Data Analysis Library, Motivation, Installation of PANDAS, PANDAS Data Structure, Series, Dataframe, Loading the Data, Descriptive Statistics, Indexing & ReIndexing, Renaming, Iteration, Sorting, Statistical functions, for and while loop in R, Window functions, Aggregations. Number of Missing values in single variable. Groupby Operations, Merging/Joining, Concatenation, Time Series, Working with Categorical Data and Text Data.						
Module 3	I/O Tools and Visualization	Assignment	Mini Project		**8 Sessions**	
Topics: **I/O API Tools**, CSV and Textual files, Reading data in CSV or text files, Using RegExp to parse txt files, Reading txt files into parts, Writing data in CSV, Reading and Writing HTML files, Reading data from XML, Reading and Writing data from excel file, JSON Data, Data inspection The **Matplotlib library**, Installation, A simple interactive chart, Adding elements to the chart, Adding a grid, Adding a legend, Converting the session to an html file, Saving your chart						

	directly as an image, Handling date values, Chart typology, Line charts, Histograms, Bar charts, Horizontal Bar Charts, Multiseries bar charts, Pie chart. Preparing time series data.				
Module 4	Introduction to R	Assignment	Programming		**10 Sessions**
	Topics: **R Environment**, Using R Studio, Vectors, List, Matrices, Arrays, Data Frames, Factors. Functions - Conditional Functions, User Defined Functions. Reading Data from files, Handling Missing Data, Installing Packages, **R Graphics** – Plot, Line, Scatter Plot, Pie Charts, Bars, Histogram, Box Plots, 3D Pie Charts, 3D Scatter Plot, Visualization with GG Plot. **R Statistics** – Dataset, Max & Min, Mean Median Mode, Subgroup Analyses, Probability Distributions, Pipes in R.				
	List of Laboratory Tasks: **Experiment No 1:** Create a Numpy array and perform the following operations on it **Level 1:** Basic Statistics, Copying, Slicing & Subsetting, Indexing, Flattening, Reshaping, Resizing, **Level 2:** Sorting, Swapping, Dealing with Missing values **Experiment No. 2:** Create a PANDAS 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 a PANDAS 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:** Demonstrate Reading and Writing using IO API tools **Level 1**: CSV and EXCEL files, HTML and XML files, **Level 2:** HDF5 CPickle **Experiment No. 5:** Using Matplotlib, Visualize the Data **Level 1**: Visualize the data using Line Chart, Bar Charts, Pie Chart, Histograms, Bar chart, Horizontal Bar Chart **Level 2:** Visualize the data using Multiseries Bar Chart, Multiseries Stacked Bar Chart **Experiment No. 6:** Install R Studio and perform basic operations **Level 1:** Vectors, List, Matrices, Arrays, Data Frames, Factors, **Level 2:** Functions and handling Missing Data **Experiment No. 7:** 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. 8:** Using R Statistics perform the following **Level 1:** Max & Min, Mean Median Mode, Subgroup Analyses, **Level 2:** Probability Distributions and Pipes				
	Targeted Application & Tools that can be used: • Data Exploration • Data Visualization • Data Analysis **Tools**: • Google Colab • Anaconda • R Studio				
	Project work				
•	• 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 and R.				

	Text Book T1. The essentials of Data Science, Knowledge Discovery Using R, Graham J Williams, CRC Press, 2017 T2. PYTHON Data Analysis, APRESS Publications, Fabio Nelli, 2015
	References R1. Comparative Approaches to using R and PYTHON for Statistical Data Analysis, Information Series Reference, 2018 R2. Practical Data Science CookBook, APRESS Publications, 2018 **Weblinks** W1.https://presiuniv.knimbus.com/user#/home W2.https://www.simplilearn.com/data-science-free-course-for-beginners-skillup
	Topics relevant to "SKILL DEVELOPMENT": Data Exploration, Data Analysis and Visualization using Python and R Programming. for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Course Code: CSE 6001	**Course Title: Deep Learning** **Type of Course: Program Core Theory and Laboratory Integrated**	**L-T-P-C**	2	0	2	3
Version No.		2.0				
Course Pre-requisites	•	--				
Anti-requisites		NIL				
Course Description		The course introduces the core intuitions behind Deep Learning, an advanced branch of Machine Learning involved in the development and application of Artificial Neural Networks that function by simulating the working principle of human brain. Deep learning algorithms extract layered high-level representations of data in a way that maximizes performance on a given task. The course includes theory and lab components which emphasizes on understanding the implementation and application of deep neural networks in various prominent problem domains like speech recognition, sentiment analysis, recommendations, and computer vision etc. The course facilitates the students to interpret and appreciate the successful application of deep neural nets in various prediction and classification tasks of ML.				
Course Objective		The objective of the course is to familiarize the learners with the concepts of **Deep Learning** and attain **SKILL DEVELOPMENT** through **Experiential Learning techniques**				
Course Out Comes		On successful completion of the course the students shall be able to: CO1: Apply basic concepts of Deep Learning to develop feed forward models CO2: Apply Supervised and Unsupervised Deep Learning techniques to build effective models for prediction or classification tasks CO3: Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains of Machine Learning and Machine vision. CO4: Analyze performance of implemented Deep Neural models				

Course Content:					
Module 1	Introduction to Deep Learning	Assignment	Programming		**10 Sessions**
	Topics: Machine Learning in a nutshell, Fundamentals of deep learning and neural networks, Deep Neural Network, Feedforward Neural Network, Perceptron, Activation Functions, Loss Functions, Gradient Descent, Back-propagation, Training Neural Networks Building your Deep Neural Network: Step by Step, Introduction to CNN				
Module 2	Improving Deep Neural Networks	Assignment	Programming		**09 Sessions**
	Topics: Hyperparameter tuning, Initialization, Overfitting and Underfitting, Regularization and Optimization, Dropout, Batch Normalization				
Module 3	Deep Supervised Learning Models	Assignment	Programming		**10 Sessions**
	Topics: Convolutional neural network with pooling flattening, Prediction of image using Convolutional Neural Networks, Deep learning in Sequential Data, RNN & LSTM, GRU,				
Module 4	Deep Unsupervised Learning	Assignment	Programming		**10 Sessions**
	Topics: Basics of Deep unsupervised learning, Auto encoders, Recommender systems, computer vision				
	List of Laboratory Tasks: **Experiment No. 1:** Programming assignment to implement a single layer feed forward neural network from scratch (Application: A basic neural network). **Level 1:** Programming scenario to implement a basic single layer feed-forward neural network perceptron. **Level 2:** Programming scenario to implement a basic single layer feed-forward neural network with a single hidden layer having ReLU activation function and sigmoid in the output layer. **Experiment No. 2:** Programming assignment to build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets. **Level 1:** Programming scenario to use the Backpropagation algorithm to build an ANN and run it on a dataset for few epochs. **Level 2:** Programming scenario to use the Backpropagation algorithm to build an ANN and run it on a dataset for few epochs and interpret the accuracy, loss and other evaluation parameters.				

Experiment No. 3: Programming assignment to build a multiple layer neural network with specific model parameters and hyperparameters on a given real life dataset.

Level 1: Programming assignment to implement a MLP with

- possibility to use 2-4 layers
- ReLU for the hidden layer
- Sigmoid in the output layer
- optimization via gradient descent (GD)

Level 2: Programming assignment to implement the neural network and add some more hyperparameters in the perceptron model

- softmax output layer
- optimization via stochastic gradient descent (SGD)
- Gradient checking code (!!!)

Generate the confusion matrix

Experiment No. 4: Programming assignment to implement classification of linearly separable Data with a Deep neural network (Application: Binary classification).

Level 1: Programming scenarios to build a binary classifier with a deep ANN.

Level 2: Programming scenarios to build a binary classifier with a deep ANN

- Weight initialization with random noise (!!!) (use normal distribution with changing std. deviation for now)
- implement dropout, *l2* regularization
- implement a different optimization scheme (RPROP, RMSPROP, ADAGRAD)
- employ batch normalization

Experiment No. 5: Programming assignment to implement a basic Convolution Neural Network.

Level 1: Programming scenarios which use the concept of convolution and pooling to implement a CNN.

Level 2: Programming scenarios which use the concept of convolution and pooling to implement a CNN and also specify some parameters like number of filters, length of feature detector, stride etc.

Experiment No. 6: Programming assignment to perform image segmentation and object detection using CNNs.

Level 1: Programming assignment to instantiate a CNN (that uses FullyConnectedLayers) and train the neural network using the training data from MNIST data set.

Level 2: Programming assignment to instantiate a CNN (that uses FullyConnectedLayers) and train the neural network using the training data from MNIST data set. Choose appropriate hyper parameters for the training of the neural network. Plot the cost versus training iterations using different mini-batch sizes: 16; 64; 256; 1024. Record the test accuracy in percentage and total training time you spent in seconds. Implement Adam Optimizer. To obtain full marks, the network should be able to achieve a test accuracy of 90% or more across many different random seeds.

Experiment No. 7: Programming assignment to employ CNN in image classification from given dataset.

Level 1: Programming scenario to instantiate a CNN (with at least one convolutional layer) and train the neural network using the training data from CIFAR10 data. Choose appropriate hyperparameters for the training of the neural network. The network should be able to achieve a test accuracy of at least 50% within 10 training epochs.

Level 2: Programming scenario to build a CNN (with more than one convolutional layer) and train the neural network using the training data from CIFAR10 data. Choose appropriate hyperparameters for the training of the neural network. The network should be able to achieve a test accuracy of at least 50% within 10 training epochs. Continue to train further and examine training and testing performance. Report hyperparameters (learning rate, number of hidden layers, number of nodes in each hidden layer, batch size and number of epochs) of the Deep Neural Network. Also, explain the observations.

Experiment No. 8: Programming assignment to perform Sentence (text) Classification using Convolutional Neural Networks.

Level 1: Programming Scenarios to utilize CNN to categorize text data in given datasets like SST movie reviews.

Level 2: Programming Scenarios to utilize CNN to categorize text data in given datasets like SST and MR movie reviews.

Experiment No. 9: Programming assignment to apply Recurrent Neural Networks for sentiment analysis of text data.

Level 1: Programming scenario to build a model to perform sentiment analysis of IMDB movie reviews using. Reviews are categorized into two polarities: positive and negative.

Level 2: Programming scenario to build a model to perform sentiment analysis of IMDB movie reviews. Reviews are categorized into three polarities: positive, negative and neutral.

Experiment No. 10: Programming assignment to create a generative model for text, character-by-character using Recurrent neural networks.

Level 1: Programming scenario to implement a multi-layer Recurrent Neural Network like LSTM for training/sampling from character-level language models, which takes one text file as input and trains an RNN that learns to predict the next character in a sequence. The RNN can then be used to generate text character by character that will look like the original training data.

Level 2: Programming scenario to implement a multi-layer Recurrent Neural Network utilizing both LSTM and GRU in turns for training/sampling from character-level language models, which takes one text file as input and trains an RNN that learns to predict the next character in a sequence. The RNN can then be used to generate text character by character that will look like the original training data. Train the model and use it to generate new text.

Experiment No. 11: Programming assignment to implement RNN models for multivariate time series forecasting.

	Level 1: Programming scenario to implement a many-to-one Recurrent Neural Network for Stock Price forecasting, i.e. trained with a certain number of day's data, the model should predict the stock price of the next day. **Level 2:** Programming scenario to implement a many-to-one Recurrent Neural Network for Stock Price forecasting, i.e. trained with a certain number of day's data, the model should predict the stock price of the next day. Students are free to use RNN, GRU, or LSTM (or compare between) and any number of layers and architecture. In the testing, plot the ground truth and your predicted values for 100 days. **Experiment No. 12:** Programming assignment to implement Autoencoders and deep Boltzmann's machines. **Level 1:** Programming scenario to implement a basic recommender system using deep Boltzmann's machines. **Level 2:** Programming scenario to build a recommender system with Collaborative filtering algorithm using deep Boltzmann's machines,
	Targeted Application & Tools that can be used: Targeted employment sector is not restricted to any single domain. Today, ML and Dl have been employed for data analysis and improved business intelligence in every sector. Targeted job profiles include Data Analyst, Data Scientist, Data Engineer, Neuroinformatician, Bioinformatician, Image Recognition, Research Analyst, Full Stack Developer for Deep Learning, Natural Language Process Engineer, Business Analyst etc. Few of the top recruiters are Amazon, NVIDIA. Microsoft, IBM, Accenture, Facebook, Intel, Samsung, Lenovo, Adobe etc., among numerous others. **Tools**: Neural Designer, AutoML, AutoDL, Keras, TensorFlow, Torch, Google Colaboratory, Spider, Jupiter Notebook
	Project work/Assignment:
	Throughout the progression in each module, students will have to submit scenario based programming Assignments/Experiments as listed in "List of Lab Tasks". On completion of each module, students will be asked to develop a Mini Project, similar to the following: • **Music genre classification system** This is one of the interesting deep learning project ideas. This is an excellent project to nurture and improve one's deep learning skills. The aim is to create a deep learning model that uses neural networks to classify the genre of music automatically. For this project, students will use an FMA (Free Music Archive) dataset. FMA is an interactive library comprising high-quality and legal audio downloads. It is an open-source and easily accessible dataset. However, it is noteworthy that before one can use the model to classify audio files by genre, he/she will have to extract the relevant information from the audio samples (like spectrograms, MFCC, etc.) • **Image Caption generator** This is one of the trending deep learning project ideas. This is a Python-based deep learning project that leverages Convolutional Neural Networks and LTSM (a type of Recurrent Neural Network) to build a deep learning model that can generate captions for an image. An Image caption generator combines both computer vision and natural language processing techniques to analyze and identify the context of an image and describe them accordingly in natural human languages (for example, English,

Spanish, Danish, etc.). This project will strengthen one's knowledge of CNN and LSTM, and one will learn how to implement them in real-world applications as this.

- **Visual tracking system**
  A visual tracking system is designed to track and locate moving object(s) in a given time frame via a camera. It is a handy tool that has numerous applications such as security and surveillance, medical imaging, augmented reality, traffic control, video editing and communication, and human-computer interaction. This system uses a deep learning algorithm to analyze sequential video frames, after which it tracks the movement of target objects between the frames. The two core components of this visual tracking system are Target representation and localization

- **Traffic Signal Classification**
  The traffic sign classification project is useful for all autonomous vehicles. Machines are able to identify traffic signs from the image. Students can use the GTSRB dataset that contains 43 different traffic sign classes. This is a good project to understand image classification.

- **Driver Drowsiness Detection**
  The driver drowsiness detection is a project which can detect whether a person is sleeping or not while driving. We can implement a model for drivers and it can also prevent accidents from happening.

- **Autocolouring old Black and white images**
  The idea of this project is to make a model that is capable of colorizing old black and white images to colorful images. Digital artists take a few hours to color the image but now with Deep Learning, it is possible to color an image within seconds.

Text Book

T1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017

References

R1. Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classification. Wiley-Inderscience, 2nd Edition. 2013
R2. Theodoridis, S. and Koutroumbas, K. Pattern Recognition. Edition 4, Academic Press, 2015
R3. Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach. Prentice Hall Series in Artificial Intelligence, 2013
R4. Bishop, C. M. Neural Networks for Pattern Recognition, Oxford University Press, 2008.

Weblinks

W1.https://presiuniv.knimbus.com/user#/home
W2.https://www.ibm.com/in-en/topics/deep-learning#:~:text=Deep%20learning%20is%20a%20subset,from%20large%20amounts%20of%20data.

Topics relevant to development of "SKILL DEVELOPMENT": Real time Data Analysis using Deep learning. for developing **SKILL DEVELOPMENT** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout

Course Code: PIP6001	**Course Title: Dissertation-I** **Type of Course:**	**L- T-P- C**	0	0	0	10
Version No.	**1.0**					
Course Pre-requisites	--					
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: 1. Identify problems based on societal /research needs. (Understand) 2. Apply Knowledge and skill to solve societal problems in a group. (Apply) 3. Develop interpersonal skills to work as member of a group or leader. (Apply) 4. Analyze the inferences from available results through theoretical / Experimental / Simulations. (Analyze) 5. Analyze the impact of solutions in societal and environmental context for sustainable development. (Analyze) 6. Improve in written and oral communication. (Create) 7. Demonstrate capabilities of self-learning in a group, which leads to lifelong learning. (Understand)					

Course Code: PIP6002	**Course Title: Dissertation-II** **Type of Course:**	**L- T-P- C**	0	0	0	14
Version No.	**1.0**					
Course Pre-requisites	--					
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: 1. Identify problems based on societal /research needs. (Understand) 2. Apply Knowledge and skill to solve societal problems in a group. (Apply) 3. Develop interpersonal skills to work as member of a group or leader. (Apply) 4. Analyze the inferences from available results through theoretical / Experimental / Simulations. (Analyze) 5. Analyze the impact of solutions in societal and environmental context for sustainable development. (Analyze) 6. Improve in written and oral communication. (Create) 7. Demonstrate capabilities of self-learning in a group, which leads to lifelong learning. (Understand)					

Course Code: SEM5001

Course Title: Seminar – I
Type of Course: L–T–P–C: 0–0–0–1
Version No.: 1.0
Course Pre-requisites: Nil
Anti-requisites: Nil

Course Description
This course is designed to enhance the research aptitude, presentation skills, and domain knowledge of postgraduate students. Students are required to select a recent topic related to their specialization, perform an extensive literature survey, and prepare a seminar report. The seminar is to be presented before a committee comprising faculty members and peers. This process fosters critical thinking, self-directed learning, and effective communication skills, while also promoting collaborative learning and peer feedback.

Course Objectives
- To develop the ability to conduct independent literature reviews and identify key issues in a chosen domain.
- To improve students' oral and written communication skills for technical and academic settings.
- To encourage active participation in academic discussions and constructive feedback.

Course Outcomes
Upon successful completion of this course, students will be able to:
1. **(Understand)** Identify and comprehend emerging research areas relevant to their field.
2. **(Apply)** Apply analytical skills to review and synthesize information from multiple sources.
3. **(Analyze)** Organize and structure academic content logically for presentation.
4. **(Create)** Prepare technical documents (seminar report) adhering to standard formats.
5. **(Apply)** Deliver an effective oral presentation using appropriate tools and techniques.
6. **(Evaluate)** Critically respond to questions and feedback from peers and faculty.
7. **(Understand)** Recognize the importance of continuous learning and staying updated in their field of study.

Course Code: SEM5002
Course Title: Seminar – II
Type of Course: L–T–P–C: 0–0–0–1
Version No.: 1.0
Course Pre-requisites: --
Anti-requisites: Nil

Course Description

Seminar–II aims to further deepen the students' research orientation and domain expertise through an advanced-level presentation. Students are expected to explore a specific research problem or recent technological advancement aligned with their dissertation work. This includes critical evaluation of literature, identification of research gaps, and articulation of research objectives. The seminar emphasizes precision in scientific communication, research ethics, and the ability to engage in scholarly discourse with clarity and confidence.

Course Objectives

- To enhance the depth of understanding in a focused research area.
- To build competence in formulating and communicating advanced technical ideas.
- To develop academic and professional presentation capabilities for conferences or pre-thesis discussions.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. **(Understand)** Identify a specific research problem and contextualize it within the broader academic framework.
2. **(Analyze)** Critically review and synthesize high-impact literature to define research gaps.
3. **(Apply)** Develop a well-structured seminar report aligned with research methodology principles.
4. **(Create)** Present a coherent and persuasive argument related to a chosen research direction.
5. **(Evaluate)** Respond analytically to queries and peer reviews with a research-oriented mindset.
6. **(Create)** Demonstrate improved academic writing and oral communication for professional contexts.
7. **(Understand)** Reflect on feedback for refining research direction and lifelong scholarly development.