PRESIDENCY UNIVERSITY

(Established under the Presidency University Act, 2013 of the Karnataka Act 41 of 2013)

School of Information Science

Three Year Degree
Program Regulations and Curriculum, 2020

Bachelor of Computer Applications

2020-2023

Regulations No.: PU/AC18.19/SoIS1/BCA/2020-23

Resolution No. 19 of the 18th Meeting of the Academic Council held on 3rd August 2022, and ratified by the Board of Management in its 19th Meeting held on 4th August 2022.

August- 2022

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Three Year Degree Program
Regulations and Curriculum, 2019

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, 2019 of the University, the Academic Council hereby makes the following Regulations, namely;

PRELIMINARY

Short Title and Commencement

(a) These Regulations shall be called the **Under Graduate (UG) Program Regulations and Curriculum, 2019**.

(b) These Regulations shall be applicable to Bachelor of Commerce, Bachelor of Business Administration and Bachelor of Computer Application Programs 2019-22 Batch and to which that may be introduced in future.

(c) These Regulations shall be applicable to the ongoing Three-Year Bachelor Degree Programs, and to all other similar programs, which may be introduced in future.

(d) They shall come into force from the Academic Session 2019-22.

Definitions

In these Regulations, unless there is anything repugnant to the subject or context:

a) "Academic Council" means the Academic Council of the University;
b) "Academic Term" means a Semester or Summer Term;
c) "Board of Examinations" means the Board of Examinations of the University;
d) "Clause" means the duly numbered Clause, with Sub-Clauses included, if any, of these Regulations;
e) "Course" means, a specific subject usually identified by its course-number 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-session/semester;
f) "Course Instructor" means, the teacher or the Course Instructor of a Course;
g) "DAC" means, the Departmental Academic Committee;
h) "Dean" means the Dean of the concerned school;
i) *"Dual Specialization" means two specialization areas which a student concentrates on or wishes to develop his/her expertise;*
j) "Elective" means courses offered under each area of Specialization;
k) "HOD" means the Head of the Concerned Department;
l) "Industrial Practice" means supervised Internship in an Organization for 8 weeks during the fourth semester;
m) *"Open elective" means a course so specified in the Program Curriculum;*
n) "Program" means the Bachelor of Commerce (B.Com), Bachelor of Business Administration (BBA)Program and Bachelor of Computer Application (BCA) ;

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o) *"Program Regulations" means the Bachelor of Commerce (B.Com), Bachelor of Business Administration (BBA) and Bachelor of Computer Application (BCA)Degree Program Regulations and Curriculum, 2019;*

p) *"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;*

q) *"Specialization" means a particular area which a student concentrates on or wishes to develop his/her expertise;*

r) *"Specialization Core Courses" means a set of courses so specified that a student has to compulsorily complete in the area of his/her specialization;*

s) *"Specialization Elective Course" means an elective course offered under each area of specialization;*

t) *"Special 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;*

u) *"Statutes" means the Statutes of Presidency University;*

v) *"Sub-Clause" means the duly numbered Sub-Clause of these Program Regulations;*

w) *"Summer Internship" means supervised Internship in an Organization for 8 weeks;*

x) *"University" means Presidency University, Bengaluru, and*

y) *"University Learning Course" means a course so specified.*

z) *"Honors degree" refers to a variant of the undergraduate bachelor's degree containing a larger volume of material or a higher standard of study, or both, rather than an "ordinary", "general" or "pass" bachelor's degree.*

1.0 INTRODUCTION

1.1 The **Academic Regulations, 2019** are applicable

1.2 e to all existing Degree Programs of the University. The Academic Regulations, and any amendments made therein, shall also be applicable to new Degree and Diploma Programs that may be offered by the University in future.

1.3 These Regulations shall be applicable to the following ongoing Three**-Year Bachelor of Degree Programs:**

1.3.1 **Bachelor of Commerce (B.Com)**;

1.3.2 **Bachelor of Business Administration (BBA)**;

1.3.3 **Bachelor of Computer Application (BCA).**

1.4 These Program Regulations and Curriculum 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.

1.5 These Program Regulations and Curriculum are structured as follows:

1.5.1 **PART A:** Specific Regulations relevant to the Three-Year, Semester Based Full Time Bachelor of Commerce and Bachelor of Business Administration Degree Program in pursuant of the provisions in Section 6.0 of the Academic Regulations, 2019 of the University

1.5.2 **PART B:** Program Curriculum for specific Bachelor of Commerce (B.Com) and

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Bachelor of Business Administration (BBA) Program of study as enumerated and named in Clause 1.2.

2.0 PART A: Program Specific Regulations

2.1 Program Description and Duration

Three-Year Degree Programs are offered in the following schools with specializations

PROGRAM	SPECIALIZATION	PARENT DEPARTMENT
Bachelor of Commerce (B.Com)	Banking and Finance	**SCHOOL OF COMMERCE AND ECONOMICS**
	Corporate Accounting and Taxation	
Bachelor of Commerce B.Com [Honors]	Business Analytics	
	Corporate Accounting with CMA US	
Bachelor Of Business Administration (BBA)	Aviation Management	**SCHOOL OF MANAGEMENT**
Bachelor Of Business Administration (BBA)	Finance Marketing Human Resource Entrepreneurship Business Analytics Supply Chain and Logistics	
Bachelor of Computer Application (BCA)	General	**SCHOOL OF INFORMATION SCIENCE**
	Gaming and Graphics	
	Augmented reality and Virtual Reality	

2.2 Degree Program is a Three –Year, full time semester based program. The minimum duration of the Program is Three (03) years and each year comprises of two academic semesters (Odd and Even Semesters) and hence the duration of the Degree Program is Six (06) Semesters. All Degree Programs are full time programs.

2.3 Admission criteria to the Three-Year Degree Programs

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 courses of the university shall be reserved

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for the students of Karnataka State 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 Degree Program is listed in the following Sub-Clauses:

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

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

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

2.3.4 Candidates must fulfill the medical standards required for admission as prescribed by the University.

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

2.3.6 The decision of the Board of Management regarding the admissions is final and binding.

2.4 Change of Branch/Discipline

A student admitted to a particular Branch of the degree Program will normally continue studying in that Branch till the completion of the program. However, the University reserves the right to provide the option for a change of Branch/Specialization, or not to provide the option for a change of branch, at the end of 1st year of the degree to eligible students in accordance with the rules framed by the University from time to time.

2.4.1 Normally, only those students, who have passed all the Courses prescribed for the 1st Year of the degree Program and obtained a CGPA of not less than 6.00 at the end of the 2nd Semester, shall be eligible for consideration of a change of branch.

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

2.4.3 The student(s) provided with the change of branch shall fully adhere to and comply with the Program Regulations and Curriculum of the concerned Program/Branch, the Fee Policy pertaining to that Program/Branch, and, all other rules pertaining to the changed Branch/Program existing at the time.

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

2.4.5 The applicants may be allowed a change in branch, strictly in order of *inter se* merit,

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subject to the limitations as given below:

2.4.5.1 The actual number of students in the third semester in any particular branch to which the transfer is to be made, should not exceed the sanctioned strength by more than 5%, and,

2.4.5.2 The actual number of students in any branch from which transfer is being sought does not fall below 75% of the total sanctioned intake.

2.5 The process of change of branch shall be completed on the first day of Registration for the 3rd Semester. **Summer Internship**

The Program requires a student to compulsorily undergo minimum 6 weeks of Summer Internship after completion of fourth semester between June and July in an Academic Year. The progress of the student's performance will be assessed and graded based on the method of evaluation prescribed in the concerned Course Handout. A minimum of 40% of the allotted marks is required for "PASS" grade (Grade D). In case a student fails to achieve the pass grade he / she will be required to repeat the summer internship at the end of the VI semester.

2.6 Social Immersion Course

The objective of a Social Immersion Course (SIC) is to sensitise and inculcate commitment to social and environmental issues and make a contribution through service and experiential learning. The outcome is to produce graduates who are sensitised and committed to serving the social and environmental needs of society.

The SIC is a 1-Credit Course coordinated by the Parent Department or a group of Departments and the student is required to complete this course ideally during any of the Semesters of the 2nd or 3rd Year of the B. Tech. Program. The nature and details of the SIC shall be approved by the concerned Departmental Academic Committee (DAC). As per the Academic Regulations, the 'S' grade is awarded for "satisfactory completion" of the Course and the 'NC' grade is awarded for "non-completion" of the Course. The student who receives the 'NC' grade shall repeat the SIC (it may be another type of SIC as approved by the concerned DAC) until the concerned student secures the 'S' grade in the SIC. The 'S' and 'NC' grades do not carry grade points and, hence, are not included in the SGPA, CGPA computations.

2.7 Open Electives

Open electives are courses offered by any department/school of the University. Primary objective of offering Open Electives is to provide interdisciplinary/transdisciplinary learning experiences. The Course details and method of evaluation shall be clearly prescribed in the concerned Course Handout.

2.8 Specific Regulations Governing Evaluation

2.8. l. Evaluation- General

2.8.1.1 The Three Year Degree Program shall follow an instructor-led evaluation system.

2.8.1.2 In courses that have a credit structure of L-0-0 or L-T-0, the components of evaluation shall be as detailed in Table 1.

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Table 1. Method of Assessment for Courses with Credit Structure L –T – 0 and L – 0 – 0			
Components of Continuous Assessments		**Weightage (% of Total Marks)**	**Duration of Assessment**
1.	*Mid Term	30%	1.5 hour
2.	This component of continuous assessment shall consist of at least TWO (02) of the followings: (1) Assignment(s) (2) Quiz (3) Technical Seminar / Report (4) Attendance / Class participation (5) Assessment on self-learning topic(s), or (6) Any other type of assessment as prescribed in the concerned Course Handout.	20%	NA
3.	End Term Final Examinations	50%	3 hours
Total		**100%**	
Note: (i) Applicable from the academic year 2022-2023 onwards			

2.8.1.3 Continuous Assessment:

Continuous Assessment will be based on the student's performance in Mid Term Examination and Internal Assessment. Internal Assessment includes regular course work, research writing, assignments, quizzes, projects, term papers, case analysis, paper presentations, Viva-Voce, role plays, etc. At the beginning of each semester, the scheme of weightage of each component of Internal Assessment shall be notified by the faculty concerned, in the Course Handout.

2.8.1.3 In courses that have a credit structure of 0-T-P or 0-0-P, the components of evaluation shall be as detailed in Table 2.

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Table 2. Method of Assessment for Practical Courses with Credit Structure 0 –0 – P and L – 0 – P			
Components of Continuous Assessments		**Weightage (%of Total Marks)**	**Duration of Assessment**
1.	Laboratory/ Practical Exercise conducted in every Practical Class and Laboratory Records, Practical/ Project Reports as prescribed by the Course Handout.	30%	NA
2.	Practical Test/ Viva/ Quiz/ Assignments as prescribed by the Course Handout.	20%	NA
3.	End Term Final Practical Examinations	50%	2 or 3 hours
Total		**100%**	

2.8.2 Evaluation – Personal and Professional Development Courses

2.8.2.1. The assessment will be made on the basis of continuous evaluation throughout the semester, which may include regular course work, practice work, assignments, presentations, quizzes, simulations, industrial tours and viva-voce.

2.8.4 Evaluation – Internship

2.8.4.1 Students shall maintain an Internship Diary detailing the day to day activities that are carried out during their summer/winter training/internship in the prescribed format.

2.8.4.2 Students shall submit one Internship Report in addition to the internship diary, detailing one particular task/project undertaken during the internship.

2.8.4.3 Students will be required to appear for a Viva -Voce Examination.

2.8.4.4 The students shall submit the Internship Diary and the Report to the Internship Coordinator of the respective batches on or before such dates duly notified by the Dean of the School.

2.8.4.5 An Assessment Committee constituted by the Dean of the School comprising of internal and external members will evaluate internship.

2.8.4.6 The Evaluation components for Internship and the respective weightages are detailed in Table 3:

Table 3 Internship Evaluation Components and Weightage		
Evaluation Components		Weightage (of the total marks)
1.	Record/Internship Diary	50 %

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2.	Internship Report	40 %
3.	Viva-Voce	10%

2.8.4 Evaluation – Dissertation

2.8.4.7 Every student shall, carryout dissertation under the overall supervision of the supervisor(s).

2.8.4.8 Normally, only a faculty member of the School concerned shall be allowed to supervise a dissertation. If the topic of a dissertation warrants, at the most two faculty members of the same School may be allowed to supervise a dissertation/project work. Considering the interdisciplinary nature of the work involved a faculty from other School and/or from industry/corporate organization active in the area in which the work is being carried may be allowed, to be associated as a co-supervisor.

2.8.4.9 The Faculty Coordinator(s) shall, in consultation with the Dean concerned, finalize the topic for dissertation along with the name(s) of the supervisor(s) in Semester IV. For this purpose, the Coordinator shall take into account the relevance of the topic on which the candidate proposes to work. However, the Coordinator may, if he considers it necessary or expedient, ask a student to carry out dissertation on a topic other than the topic proposed by the student and/or under a supervisor other than the one under whom the student proposed to carry out his/her dissertation.

2.8.4.10 Midcourse alteration/ modification in the scope of dissertation would need explicit approval from the Dean of the School. The Coordinator shall prepare a list comprising the names of the students, topic allotted to each of them along with the name of the supervisor(s). The list duly approved by the Dean of the School shall be sent to the CoE.

2.8.4.11 A certificate in the prescribed format to the effect that the dissertation carried out by the student independently or in collaboration with other student(s) issued by the Supervisor(s) concerned and endorsed by the Faculty Coordinator concerned, shall form the part of the submission for evaluation.

2.8.4.12 Every student who spends a specified period of time in an industry/organization/institute for reasons of work related to his/her dissertation, with prior permission from the Faculty Coordinator concerned will explicitly acknowledge working in the relevant industry/organization/institute.

2.8.4.13 The dissertation will normally be of 30 to 60 pages. Students are required to submit the dissertation in the VI Semester within the stipulated time. The dissertation will not be accepted after expiry of last date as stipulated. If a student fails to submit the same by the stipulated date, he/she will be declared failed and will be required to repeat the same in the appropriate semester of the next academic session provided other provisions of the

Regulations permit continuance of studies in the University.

2.8.4.14 The student shall submit to Program Coordinator one printed soft bound copy of his/her dissertation.

2.8.4.15 An Assessment Committee constituted by the Dean of the School comprising of internal and external members shall conduct Viva-Voce on dissertation.

2.8.4.16 The Evaluation components for dissertation and the respective weightages are detailed in Table 4:

Table 4
Dissertation Evaluation Components and Weightage

Evaluation Components		Weightage (of the total marks)
1.	Dissertation	50 %
2.	Supervisor Evaluation and Feedback	20%
3.	Viva-Voce	30 %

2.8.4.17 The final grade on Dissertation shall be awarded by the Assessment Committee and shall be forwarded to the CoE.

2.8.5 Evaluation – Other courses

2.8.6 The courses with only continuous evaluation the faculty concerned shall in consultation with the Dean of the School decide on the type of evaluation component to be adopted for the course and the minimum performance criteria shall be as per the academic regulations of the university.

For the courses with grades but without grade points, 'S' or 'NC' grades shall be awarded as per the Academic Regulations of the university

2.9 Course Handout

The Course Handout is a comprehensive document describing the Objectives/Outcomes of the Course, the detailed syllabus (with the prescribed Text Book(s) and Reference Material) and the Lesson/Session-wise Plan, and all the relevant and necessary details regarding the pedagogy, expectation from the students regarding preparation, participation and self-learning, components of continuous assessment and respective weightage (in percentage (%) of the total marks of all components of assessment) given to the components, and the method of evaluation. The guidelines for preparation of the Course Handout, its approval and delivery is listed in the following Sub-Clauses:

2.9.1 Normally the Course Handout is prepared by the Course Instructor(s) assigned to teach the Course. In cases of multiple sections of students registered for the same Course, an Instructor In-Charge, assigned by the DAC, shall prepare the Course Handout in consultation with the other Course Instructors assigned to the concerned Course.

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2.9.2 The DAC shall examine each Course Handout and arrange for necessary deliberations as required. On acceptance of the completeness and quality of the Course Handout, the DAC shall

approve the Course Handout.

2.9.3 A consolidated printed Booklet of all Course Handouts corresponding to the academic semester of a particular Program of Study shall be provided to every student concerned on the first day/Registration day of the concerned Semester.

2.9.4 The Course Handout is a very important guide for the students registered in the concerned course. The students are expected to use the Course Handout Booklet to prepare regularly and benefit from each session (lecture/tutorial/practical) of the course(s) and perform well in the continuous assessments and end term final examination, as applicable. Every student shall read and adhere to all the guidelines prescribed in the Course Handout.

2.10 Rules and Guidelines for Transfer of Credits from Massive Open Online Courses

(Refer Section 18.0 of the Academic Regulations, 2019.)

The provisions and rules pertaining to the transfer of credits through Massive Open Online Courses are outlined in Section 18.0 of the Academic Regulations, 2019.

With reference to Clause 18.2 of the Academic Regulations, the rules and guidelines for transfer of credits specifically from Study Webs of Active-Learning for Young Aspiring Minds-National Program on Technology Enhanced Learning (SWAYAM-NPTEL) are as stated in the following Sub-Clauses:

2.10.1. A student may complete SWAYAM-NPTEL courses 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 and/or the mandatory credit requirements of Management Sciences Courses as prescribed in the concerned B. Tech. Program Regulations and Curriculum. However, it is the sole responsibility of the student to complete the mandatory credit requirements of the Discipline Elective Courses, the Open Elective Courses and the Management Sciences Courses as prescribed by the Program Regulations and Curriculum of the concerned B. Tech. Program.

2.10.2. Approved SWAYAM-NPTEL Courses shall be included as annexes to the Program Regulations and Curriculum for the concerned B. Tech. Program and shall be announced through University Notifications to the students from time to time. A student shall only request for transfer of credits from such approved/notified SWAYAM-NPTEL Courses as published by the concerned Departments.

2.10.3. SWAYAM-NPTEL Courses are considered for transfer of credits only if the concerned student has successfully completed the SWAYAM-NPTEL Course(s) and obtained the SWAYAM-NPTEL Certificate to this effect.

2.10.4. A student cannot transfer credits from SWAYAM-NPTEL Courses to earn the mandatory credits assigned for any other type of Courses (other than Discipline, Open Elective Courses and Management Sciences Courses) as prescribed in the concerned Program Regulations and Curriculum. However, a student may complete SWAYAM-NPTEL Courses and transfer equivalent credits in excess of the required mandatory Credits (and Courses). In the case of such transfers beyond the mandatory Credits the transferred Credits will be included in the calculations of SGPA and CGPA.

2.10.5. Before the commencement of each Semester or during Pre-Registration schedule as per the Academic Calendar, Parent Departments may release a list of SWAYAM-NPTEL courses approved as Discipline Elective courses for each B. Tech. Program offered by them. In addition, Departments may also release a list of Open Elective courses offered for all B. Tech. Programs.

2.10.6. Students may Pre-Register for the approved SWAYAM-NPTEL Courses in the respective Departments and register for the SWAYAM-NPTEL Courses as per the schedule announced by SWAYAM-NPTEL.

2.10.7. The credit equivalence of the SWAYAM-NPTEL Courses are based on course durations and/or as recommended by SWAYAM-NPTEL. The Credit Equivalence mapped to SWAYAM-NPTEL course durations for transfer of credits is summarised in Table 2.10.1 below.

Table 2.10.1 SWAYAM-NPTEL Course Durations and Credit Equivalence

S. No.	Course Duration	Credit Equivalence for Transfer of Credits
1	4 Weeks	1 Credit
2	8 Weeks	2 Credits
3	12 Weeks	3 Credits

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2.10.8 A student who has successfully completed the approved SWAYAM-NPTEL Course(s) and wants to avail the provision of transfer of equivalent credits to fulfil (partially or fully) the mandatory credit requirements of the Discipline Electives and/or Open Electives and/or Management Sciences Courses as prescribed in the concerned Program Regulations and Curriculum, must submit the original SWAYAM-NPTEL Course Certificates to the Head of the Parent Department concerned, with a written request for the transfer of the equivalent credits. On verification of the SWAYAM-NPTEL Course Certificates and approval by the Head of the Department concerned, the SWAYAM-NPTEL Course(s) and equivalent Credits will be included in Course (with associated Credits) Registration of the concerned student in the Semester immediately following the completion of the SWAYAM-NPTEL Course(s).

2.10.9 The grading system for such SWAYAM-NPTEL Courses with transfer of credits is specified in Table 2.10.2 below.

Table 2.10.2 Grading System for SWAYAM-NPTEL Courses

S. No.	Final Score on the SWAYAM-NPTEL Certificate	Grade Awarded
1	90% and above	O
2	From 80% to 89%	A+
3	From 70% to 79%	A
4	From 60% to 69%	B+
5	From 50% to 59%	B
6	From 40% to 49%	C

2.10.10. A student may submit a request for credit transfer from SWAYAM-NPTEL Courses before the last instruction day of the seventh (7th) Semester of the B. Tech. program as specified in the Academic Calendar. Requests for credit transfers shall not be permissible in the eighth (8th) semester.

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2.10.11. The maximum permissible number of credits that a student may request for transfer in a Semester is ten (10) credits.

2.10.12. The University shall not reimburse any fees/expense, a student may incur for the SWAYAM-NPTEL Courses.

PART B: Three Year Degree Program Curriculum and Structure

3. Bachelor of Computer Applications (BCA) Degree Program – Program Structure and Curriculum

The Bachelor of Computer Applications (BCA) is a three-year undergraduate program that span six semesters. It is designed to bridge the gap between the studies of computers and its applications The Bachelor of Computer Applications course usually consists of core courses in programming with C, algorithm and data structures, advanced programming with C, computer organization and network fundamentals, relational database management systems, Web programming, software engineering and visual programming. Some of the main course highlights are meant to heighten technological know-how, to train students to become industry specialists, to provide research-based training and to encourage software development. The syllabus is intended to not only teach students theory and applications, but can also help equip them with professional and communication skills.

PEOs

After the completion of BCA Program from Presidency University, the graduates shall:

PEO1: Demonstrate success as a Computer professional with innovative skills, having moral and ethical values.

PEO2: Engage in lifelong learning through software development

PEO3: Serve as a leader in the profession through consultancy, extension activities and/ or entrepreneurship.

Program Outcomes (PO)

Graduates of the BCA Program will acquire:

PO1: Application Knowledge: Apply the knowledge of mathematics, science and software engineering fundamentals in software development.

PO2: Problem Analysis: Identify, formulate and apply appropriate techniques to solve domain problems.

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PO3: Design/Development of Solution: Apply relevant resources and design optimal software solutions to real-time applications.

PO4: Conduct investigations of complex problems: Conduct and design experiments relevant to software development.

PO5: Professional and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional practices.

PO6: Environment and Sustainability: Understand the impact of the professional solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO7: Ethics: Apply ethical principles and commit to professional ethics and responsibilities.

PO8: Individual and Team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Program Specific Outcomes (PSO)

At the end of the BCA Program the students shall:

PSO1: Apply the knowledge of mathematics, science, software engineering, structured and object oriented programming concepts to provide efficient solutions.

PSO2: Identify, formulate and apply appropriate techniques in the areas related to machine learning, IoT and data analytics of varying complexities in real-time applications.

PSO3: Apply relevant resources, design and develop Web and Cloud based solutions for real-time applications.

3.1 Structure of BCA

S.No	Table 3.1 Structure of BCA	BCA Credits
1	**Core Courses**	**85**
2	**Ability Enhancement Compulsory Course (AECC)**	**10**

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3	**Skill Enhancement Courses (SEC)/Value added Courses Personal and Professional Development (PPD)**	**00**
4	**Specific Electives** **a) Discipline Elective Courses**	**12**
5	**Open Elective Courses**	**06**
6	**Summer Internship**	**02**
7	**University Learning Course**	**01**
8	**Project/Dissertation**	**04**
	Total	**120**

In order to qualify for the award of the BCA Degree, a student must obtain a total of 120 Credits as per the Structure of the BCA Programme .

3.2 BCA Program Structure

Table 3.1.1
BCA PROGRAM STRUCTURE

Semester	Courses	Total Credits
Semester I	1Core Course x 4 Credits 2Core Course x 3 Credits 1 Core course x 1credit 3 AECC x 2 Credits 1fundational course X1 1 VAC **Sub-Total**	4 Credits 6 Credits 1 Credit 6 credits 1 credit **18 Credits**
Semester II	2 Core Course x 4 Credits 3 Core Course x 3 Credits 1 Core Course x 2 Credits 2 AECC x 2 Credits 1 VAC **Sub-Total**	8 Credits 9 Credits 2 Credits 4 credits **23 Credits**
Semester III	1 Core Course x 4 Credits 3 Core Course x 3 Credits 2 Core Course x 2 credits 1 ULC x 1 Credit 1 VAC **Sub-Total**	4 Credits 9 Credits 4 credits 1 Credit **18 Credits**

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Semester IV	2 Core Course x 4 Credits 4 Core Course x 3 Credits 1 VAC **Sub-Total**	8 Credits 12 Credits **20 Credits**
Semester V	1 Core Course x 4 Credits 2 Core Course x 3 Credits 2 DE x 3Credits 1 OE x 3 credits Internship **Sub-Total**	4 Credits 6 Credits 6 Credits 3 credits 2 Credits **21 Credits**
Semester VI	1 Core Course x 4 Credits 1 Core Course x3 Credits 2 DE x 3 Credits 1 OE x 3 credits Dissertation 1 x4 credits **Sub-Total**	4 Credits 3 Credits 6 Credits 3 Credits 4 Credits **20 Credits**
	Grand Total	**120 Credits**

3.3 BCA PROGRAMME STRUCUTRE

SUGGESTED SEMESTER-WISE COURSES
I Semester

SL.No	COURSE CODE	COURSE NAME	TYPE	CREDIT STRUCTURE				CONTACT HOURS
				L	T	P	C	
1	MAT111	Statistical Methods and Techniques	Core	3	0	0	3	3
2	BCA 101	Problem Solving using C	Core	2	0	4	4	6
3	BCA 102	Digital electronics	Core	3	0	0	3	3
4	BCA251	Digital electronics Lab	Core	0	0	2	1	2
5	ENG105	Essentials of English	AECC	2	0	0	2	2
6	LNG106	Communicative English-1	AECC	2	0	0	2	2
7	KAN 101	Kannada Kali	F	1	0	0	1	1
8	PPD111	Personal and Professional Development-1	VAC	0	0	2	-	2
9	EVS107	Environmental Studies	AECC	2	0	0	2	2
Total				**19**	**0**	**6**	**18**	**23**

LTPC refers to Lecture, Tutorial, Practical, and Credits

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II Semester

SL.No	COURSE CODE	COURSE NAME	TYPE	CREDIT STRUCTURE				CONTACT HOURS
				L	T	P	C	
1	BCA 103	Discrete Mathematics	Core	3	1	0	4	4
2	MAT 110	Applied Mathematics	Core	3	1	0	4	4
3	BCA 105	Data Structures	Core	3	0	0	3	3
4	BCA 252	Data Structures Lab	Core	0	0	4	2	4
5	BCA 106	Computer Organization	Core	3	0	0	3	3
6	BCA 107	Programming in Python	Core	1	0	4	3	5
7	ENG 207	Technical Written Communication	AECC	2	0	0	2	2
8	LNG 206	Communicative English-2	AECC	2	0	0	2	2
9	PPD 112	Personal and Professional Development-2	VAC	0	0	2	0	2
Total				**17**	**2**	**10**	**23**	**29**

III Semester

SL.No	COURSE CODE	COURSE NAME	TYPE	CREDIT STRUCTURE				CONTACT HOURS
				L	T	P	C	
1	BCA 201	Optimization Techniques	Core	**3**	**0**	**0**	**3**	**4**
2	BCA 202	Object Oriented Programming	Core	2	0	4	4	6
3	BCA 203	Database Management Systems	Core	3	0	0	3	3
4	BCA 204	Operating System	Core	3	0	0	3	3
5	BCA 108	Unix Programming	Core	0	0	4	2	4
6	BCA 205	Database Management Systems Lab	Core	0	0	4	2	4
7	SIC 501	Social Immersion Course		-	-	-	1	
8	PPD 131	Personal and Professional Development-3	SEC	0	0	2	-	2
Total				**11**	**1**	**10**	**18**	**26**

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IV Semester

SL.No	COURSE CODE	COURSE NAME	TYPE	CREDIT STRUCTURE				CONTACT HOURS
				L	T	P	C	
1	BCA 206	Computer Graphics	Core	3	0	2	4	5
2	BCA 207	Web Technologies	Core	1	0	4	3	5
3	BCA 208	Computer Networks	Core	2	0	2	3	3
4	BCA 209	Design Analysis of Algorithms	Core	3	0	2	4	5
5	BCA 210	Software Engineering	Core	3	0	0	3	3
6	BCA 211	Data Mining	Core	3	0	0	3	3
7	PPD 132	Personal and Professional Development-4	VAC	0	0	2	-	2
Total				**17**	**0**	**10**	**20**	**27**

Note: Summer Internship during Summer Vacation

V Semester

SL.No	COURSE CODE	COURSE NAME	TYPE	CREDIT STRUCTURE				CONTACT HOURS
				L	T	P	C	
1	BCA 212	Artificial Intelligence	Core	3	0	2	4	3
2	BCA 213	Cloud Computing	Core	3	0	0	3	3
3	BCA 214	Mobile Applications Development	Core	1	0	4	3	5
4	BCA XXX	Discipline Elective – I	DE	1	0	4	3	3
5	BCA XXX	Discipline Elective – II	DE	1	0	4	3	3
6	XXX XXX	Open Elective – I	OE	3	0	0	3	3
7	BCA320	Summer Internship/ UP-I		-	--	-	2	2
		Total		**19**	**0**	**4**	**21**	**23**

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Discipline Elective – I	**BCA301**	**Advanced Java**
	BCA302	**Advanced Data bases**
	BCA303	**Advanced Python**
	BCA304	**R Programming**
Discipline Elective – II	**BCA305**	**Cryptography and Network security**
	BCA306	**Embedded Systems**
	BCA307	**Storage Area Networks**
	BCA308	**Wireless sensor Networks**

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VI Semester

SL.No	COURSE CODE	COURSE NAME	TYPE	CREDIT STRUCTURE				CONTACT HOURS
				L	T	P	C	
1	BCA 215	Machine Learning	Core	3	0	2	4	5
2	BCA 216	Data Analytics& Business Intelligence	Core	2	0	2	3	4
3	BCA XXX	Discipline Elective – III	DE	1	0	4	3	3
4	BCA XXX	Discipline Elective – IV	DE	2	0	2	3	3
5	XXX XXX	Open Elective – II	OE	3	0	0	3	3
6	BCA315	Dissertation / UP-II		-	-	8	4	8
		Total		**14**	**0**	**12**	**20**	**26**

Discipline Elective - III	**BCA309**	**Web Data Mining**
	BCA310	**Semantic Web Technologies**
	BCA311	**Robotic Process Automation**
Discipline Elective – IV	**BCA312**	**Parallel Computing**
	BCA313	**Image Processing**
	BCA314	**Bio Informatics**

Note: The course structure of BCA is tentative & subject to revision & approval of the Academic Council.

BCA COURSES OF 1ST SEMESTER

Course Name:	**Statistical Methods and Techniques**					
Course Code:	**MAT111**	**Credit Structure :**	**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**

Course Objectives/Course Description: To acquaint students with various statistical methods. To cultivate statistical thinking among students. To prepare students for future courses having quantitative components.

Text Book:

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Schaum Series – Statistics and Probability, McGraw Hill Publications

Reference Book:

Berenson and Levine, Basic Business Statistics, New Jersey, 6th edition, Prentice- Hall India, 1996.

D.C. Montogomery and G.C.Runger, Applied Statistics and Probability for engineers, New Jersey, John Wiley and Sons, 3rd edition, 2003.

Course Name:	**Problem Solving Using C**					
Course Code:	**BCA101**	**Credit Structure :**	**L**	**T**	**P**	**C**
			2	**0**	**4**	**4**

COURSE DESCRIPTION:

This Course will provide an introduction to foundational concepts of computer programming to students of all branches of Engineering. Topics covered in this Course are problem formulation and development of simple programs, Pseudo code, Flow Chart, Algorithms, data types, operators, decision making and branching, looping statements, arrays, functions, structures, Unions, File handling and pointers. In the lab secession students are required to solve problems based on the above concepts to illustrate the features of the structured programming.

REFERENCE MATERIALS: Textbooks, reference books, any other resources, like webpages.

(i)Textbook(s)

1. E. Balagurusamy, “Programming in ANSI C”, Seventh Edition - Tata McGraw Hill.

(ii)Reference Book(s)

1. Yale Patt, Sanjay Patel, “Introduction to Computing Systems: From bits and gates to C and beyond”, McGraw Hill.

2. Behrouz A Forouzan, Richard F Gilberg, “Computer Science: A structured programming approach using C”, Cengage Learning.

3. B.W. Kernighan & D. M. Ritchie, “The C Programming Language”, Second Edition, 2001,Pearson Education

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Course Name:	Digital Electronics					
Course Code:	BCA102	Credit Structure :	L	T	P	C
			3	0	0	3

Course description:

Digital Electronics is a study of electronics that are used to process and control digital signals. In contrast to analog electronics, where information is represented by a continuously varying voltage, digital signals are represented by logic levels. This course is designed to provide knowledge on basic logic gates, universal gates and its requirement in designing digital circuits. This course also aims at reducing and implementing complex Boolean expression using simplification techniques namely K-map and QM. This course also deals with broad classification of digital systems such as combinational logic and sequential logic.

Topics include: Number system, Boolean algebra, Logic Gates, K-map, Quine McClusky method, Adders, Subtractor, Multiplexer, De-Multiplexer, Encoder, Decoder, Code converters, Latches, Flip-flops, Shift Registers, Counters.

REFERENCE MATERIALS:

Textbooks:

1. Donald P Leach, Albert Paul Malvino, & Goutam Saha: Digital Principles and Applications, 8th Edition, Tata McGraw Hill, 2010

Reference books:

1. Mano. M. Morris and Cilletti Michael D., - Digital Design, Pearson Education

2. Floyd T, Digital Fundamentals, Pearson

3. Charles H. Roth: Fundamentals of Logic Design, Jr., 5th edition

Course Name:	Digital Electronics Lab					
Course Code:	BCA251	Credit Structure :	L	T	P	C
			0	0	2	1

Course Description:

To provide hands-on experience in designing and implementing digital/logic circuits like verification of logic gates, universal gates, De Morgan's theorem, reducing Boolean expression using K-map, Adder and Subtractor circuits, Multiplexer and De multiplexer using gates, Flip flops. The laboratory exercises are designed to give students ability to design, build, and implement digital circuits and systems.

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Course Name:	English-1 Essentials of English					
Course Code:	ENG105	Credit Structure :	L	T	P	C
			2	0	0	2

COURSE DESCRIPTION:

A course on **Essentials of English** is designed primarily to help develop the linguistic skills of learners. First module consists of short literary pieces which facilitate the learners in generating ideas and enjoying in discussing issues which are sensitive as well as of global interest. Learners are required to read the main text outside the class hours. Exercises, Tasks, and Activities that are designed for classroom discussion direct them to understand not only the main ideas but also provide opportunities to use language fruitfully. The other modules focus on essential grammar, vocabulary and basic write-ups like note-making and note-taking, summary writing and paragraph writing. Continuous assessment helps the learners to develop confidence and hone their language and life skills.

REFERENCE MATERIALS:

1. Steve Hart, Aravind R.Nair, Veena Bhambani. *Embark- English for Undergraduates*. Cambridge University Press, 2016
2. Course Manual cum Workbook by the Instructor.
3. Videos and PPT's suggested by the instructor.
4. Michael Vince, Peter Sunderland. *Advanced language Practice,* Macmillan, 2003
5. Raman, Meenakshi. Sharma, Sangeetha. *Technical Communication: Principles and Practice*. Oxford University Press, New Delhi. 2015.

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Course Name:	Communicative English-I					
Course Code:	LNG106	Credit Structure :	L	T	P	C
			2	0	0	2

COURSE DESCRIPTION:

A course on **Communicative English-I** facilitates the holistic development of English language skills i.e., Listening, Speaking, Reading and Writing. The listening module includes monologues and interacting speakers which focuses comprehension of gist and detailed information A module on Speaking skills aims at developing the communicative competence of learners by participating in various narration related group activities and by enacting in role-plays pertaining to functional

English. The Writing skills module expects the learners to produce written texts of various types of discourse and draft professional business letters. Lastly, the Reading skills module involves comprehension of business-related texts of topical relevance and drawing inferences from the given text.

REFERENCE MATERIALS:

1. Course Material by the Instructor.
2. PPT's and Videos provided by the instructor.

SUGGESTED READINGS:

3. Hart, Steve. Nari, Aravind R. and Bhambhani, Veena. *Embark: English for Undergraduates*. New Delhi; Cambridge University Press, 2016.
4. J. K. Gangal, *A Practical course in Spoken English*, PHL Learning Private Limited, Delhi-2014.

Course Name:	Personal and Professional Development 1					
Course Code:	PPD 111	Credit Structure :	L	T	P	C
			0	0	2	0

COURSE DESCRIPTION:

Confidence Building

Self-Esteem

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Having a high self-esteem helps an individual believe in himself which eventually helps him to carry out his roles and responsibilities effectively. He is also perceived as a great influencer.

Speak Better

Management is all about good people skills. Effective communication from Manager enhances the team productivity. The art of effectively communicating binds the team together and is helpful in influencing people and building relationships. The importance of voice clarity & body language.

Story Telling

Everyone is telling stories to promote their vision, mission, product, companies and philosophy. Use this art to train voice modulation, body language and facial expressions.

RECOMMENDED BOOK:

(i) Textbook(s)

Building Self Confidence Training Manual

REFERENCE BOOKS :

Prakash Iyer, *"The Habit of Winning"*, 2nd Edition, Penguin Books Ltd., 2016

Jack Canfield, *"The Success Principles"*, 8th Edition, HarperCollins Publishers India, 2015

Shiv Khera, 3d Edition, *"You Can Win", Bloomsbury India*

Course Name:	Environmental Studies					
Course Code:	EVS107	Credit Structure :	L	T	P	C
			2	0	0	2

Course Name:	Kannada Kali/ Kannada Manasu					
Course Code:	KAN101	Credit Structure :	L	T	P	C
			1	0	0	1

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II SEMESTER

	Discrete Mathematics					
Course Code:	**BCA103**	**Credit Structure :**	**L**	**T**	**P**	**C**
			3	**1**	**0**	**4**

Course Description: Discrete Mathematics must be a core subject in computer Science as per ACM and IEEE. In contrast to calculus (for all engineering Courses), Discrete Mathematics is the back bone for Computer Science.

Topics include: Prepositional logic, Predicate logic, Sets, functions, sequences and sums, Basic and Advance counting techniques, Induction and Recursion, Fundamental Algorithms, the integers, Matrices and Relations

Text Book(s):

Kenneth H Rosen *"Discrete Mathematics and its Applications"*,McGraw Hill.

Reference Book(s):

1.S.EPP, *"Discrete Mathematics"*, Academic Press.

2. Thomas Kochy,*"Discrete Mathematics"*, Academic Press

Course Name:	**Applied Mathematics**					
Course Code:	**MAT110**	**Credit Structure :**	**L**	**T**	**P**	**C**
			3	**1**	**0**	4

COURSE DESCRIPTION:

This course aims to introduce the idea of trigonometric functions and applications of mean value theorems. Also introduce the idea of applying differential and integral calculus to notions of curvature and to improper integrals. Express a transcendental function as a power series to learn advanced Mathematics. Familiarize the student with functions of several variables and develop the essential tool of matrices in a comprehensive manner.

REFERENCE MATERIALS:

(a) Textbook

T1 : Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

T2 : Hugh Neill, Trigonometry : A complete Introduction, John Murray Learning, 2018

(b) Reference Books

R1: B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2010.

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R2: Ron Larson, Trigonometry, Brooks/Cole, 9th Edition, 2013

Course Name:	**Data Structures**					
Course Code:	**BCA105**	**Credit Structure :**	**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**

Course Description: The purpose of this Course is to provide the students with solid foundations in data structures and algorithms. It focuses on logical structures of data, their physical representation, design of algorithms and techniques for program development and debugging. Emphasis is placed on the appropriate use and choice of standard data structures.

Topics include: ADT, lists, stacks, queues, trees, heaps, hash tables, and graphs.

Text Book(s):

Richard F Gilberg and Behrouz A Forouzan, *"Data Structures: A Pseudocode Approach with C", Cengage learning.*

Reference Book(s):

1. Robert L Kruse, Bruce P Leung and Clovis L Tondo, *"Data Structures and Program Design in C"*, Pearson.

2**.** Seymour Lipschutz, "*Data Structures with C(Schaum's Outline Series)"*, McGraw Hill Education.

Course Name:	**Computer Organization**					
Course Code:	**BCA106**	**Credit Structure :**	**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**

Course Description: This Course introduces the modern computer organization and architectures. The emphasis is on understanding the interaction between computer hardware and software at various levels. The students will learn the concepts of computer technology, performance evaluation, instruction set design, computer arithmetic, data path and control unit design of processors and enhancing performance with pipelining.

Topics include: Introduction to Computer Arithmetic, Instruction sets, Computer organization, CPU Design, Memory system, Input-Output Interface, Asynchronous Data Transfer, Programmed I/ O, Interrupts, Direct Memory Access, Basic Input / Output Structure, serial and parallel communications, Device Drivers, Buses, Introduction to Parallel Processing: Evolution of computer systems (RISC vs. CISC), Parallelism in uniprocessor systems, Architectural classification schemes, Principles of Pipelining and Vector processing.

REGISTRAR Registrar PES UNIVERSITY BANGALORE

Text Book(s):

1. Cart Hamacher,Vranesky and zaky « Computer Organisation and Embedded systems »,MGH.

2. Patterson, Hennessy , "*Computer Organization and Design"*,Morgan Kaufmann.

Reference Book(s):

1. Carter ,*"Computer Architecture"*,Tata McGraw Hill.

2. John D. Carpinelli, *"Computer System Organization and Architecture"* ,Pearson Education.

Course Name:	**Programming in Python**					
Course Code:	**BCA107**	**Credit Structure :**	**L**	**T**	**P**	**C**
			1	**0**	**4**	**3**

COURSE DESCRIPTION: This course provides the opportunity for the students of BCA to develop Python scripts using its powerful programming features like lists, sets, tuples, dictionaries and sets. Students will also be introduced to object oriented programming concepts and packages for data visualization. Topics include: Basics of Python programming, operators and expressions, decision statements, loop control statements, functions, strings, lists, list processing : searching and sorting, nested list, list comprehension, tuples and dictionaries, sets, file handling, exception handling, object oriented programming concepts, modules and packages for data visualization.

REFERENCE MATERIALS:

Textbooks, reference books, any other resources, like webpages.

Textbook(s)

1. Ashok Namdev Kamthane and Amit Ashok Kamthane, "Problem Solving and Python Programming", Tata Mc Graw Hill Edition, 2018.

2. Charles Dierbach, "Introduction to Computer Science Using Python", Wiley India Edition, 2015.

3. Reema Thareja, "Python Programming Using Problem Solving Approach", Oxford University Press, 2017.

Reference Book(s)

1. E. Balagurusamy, "Introduction to Computing and Problem Solving Using Python", Tata McGraw-Hill, 2016

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2. Y. Daniel Liang, “Introduction to Programming Using Python”, Pearson, 2017

Course Name:	**Data Structures Lab**					
Course Code:	**BCA252**	**Credit Structure :**	**L**	**T**	**P**	**C**
			0	**0**	**4**	**2**

Course Description: Implementing Data structures like Stacks, Queues, Linked lists, Trees, Binary search trees, Heaps, Graph traversal using C language.

Text Book(s):

Richard F Gilberg and Behrouz A Forouzan, *“Data Structures: A Pseudocode Approach with C”*, Cengage learning.

Reference Book(s):

1**.** Behrouz A Forouzanand Richard F Gilberg, “*Computer science: A structured programming approach using C”,*Cengage Learning.

2. Robert L Kruse, Bruce P Leung and Clovis L Tondo, “*Data Structures and Program Design in C”*, Pearson.

Course Name:	**English-2 Technical Written Communication**					
Course Code:	**ENG207**	**Credit Structure :**	**L**	**T**	**P**	**C**
			2	**0**	**0**	**2**

COURSE DESCRIPTION:

The course aims at initiating writing skills in the field of technical communication concentrating letters, emails, minutes of meeting, memos etc. New media and communication technologies are dramatically altering technical fields at an outstanding rate. Students are prone to work more efficiently, more globally and more visually. These changes are incorporated in the course giving importance to online communication.

REFERENCE MATERIALS:

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1. Van Akens, David C., Hosford, William F. *Reporting Results: A Practical Guide for Engineers and Scientists.* Cambridge University Press, 2008
2. Alred, Gerald J., Brusaw, Charles T., Oliu, Walter E. *Handbook of Technical Writing.* Bedford/St. Martin's, Boston, 2015
3. Johnson, Richard. *Technical Communication Today.* Pearson, 2015

Course Name:	**Communicative English-2**					
Course Code:	**LNG206**	**Credit Structure :**	**L**	**T**	**P**	**C**
			2	**0**	**0**	**2**

COURSE DESCRIPTION:

The course is specially designed for the students, to make them face the competitive world. Each chapter of this book is clearly structured with a strategic approach to learn the target language through all the skill areas – Listening, Speaking, Reading and Writing. It also prepares the learners for effective communication not only as students during their collegiate days but also as employees after being employed. The students will also discover society and its norms which controls the lives of people who apparently have built it by coming and living together. To set or decide the target audience or customers this will help students to understand and respect various backgrounds and beliefs.

The objective of this course is to provide crucial support for English language learners in enhancing and equipping them with the basic communication skills which in turn will help them to converse effectively in the target language and be employable. As per the statement "Action is the language of commitment; it speaks louder than words", the course with its specific and target oriented topics is based on learning process followed by the functional application in the classroom. The course includes a lot of interaction which enables language practice; of course an immense help for the learners in learning English.

REFERENCE MATERIALS:

1. Course Material by the Instructor.
2. PPT's and Videos provided by the instructor.

SUGGESTED READINGS:

3. Hart, Steve. Nari, Aravind R. and Bhambhani, Veena. *Embark: English for Undergraduates*. New Delhi; Cambridge University Press, 2016.

Course Name:	**Personal and Professional Development 2**					
Course Code:	**PPD 112**	**Credit Structure :**	**L**	**T**	**P**	**C**
			0	**0**	2	**0**

III SEMESTER

Course Name:	Optimization Techniques					
Course Code:	BCA201	Credit Structure :	L	T	P	C
			3	0	0	3

Course Description:

This course aims to introduce students to use quantitative methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems. This course will focus on mathematical modelling, analysis and planning of complex systems. A strong emphasis will be given to model formulation.

Topics include: linear programming, Replacement Theory, Inventory Theory, Job Sequencing, Transportation, Assignment, Game Theory and CPM/ PERT techniques. Analytic techniques and computer packages will be used to solve problems facing business managers in decision environments.

Text Books:

- J K Sharma, Operations Research Theory and Applications, MacMillan India Ltd.

Reference Books:

- N D Vohra, Quantitative Techniques in management, Tata McGraw Hill.
- Handy A Taha, Operations Research – An Introduction, Prentice Hall of India, New Delhi.
- Wagner H M, Principles of Operations Research: With Applications to ManagementDecisions, Prentice-Hall of India, New Delhi.
- Hillier F S and Lieberman G J, Operations Research, Holden Day Inc., San Francisco.

Course Name:	Object Oriented Programming					
Course Code:	BCA202	Credit Structure :	L	T	P	C
			2	0	4	4

Course Description: This Course is designed for students who have prior programming experience. It introduces the concepts of object-oriented programming by focusing on the definitions and use of classes along with the fundamentals of object-oriented design.

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Topics include: Control structures and data types, Object-oriented design- encapsulation and information-hiding, classes, objects, Constructor, Array, String, Inheritance, Polymorphism, Packages, Exception Handling, Thread, GUI and Applets

Text Book(s):

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

2. Cay S Horstmann and Cary Gornell, *"CORE JAVA volume II-Advanced Features"*, Pearson.

Reference Book(s):

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

2. James W. Cooper*, "Java TM Design Patterns – A Tutorial"*, Addison-Wesley Publishers

Course Name:	**Database Management Systems**					
Course Code:	**BCA203**	**Credit Structure :**	**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**

Course Description: This Course aims at developing and managing efficient and effective databases. It helps the students to learn and practice data modelling using the entity-relationship diagrams and developing database designs using structured query languages.

Topics include: Introduction to Database systems, Data modelling, Relational Database design, Various Database Languages, Relational Database Issues , Transaction Management, File structure Techniques, Query processing and optimization, Advanced topics- introduction to distributed databases and spatial-temporal databases.

Text Book(s):

Silberschatz A, Korth H F and Sudarshan S, "*Database System Concepts*", McGraw Hill Education.

Reference Book(s):

1. Elmasri R andNavathe S B, *"Fundamentals of Database System"*, Pearson Education.

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2. Hector G Molina, Jeffrey D Ullman and Jennifer Widom, *"Database Management Systems"*, McGraw Hill Education.

Course Name:	**Operating Systems**					
Course Code:	**BCA204**	**Credit Structure :**	**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**

Course Description: Operating systems being central to computing activities, this Course provide understanding of the functions and functional modules of operating systems. The design and implementation of Operating systems is also covered.

Topics include: Core concepts of operating systems, such as processes and threads, scheduling, synchronization, memory management, file systems, input and output device management and security.

Students should have previous familiarity with programming in a high-level language, assembly language programming, CPU organization, instruction sets and registers.

Text Book(s):

Silberschatcz A, Galvin P B and Gagne G, "*Operating System Concepts*", Wiley.

Reference Book(s):

1. William Stallings, *"Operating systems",* Prentice Hall, Pearson.

2. Andrew S Tanenbaum and Albert S Woodhull, *"Operating Systems Design and Implementation"*, Pearson.

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Course Name:	Unix Programming					
Course Code:	BCA108	Credit Structure :	L	T	P	C
			0	0	4	2

COURSE DESCRIPTION: This course provides an opportunity for the students to explore Operating System concepts studied in a corresponding theory course Operating Systems (BCA 204). It will reinforce their knowledge of Operating Systems and will enable them to interact with and handle the Operating System using commands.

Topics include: Basic UNIX commands and General Purpose UNIX Utilities, commands to handle Files and File System, commands for Customizing the Environment, Shell and Shell Programming, commands for Process handling and creating Filters using Regular Expressions.

Text Book

1. Sumitabha Das, "UNIX Concepts and applications", 4th edition, Tata MacGraw-Hill, 2006.

Reference books:

1. Yeshavant Kanetkar, "Unix Shell Programming", BPB Publications, 2003.

2. Stephen.G.Kochan and Patrick Wood, "Shell Programming in UNIX, Linux and OS X", 4th edition, SAMS, 2016

Course Name:	Database Management Systems Lab					
Course Code:	BCA205	Credit Structure :	L	T	P	C
			0	0	4	2

COURSE DESCRIPTION: Database management lab is designed to have a real feel of database design using structured query languages, which includes use of various data definition, data manipulation commands, functions, joins, sub-queries, views, set operations, procedures and triggers.

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Text Book(s):

Elmasri R and Navathe S B, “Fundamentals of Database System”, Pearson Education.

Reference Book(s):

Silberschatz A, Korth H F and Sudarshan S, “Database System Concepts”,McGraw Hill Education.

P

Course Name:	**Personal and Professional Development - 3**					
Course Code:	**PPD131**	**Credit Structure :**	**L**	**T**	**P**	**C**
			0	**0**	**2**	**0**

Course Name:	**Social Emmersion Course**					
Course Code:	**SIC501**	**Credit Structure :**	**L**	**T**	**P**	**C**
			0	**0**	**0**	**1**

Course Description: Social Immersion Course is one credit Course which includes the knowledge, skills and competencies embedded within every aspect of the college to inspire and enhance each student’s transferable learning skills. It represents the broad categories of competence that enable students to be successful in further education, careers, as citizens and in their personal lives. Students will effectively express and exchange ideas through listening, speaking, reading, writing and other modes of interpersonal expression. Students will be able to gather and synthesize relevant information, evaluate alternatives and implement creative and effective solutions. Students will be prepared to practice community engagement that addresses environmental responsibility, social justice and cultural diversity. Students will become independent learners who understand and express the lifelong skills necessary for physical, social, economic, mental and emotional health.

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PRESIDENCY UNIVERSITY Registrar BANGALORE

IV SEMESTER

Course Name:	Computer Graphics					
Course Code:	BCA206	Credit Structure :	L	T	P	C
			3	0	2	4

Course Description:

The Course is intended to teach students the basic techniques to stimulate the human visual sense by introducing the visual forms of communication between user and the computer. The course will introduce the concepts not just about creating little 3-eyed aliens, but all aspects of computer data storage, from scientific visualization, to 3D modelling, to statistical results.

Topics include: 3D Mathematics, 2D Graphics, Animation, 3D Graphics Pipeline, Data representation for graphics, Lighting and Textures, Vertex buffer objects and Pixel buffer objects, Management of graphical assets, Advanced surface descriptions including normal mapping, Ray Tracing, WebGL, Shadows and reflections

Text Book(s):

Computer Graphics with OpenGL, 3/E Donald D Hearn & M. Pauline Baker, Publisher: Prentice Hall.

Reference Book(s):

1. OpenGL Programming Guide, VI edition, Jackie Neider, Tom Davis, Mason Woo. Shreiner, Addison-Wesley Publishing Company

2. Interactive Computer Graphics A Top-Down Approach with OpenGL -Edward Angel, 5th Edition, Addison-Wesley, 2008.

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Course Name:	Web Technologies					
Course Code:	BCA207	Credit Structure :	L	T	P	C
			1	0	4	3

Course Description: This course introduces students to basic web design using Hypertext Markup Language (HTML) and Cascading Style Sheets (CSS). Throughout the course students are introduced to planning and designing effective web pages; implementing web pages by writing HTML and CSS code; enhancing web pages with the use of page layout techniques, text formatting, graphics, images, and multimedia; and producing a functional, multi-page website.

Topics include: introduction to internet, browser and search engines, Internet Protocols, JAVA and HTML tools for Internet programming, scripting languages – Java Script, CSS, dynamic paging, Introduction to Dreamweaver-PHP,Server Side Programming tools, web database and XML.

Text book(s):

1. Deitel, Deitel and Nieto, “Internet and World Wide Web – How to program”, Pearson Education.

2. Elliotte Rusty Harold, “Java Network Programming”, O’Reilly Publishers.

Reference book(s):

1 .R. Krishnamoorthyand S. Prabhu, “Internet and Java Programming”, New Age International.

2. Thomno A. Powell, “The Complete Reference HTML and XHTML”, Tata McGraw Hill.

Course Name:	Computer Networks					
Course Code:	BCA208	Credit Structure :	L	T	P	C
			2	0	2	3

Course description: The main emphasis of this course is on the organization and management of networks. The course objectives include learning about computer network organization and implementation, obtaining a theoretical understanding of data communication and computer networks, and gaining practical experience in installation, monitoring, and troubleshooting of LAN systems.

Topics include: Fundamental concepts on data communication and the design, deployment, and management of computer networks. Components, protocols and standards, Network and Protocol Architecture , Open Systems Interconnection, communication model, error detection and recovery; local area networks; bridges, routers and gateways; network naming and addressing, and local and remote procedures.

Text Book(s):

1. Larry L, Peterson and Bruce S. Davie, “Computer Networks: A system Approach”, Elsevier.

2. A. S. Tannenbum, D. Wetherall, “Computer Networks”, Prentice Hall.

Reference Book(s):

1. FredHalsall, “Computer Networks”, Addison – Wesley Pub. Co.

2. Behrouz A. Forouzan, “Data Communications and Networking”, Tata McGraw-Hill.

3. Tomasi, “Introduction To Data Communications and Networking”, Pearson.

4. William Stallings, “Data and Computer Communications”, Prentice Hall.

Course	Design and Analysis of Algorithms

Name:						
Course Code:	BCA209	Credit Structure :	L	T	P	C
			3	0	2	4

Course Description:

Course Description: Design and implement algorithms for the following problems using C/C++ Language in LINUX/Windows.

Brute force- Travelling Salesman, Knapsack Problem, Divide-and-conquer- Merge sort, Quick sort, Binary search. Dynamic programming and greedy technique- Prim's, Kruskal's, Dijkstra's Algorithm- Backtracking – N Queens Problem.

Text Book(s):

Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", PHI Learning Private Limited.

Reference Book(s):

1. AnanyLevitin, "Introduction to the Design and Analysis of Algorithms", Pearson Education .

2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson.

Course Code:	BCA210	Credit Structure :	L	T	P	C
			3	0	0	3

Course Description: This course is aimed at helping students to understand the process and fundamental principles of software system development. It will initiate students with the different software process models, project management, software requirements engineering process, systems analysis and design as a problem-solving activity.

Topics include: Introduction to Software Engineering, Process life cycle Models, Software Project Management, Project Scheduling, Risk Management. Requirements Analysis and Specification-, User Interface analysis and Design, Testing, Risk Management - Process and Project Metrics.

Text book(s):

1. Roger S. Pressman, “Software Engineering – A Practitioner’s Approach”, McGraw-Hill

Reference book(s):

1. Ian Sommerville, “Software Engineering”, Pearson Education Asia.

2. Rajib Mall, “Fundamentals of Software Engineering”, PHI.

Course Name:	Data Mining

REGISTRAR

Course Code:	BCA211	Credit Structure :	L	T	P	C
			3	0	0	3

Course Description: This Course covers theory and practice of extremely large information storage (warehousing) and analysis (mining) mechanisms, with data growing at exponential rates knowledge gathering and exploration techniques are essential for gaining useful intelligence.

Topics include: Data Model for Data Warehouses, data extraction, cleansing, transformation and loading, data cube computation, materialized view selection, OLAP query processing. Data mining-Fundamentals, data mining process and system architecture, relationship with data warehouse and OLAP systems, data pre-processing. Mining Techniques and Application: association rules, mining spatial databases, mining multimedia databases, web mining, mining sequence and time-series data, text mining.

Text Book(s):

1. Tan P. N., Steinbach M & Kumar V. “Introduction to Data Mining” ,Pearson Education, 2016.

Reference Book(s):

1. Han J & Kamber M, “Data Mining: Concepts and Techniques”, Elsevier, Second Edition, 2006

2. G K Gupta, “Introduction to Data Mining with Case Studies”, PHI, Third Edition, 2014.

3. Alex Berson and Stephen J. Smith, “Data Warehousing, Data Mining and OLAP”, Tata McGraw – Hill.

Course Name:	Personal and Professional Development-4					
Course Code:	PPD132	Credit Structure :	L	T	P	C
			0	0	2	0

V SEMESTER

REGISTRAR

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Course Name:	Artificial Intelligence					
Course Code:	BCA212	Credit Structure :	L	T	P	C
			3	0	2	4

- Credits are different in 2019
- **Course Description**: The course explores the intelligent system structure, working and various levels of representation. The students learn how to identify, differentiate, and categorize a wide range of intelligent system, as well as to evaluate how AI contribute to the design and development of intelligent system design. Students also evaluate the role and contribution of Artificial intelligence in various field through interactive lectures, in-class and online assignments, and group projects students learn how to regulate which models are best suited for achieving an intended system result, and to judge whether or not Intelligent systems have been implemented successfully
- **Type of Skill**: Skill development
- **Nature of the Course**: Mathematics intensive

1] Define the basic of local search algorithms, various optimization techniques for a given AI algorithm.
2] Identify the smart intelligent way to represent the knowledge Engineering.
3] Illustrates the key aspects of planning models of artificial intelligence.
4] Understand the expert based intelligent system.

- **Text Book(s):**

1. E. Rich and K. Knight," Artificial Intelligence", Tata McGraw Hill, 2013
2. Dan W. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, PHI, 2013.

- **Reference Book(s):**

1. Nils J. Nilson, “Principles of Artificial Intelligence”, Narosa Publishing Co. 2002.
2. M.Timjones “Artificial Intelligence a Systems Approach” University Science Press 2010.
3. E. Charnaik and D.McDermott," Introduction to artificial Intelligence”, Pearson Education, 2012.

Web Links Reference:
W1. https://www.fer.unizg.hr/_download/repository/AI-1-Introduction.pdf
W2.https://www.gettextbooks.com/search/?sa=4&isbn=Artificial+Intelligence+Elaine+Rich%2CKevin+Knight

W3. Presidency University -E Library(Knimbus)
https://presiuniv.knimbus.com/user#/searchresult?searchId=eBook&curPage=0&layout=grid&sorFieldId=none&topresult=false&content=*cloud*

Course Name:	**Cloud Computing**					
Course Code:	**BCA213**	**Credit Structure :**	**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**

Course description: This Course is designed to introduce the concepts of Cloud Computing as a new computing paradigm. Cloud Computing has emerged in recent years as a new paradigm for hosting and delivering services over the Internet. The students can explore various Cloud Computing terminology, principles and applications. Understanding different views of the Cloud Computing such as theoretical, technical and commercial aspects.

Topics include: Evolution of cloud computing and its services available today, Introduction, Architecture of cloud computing, Infrastructure, platform, software, Types of cloud, Business models, cloud services, Collaborating using cloud services, Virtualization for cloud, Security, Standards and Applications.

Text Book(s):

John Rittinghouseand James Ransome, *"Cloud Computing, Implementation, Management and Strategy",* CRC Press.

Reference Book(s):

1. David E.Y. Sarna,*"Implementing and Developing Cloud Application",* CRC press

2. Anthony T Velte, Toby J Velte, Robert Elsenpeter, *"Cloud Computing : A Practical Approach"*, Tata McGraw-Hill

REGISTRAR

Course Name:	Mobile Applications Development					
Course Code:	BCA214	Credit Structure :	L	T	P	C
			1	0	4	3

Course Description The main objective of the Mobile Applications Development course is to teach students the basics of android platform and application life cycle. Students will develop mobile applications with Android containing at least one of the following phone material components: GPS, accelerometer or phone camera, use simple GUI applications and work with database to store data locally or in a server.

Topics will include user interface design; user interface building; input methods; data handling; network techniques and URL loading; GPS and motion sensing. Android application framework and deployment. Power management, Screen resolution, Touch interface, Store data on the device.

Type of Skill: Employability / Entrepreneurship

Nature of the Course: Application Based/ Programming Based

(i) Text Book(s)	
T1	Dawn Griffiths, David Griffiths, "Head First Android Development", OReilly, 3rd Edition, November 2021.
(ii) Reference Book(s)	
R1	Barry Burd, "Android Application Development" All-in-one Dummies, Wiley, 3rd Edition, January 2021.
R2	J F DiMarzio, "Beginning Android Programming with Android Studio", 4th Edition, Wiley, 2016.
R3	Pradeep kothari, "Android Application Development - Black Book", DreamTech Press, May 2014.
R4	Erik Hellman, "Android Programming – Pushing the Limits", 1st Edition, Wiley, 2014.
R5	Anubhav Pradhan, Anil V Deshpande, "Composing Mobile Apps" using Android, Wiley, 2014.

(ii) Additional web-based resources

1. https://developer.android.com/reference/classes.html
2. https://www.gitbook.com/book/google-developer-training/android-developer-fundamentals-course-concepts/details
3. Presidency University -E Library(Knimbus) : https://presiuniv.knimbus.com/user#/searchresult?searchId=eBook&curPage=0&layout=grid&sortFieldId=none&topresult=false&content=*cloud*

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(iii) Research Journals

1. Juan D.Gutiérrez, Antonio R.Jiménez FernandoSeco, Fernando J.Álvarez et.al, GetSensorData: An extensible Android-based application for multi-sensor data registration, SoftwareX, 19, 2022, 101186.
2. P. Cuesta-Morales et al, VARSE: Android app for real-time acquisition and analysis of heart rate signals, International Journal of Medical Informatics 160 (2022) 104692.
3. A.E. Amoran, A.S. Oluwole, E.O. Fagorola et al, Home automated system using Bluetooth and an android Application, Scientific African 11 (2021) e00711.
4. Rara W.Gayatri, SeptaKatmawanti, Android application for type 2 diabetes mellitus, Enfermería Clínica, Volume 31, Supplement 2, April 2021, Pages S311-S315.
5. N Rajkumar, A B Rajendra, Prafulla, Viji Vinod, H2M communication for Home Appliances Automation using Android Application, Procedia Computer Science, Volume 167, 2020, Pages 2561-2569.
6. Liang Q., Liu M. An automatic site survey approach for indoor localization using a smartphone, IEEE Trans Autom Sci Eng, 17 (1) (2020), pp. 191-206.

Course Name:	**Advanced Java**					
Course Code:	**BCA301**	**Credit Structure :**	**L**	**T**	**P**	**C**
			1	**0**	**4**	**3**

Course Description: This intensive, hands-on Course explores advanced Java features and packages. Students will learn Multi-threaded applications, client server programming and JDBC connection.

This Course provide in-depth knowledge in JAVA programming - advanced concepts in java , packages and applets, GUI concepts in java-swing, java database connectivity, servlets, J2EE framework, java script and XML.

Text Book(s):

Cay S Horstmann and Cary Gornell, *"CORE JAVA volume II-Advanced Features"*. Prentice Hall.

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Reference Book(s):

1. Cay S. Horstman and Gary Cornell, "Core Java Volume I-Fundamentals", ,Prentice Hall.

2. Schildt Herbert, *"Java 2: The Complete Reference"*, Tata McGraw-Hill.

3. DeitelandDeitel, "*Java How to Program"*, Pearson Education Asia.

Course Name:	**Advanced Web Design**					
Course Code:	**BCA317**	**Credit Structure :**	**L**	**T**	**P**	**C**
			1	**0**	**4**	**3**

COURSE DESCRIPTION:

The advanced web design course aims at building fully-fledged websites and web apps. Developing advanced websites with interactivity such as animated slideshows, light boxes (image enlargers), show/hide content, validate forms, and more.

Topics Include: Developing Responsive Websites using HTML5, Implementing CSS Frameworks, Javascript, Ajax and API's, developing blog application from scratch using Node, Express, and MongoDB.

Type Of skill:Skill Development

REFERENCE MATERIALS:

(i) Textbooks

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T1	Sergey Akopkokhyants & Stephen Radford, "*Learning Web Development with Bootstrap and Angular*", first edition, packt publication.
T2	Alan forbes ,"*The Joy of PHP Programming: A Beginner's Guide to Programming Interactive Web Applications with PHP and MySQL*", 6th edition , BeakCheck LLC.
	Robert. W. Sebesta, "Programming the World Wide Web", Pearson Education, 8th Edition,2015.
T3	CSS Notes for Professionals, ebook available at https://books.goalkicker.com/CSSBook/ (Retrieved on Jan. 20, 2022)
T4	Deitel, Deitel, Goldberg,"Internet & World Wide Web How to Program", Fifth Edition, Pearson Education,2021.

(ii) Reference Book(s)

R 1	Matthew David,"*HTML5 Mobile Websites: Turbocharging HTML5 with jQuery Mobile, Sencha Touch, and Other Frameworks*", 1st Edition, New York.

(iii) Additional web-based resources

1. https://www.w3schools.com/html/
2. https://www.php.net/
3. https://developer.mozilla.org/en-US/docs/Web/JavaScript
4. https://www.w3schools.com/nodejs/
5. https://www.w3schools.com/xml/ajax_intro.asp

Journal Articles:

1. Peroni S, Osborne F, Di Iorio A, Nuzzolese AG, Poggi F, Vitali F, Motta E. 2017. Research Articles in Simplified HTML: a Web-first format for HTML-based scholarly articles. PeerJ Computer Science 3:e132 https://doi.org/10.7717/peerj-cs.132
2. Mohit Bajpai, Ayush Jain, Chandan Kumar, Bhawani Shankar Purohit. A Research Paper on Web Development Using HTML5 and CSS3. Journal of Advanced Database Management & Systems. 2019; 6(3): 1–4p.
3. https://developer.mozilla.org/en-US/docs/Learn/Getting_started_with_the_web/JavaScript_basics
4. https://developer.ibm.com/articles/secure-javascript-applications-with-web-crypto-api/
5. https://developer.ibm.com/articles/server-unavailable-custom-php-script/
6. https://developer.ibm.com/articles/deploy-a-game-server-on-red-hat-openshift/

REGISTRAR

Course Name:	UI/UX Design					
Course Code:	BCA316	Credit Structure :	L	T	P	C
			1	0	4	3

COURSE DESCRIPTION:

The UI/UX Design brings a design-centric approach to user interface and user experience design, and offers practical, skill-based instruction centered on a visual communications perspective, rather than on one focused on marketing or programming alone. User interface and user experience design is a high-demand field, but the skills and knowledge you will learn in this Specialization are applicable to a wide variety of careers, from marketing to web design to human-computer interaction. The course is foundational and hands-on learning in using popular design tools such as Balsamiq and Figma.

Type of Skill: Skill development

Nature of the Course: Conceptual/Application Based

REFERENCE MATERIALS:

(i) Textbooks	
T1	**Steven Branson, "UX / UI Design: Introduction Guide To Intuitive Design And User-Friendly Experience" 2020**
T2	Nick de Voil, 'User Experience Foundations', The Chartered Institute for IT, 2020. (https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=2524371&site=ehost-live)
(ii) Reference Book(s)	
R1	Buxton, B. Sketching User Experiences: Getting the Design Right and the Right Design. Morgan Kaufmann, (2007)
R2	Ulloa, Roberto 'Kivy – Interactive Applications and Games in Python - Second Edition, Packt Publishing, (https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=1018008&site=ehost-live)
R3	Morris, Jason, 'Hands-On Android UI Development : Design and Develop Attractive User

	Interfaces for Android Applications', Packt Publishing, 2017. (https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=1637909&site=ehost-live)
R4	Wigdor D., Wixon D., 'Brave NUI World : Designing Natural User Interfaces for Touch and Gesture', Morgan Kaufmann, 2010. (https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=365552&site=ehost-live)

(iii) Additional web-based resources

a) https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=1018908&site=ehost-live
b) https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=1637909&site=ehost-live
c) https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=365552&site=ehost-live
d) https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=2524371&site=ehost-live

(iv) Journal Article:

Z. I. Paramarini Hardianto and Karmilasari, "Analysis and Design of User Interface and User Experience (UI / UX) E-Commerce Website PT Pentasada Andalan Kelola Using Task System Centered Design (TCSD) Method," 2019 Fourth International Conference on Informatics and Computing (ICIC), 2019, pp. 1-8, doi: 10.1109/ICIC47613.2019.8985854.

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