



St. PETER'S INSTITUTE OF HIGHER EDUCATION AND RESEARCH
(Deemed to be University U/S 3 of the UGC Act,1956)
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B.E. (COMPUTER SCIENCE AND ENGINEERING)

**(Approved by AICTE)
I to VIII Semester**

CURRICULUM AND SYLLABI UNDER CHOICE BASED CREDIT SYSTEM

Effective from the Academic Year 2023-2024



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(Deemed to be university U/S 3 of UGC Act 1956)

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AVADI, Chennai - 600054

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I. PREAMBLE

As per the recommendations of UGC, St.Peter's Institute of Higher Education and Research (SPIHER) has introduced Choice Based Credit System (CBCS) from the academic year 2015-16. Along with Choice Based Credit System the institution also adopted Outcome based Education (OBE) from 2015-16 academic year, with more emphasis on modified academic curriculum to meet corporate needs. Open electives, credits for internship, and semester abroad program are the measures taken to induce prolific quality component into the system. Continuous evaluation system is further strengthened with 40-60 percentage weightage that is in place for internal and external examinations respectively.

SPIHER has always strived to be a pioneer in delivering quality education. SPIHER has taken incremental steps in the right direction to provide holistic development to students through its academic curriculum. The four verticals namely knowledge, skill, self-development and learning to learn are considered while designing the curriculum. The curriculum is designed to facilitate multi-disciplinary learning, experiential learning through Project Based Learning as part of the learning process.

II. DEFINITIONS AND NOMENCLATURE

PRELIMINARY DEFINITIONS & NOMENCLATURE

- i. **"Degree"** Refers the academic award conferred up a student after the successful completion of the programme in the stipulated period with required credits and set procedures. The Degree is a Under graduate program which is "Bachelor of Engineering" or Bachelor of Technology", also referred "B.E." or "B.Tech" respectively.
- ii. **"Programme"** means B.E./B.Tech. Degree Programme.
- iii. **"Branch"** means specialization or discipline of B.E./B.Tech. Degree Programme like Civil Engineering, Mechanical Engineering, etc.,
- iv. **"Course"** means theory/ practical/ laboratory integrated theory/ seminar / internship / project and any other subject that is normally studied in a semester like English, Mathematics, Environmental Science, Engineering Graphics, Electronic Devices etc.,

- v. **"Institution"** means St.Peter's Institute of Higher Education and Research, Avadi, Chennai.
- vi. **"Academic Council"** means the Academic Council, which is the apex body on all academic matters of this Institute.
- vii. **"Director (Academic Affairs)"** means the Director (Academic Affairs) of the Institution who is responsible for the implementation of relevant rules and regulations for all the academic activities.
- viii. **"Controller of Examinations (CoE)"** means the Controller of Examinations of the Institution who is responsible for the conduct of examinations and declaration of results.
- ix. **"Head of the Department (HoD)"** means the Head of the Department concerned.
- x. **"Minor "The** discipline other than the major stream of study selected by the student, for secondary specialization
- xi. **"UGC"** means, University Grants Commission
- xii. **"AICTE"** All India Council of Technical Education
- xiii. **"SWAYAM" means** Study Webs of Active-Learning for Young Aspiring Minds is an Indian Massive Open Online Course (MOOC) platform

ACADEMIC REGULATIONS 2023

Under Choice Based Credit System (CBCS)

1.0 VISION AND MISSION OF THE INSTITUTION

1.1 Vision:

To be a globally renowned institution in academic excellence, research and innovation by providing inspirational learning to produce socially conscious leaders capable of addressing future challenges with ethical values.

1.2 Mission:

- To provide a vibrant learning environment, fostering innovation and creativity inspired by cutting edge research.
- To instill ethical values, imbibe a sense of social responsibility and strive for societal wellbeing.
- To promote National and International alliances and collaborative initiatives to achieve global excellence.

2.0 ADMISSION

2.1 Candidates for admission to the first semester of the eight semester B.E / B. Tech. degree programme shall be required to have passed the Higher Secondary Examination of the 10+2 curriculum (Academic stream) prescribed by the appropriate authority or any other examination of any University or authority accepted by the Institution as equivalent thereto.

2.2 Candidate shall also write an entrance examination prescribed by the Institution for admission. The entrance examination shall test the proficiency of the candidate in the courses considered eligible for admission on the standards prescribed for 10+2 academic stream.

2.3 Candidates for admission to the third semester of the eight semester B.E / B.Tech. programme under lateral entry category shall be required to have passed minimum Three years / Two years (Lateral Entry) Diploma examination in any branch of Engineering / Technology or passed B.Sc. Degree from a recognized University as defined by UGC and passed 10+2 examination with Mathematics as a subject or

Passed three year Diploma of Vocation Stream (D.Voc) in the same or allied sector or any other examination of any other authority accepted by the Institution as equivalent thereto.

- 2.4 Multiple Entry options (Credit transfer through ABC), credit exemptions as per the direction of duly appointed expert committee in the respective department
- 2.5 The Institution shall offer suitable bridge courses in Mathematics, Physics, Engineering drawing, etc., for the students of diverse backgrounds.
- 2.6 The eligibility criteria such as marks, number of attempts and physical fitness shall be as prescribed by the Institution in adherence to the guidelines of regulatory authorities from time to time.
- 2.7 The duration of the programme for the Degree of Bachelor of Engineering and Bachelor of Technology will be four academic years, with two semesters in each year. The duration of each semester will normally be 90 working days. However, a student may complete the programme at a slower pace by taking more time, but not more than seven years.

3.0 PROGRAMMES OF STUDY

Regulations are applicable to the following B.E./B.Tech. programmes in various branches of Engineering and Technology, each distributed over eight semesters, with two semesters per academic year.

S. No.	Programme	Discipline
1.	B.E	Artificial Intelligence and Data Science
2.	B.E.	Biomedical Engineering
3.	B.E.	Civil Engineering
4.	B.E.	Computer Science and Engineering
5.	B.Tech.	Cyber Security
6.	B.E.	Electrical and Electronics Engineering
7.	B.E.	Electronics and Communication Engineering
8.	B.Tech.	Information Technology
9.	B.E	Mechanical Engineering

4.0 STRUCTURE OF THE PROGRAMME

The detailed courses of study for a programme will be decided by the respective department's Board of Studies. As per NEP 2020, the structure and lengths of degree programmes are adjustable. The undergraduate degree will be of 4-year duration, with multiple entries/exit options as per AICTE/UGC guidelines.

The students are allowed to exit the programme after I or II or III or IV year with Undergraduate Certificate, Undergraduate Diploma, Undergraduate Degree (B.Sc) and Undergraduate B.E. / B.Tech. respectively as per the regulations of NEP 2020, Government of India. Similarly, the students from other institutions can join SPIHER institution in the 3rd or 5th or 7th semester with an appropriate Undergraduate Certificate or Undergraduate Diploma or Undergraduate Degree Certificates respectively.

The 4-year multidisciplinary Bachelor's programme, however, shall be the preferred option since it allows the opportunity to experience the full range of holistic and multidisciplinary education in addition with the focus on the chosen major and minors as per the choices of the student. Every programme will have a curriculum with a syllabus consisting of theory, practical, Theory based practical, Project based theory, internship, project work, etc. for 161 credits.

4.1 Categorization of Courses

- i. **Humanities, Social Sciences and Management Courses (HSC)** include English for communication, Employability Skills, Engineering Ethics and Human Values and Management courses.
- ii. **Basic Science Courses (BSC)** include Mathematics, Physics, Chemistry, Biology, Environmental Science and Sustainability, etc.
- iii. **Engineering Science Courses (ESC)** include Engineering Practices, Engineering Drawing, Basics of Civil / Electrical / Electronics / Mechanical / Computer Engineering, Instrumentation etc.
- iv. **Professional Core Courses (PCC)** include the core courses relevant to the chosen specialisation/branch.
- v. **Professional Elective Courses (PEC)** include the verticals with elective courses and elective courses relevant to the chosen specialisation/ branch.
- vi. **Open Elective Courses (OEC)** are Multidisciplinary courses that include the courses from Humanities and other disciplines of Engineering and Technology. Students can choose these courses from the list of Open Elective courses specified in the respective curriculum. Students may also choose courses from other disciplines from Swayam/NPTEL platform, including non-engineering courses.

- vii. **Employability Enhancement Courses (EEC)** Includes Project Work and/or Internship, Career Development Skills, Creative and Innovative Project, Seminar, Professional Practices, Case Study and Industrial/Practical Training
- viii. **Mandatory Courses (MC)** Mandatory Audit Courses like Environmental Science, Constitution of India, Behavioral Science, etc. are noncredit courses offered to all engineering programs of the Institution.

4.1.1 Mandatory Induction Programme for First year Students

The first-year students upon admission shall undergo a mandatory three week induction programme consisting of physical activity, creative arts, universal human values, literary, proficiency modules, lectures by eminent people, visits to local areas, familiarization with departments / schools and centres, etc.,

4.1.2 Personality and Character Development

All students shall enroll, on admission, in any of the following personality and character development programmes:

- National Service Scheme (NSS)
- Youth Red Cross (YRC)

The training activities / events / camp shall normally be organized during the weekends / vacation period.

4.1.3 Online Courses for Credit Transfer

Students are permitted to undergo department approved online courses under SWAYAM and others from 3rd to 8th Semester with the recommendation of the Head of the Department and with the prior approval of Director (Academic) during his / her period of study. The credits earned through online courses ratified by the respective Board of Studies shall be transferred following the due approval procedures. The online courses can be considered in lieu of core courses and elective courses.

4.1.4 Value Added Courses

The students are permitted to pursue department approved online courses (excluding courses registered for credit transfer) or courses offered / approved by the department as value added courses. The details of the value-added course viz., syllabus, schedule of classes and the course faculty shall be sent to the Director (Academic) for approval. The students may also undergo the valued added courses offered by other departments with the consent of the Head of the Department offering the course. These value-added courses shall be specified in the consolidated mark sheet as additional courses pursued by the student over and above the curriculum during the period of study

4.1.5 Industry Internship

The students shall undergo training for a period as specified in the curriculum during the summer vacation in any industry relevant to the field study. The students are also permitted to undergo internship at research organizations / eminent academic institutions for the period prescribed in the curriculum during the summer vacation, in lieu of Industrial training. In any case, the student shall obtain necessary approval from the Head of the Department / Director Academic and the training has to be taken up at a stretch.

4.1.6 Industrial Visit

The student shall undergo at least one industrial visit every year from the second year of the programme. The Heads of Departments / Director Academic shall ensure the same.

4.2 CREDIT ASSIGNMENT FOR SEMESTER PROGRAM OF 15 WEEKS

Each course is normally assigned certain number of credits:

Lecture Hours (Theory)	1 Credit Per Lecture hour per week
Practical Hours	1 Credit for 2 Practical hours, 2 Credits for 4 hours of practical per week
Tutorial	1 Credit for 1 hour per week.
Courses with Project Based Learning Approach (PBLA)	1 Credit Per Lecture Hour Per week
Project Work Phase I	6 Credits for 6 hours of project work (Phase-I) per week

Project Work Phase II	12 Credits for 18 hours of project work (Phase - II) per week
Internship/Entrepreneurship/ Consultancy/In plant training/	1 Credit for minimum 2 weeks during vacation

4.3 Each semester curriculum shall normally have a blend of lecture courses, laboratory courses, laboratory integrated theory courses, etc.

4.3.1 Course Coordinator for Common Course

Each common theory course offered to more than one class or branch or group of branches, shall have a “course coordinator”. The course coordinator will be nominated by the dean in consultation with respective head of the department. The course coordinator will be normally a senior staff who is one among the teachers teaching the course.

The “Course Coordinator” shall meet the teachers handling the course, as often as possible and ensure

- A common teaching methodology is followed for the course.
- The study materials are prepared by the staff members and communicated to the students periodically.
- The involvement of students in course based projects and assignments.
- To prepare common question paper for continuous internal assessment tests.
- For uniform evaluation of continuous internal assessments answer sheets by arriving at a common scheme of evaluation.

The course coordinator is responsible for evaluating the performance of the students in the continuous internal assessments and end semester examinations and analyse them to find suitable methodologies for improvement in the performance. The analysis should be submitted to the HoD and Dean for suitable action.

4.4 The medium of instruction, examinations and project report shall be in English, except for courses in languages other than English.

4.5 ENROLLMENT FOR B.E. / B. Tech. (Honours) and B.E. / B. Tech. minor with specialisation in another discipline. (OPTIONAL)

4.5.1 B.E / B.Tech. (Hons.)

- a) The students should have taken additional courses from a specified group of Professional Electives (vertical) or from any of the verticals of the same programme and earned a minimum of 18 credits.
- b) Should have passed all the courses prescribed in the curriculum and additional courses in the first attempt.
- c) Should have earned a minimum of 7.50 CGPA taking into account of all the courses prescribed in the curriculum and additional courses.
- d) Lateral Entry students shall be permitted to register for the courses from Semester V onwards provided the students have earned a minimum CGPA of 7.50 until Semester III and have cleared all the courses in the first attempt.
- e) If a student decides not to opt for Honor's, after completing certain number of additional courses, such additional courses studied shall be considered instead of the Professional Elective courses which are part of the curriculum.

If the student has studied more number of such courses than the number of Professional Elective courses required as per the curriculum, the courses with higher grades shall be considered for the calculation of CGPA. Remaining courses shall be printed in the grade sheet, however, they will not be considered for calculation of CGPA and the same shall be indicated in a foot note appropriately.

If the student has failed in the additional courses or faced shortage of attendance, they will not be printed in the grade sheet and will not be considered for CPGA calculation and classification of degree.

4.5.2 B.E./B.Tech. Minor with specialisation in another discipline:

The student should have earned additionally a minimum of 18 credits in any one of the verticals offered from other Engineering Disciplines / Science and Humanities / Management.

- a) For these 18 credits students can optionally enroll and study a maximum of 6 credits in online mode from SWAYAM-NPTEL platform (in addition to the three online courses permitted for courses of curriculum), as approved by Head of the Department / Director Academic

- b) B.E / B.Tech. (Hons.) and B.E./B.Tech. minor with specialisation in another discipline will be optional for students and the students shall be permitted to select any one of them only.
- c) For the category 4.5.2, the students, including Lateral Entry, will be permitted to register the courses from Semester V onwards provided the marks earned by the students until Semester III is CGPA 7.50 and above.
- d) B.E/B.Tech. (Hons.) or B.E./ B.Tech. Minor shall be offered by the Department irrespective of the number of students enrolled.
- e) If a student decides not to opt for Minor, after completing certain number of courses, the additional courses studied shall be considered instead of Open Elective courses which are part of the curriculum.

If the student has studied more number of such courses than the number of open electives required as per the curriculum, the courses with higher grades shall be considered for calculation of CGPA. Remaining courses shall be printed in the grade sheet, however, they will not be considered for calculation of CGPA and the same shall be indicated in a foot note appropriately.

If the student has failed in the additional courses or faced shortage of attendance, they will not be printed in the grade sheet and will not be considered for CGPA calculation and classification of degree.

The student has to enroll for these additional courses separately and pay a tuition fee for studying these six additional courses and pay additional exam fee.

5.0 REGISTRATION AND ENROLLMENT

- 5.1** Each student, on admission, shall be assigned to a Mentor, who shall advise and counsel the student about the details of the academic programme and the choice of courses, considering the student's academic background and career objectives.
- 5.2** After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn continuous assessment marks and appear for the end semester examinations.

5.3 Each student on admission shall register for all the courses prescribed in the curriculum in the student's first Semester of study.

The enrollment for all the courses of curriculum from the Semesters II to VIII and additional courses for Honours and Minor from the semesters V and VIII will commence 5 working days prior to the commencement of the succeeding semester. The courses for Honours and Minor shall be registered separately under additional courses. The student shall enroll for the courses with the guidance of the student's Mentor. If the student wishes, the student may drop or add courses within 10 working days after the commencement of the concerned semester and complete the registration process duly authorized by the faculty incharge within 30 days from the commencement of concerned semester. The list of students approved by the respective faculty incharge shall be final and would be considered for attendance, grades and calculation of CGPA and no changes shall be made thereafter.

5.4 For enrollment, a student MUST have

- I. Cleared all the Institute and Hostel dues of the previous semesters and the current semester fees.
- II. Not been debarred from registering for a specified period on disciplinary or any other ground.

5.5 Flexibility to Add or Drop courses:

5.5.1 A student has to earn the total number of credits specified in the curriculum of the respective programme of study in order to be eligible to obtain the degree. From the II to VII semesters, the student has the option of registering for additional courses or dropping existing courses in a semester. The total number of credits that a student can add or drop in a semester is limited to 8, subject to a maximum of 2 courses. Maximum number of credits enrolled in a semester (including Shortage of Attendance (SA), Honours and Minor) shall not exceed 30. The online courses registered shall be over and above this 30 credits.

5.5.2 If the student wishes to earn more than the total number of credits prescribed in the curriculum of the student's programme within the minimum duration of the programme, then he/she can enroll for such additional courses in any programme with the permission of Head of the Department to which student belongs and Head of the Department in which the course is offered by paying the examination fee. The credits earned will be neither considered for the computation of CGPA nor for the classification of the degree. The courses successfully completed will be printed in the grade sheet, however if there is shortage of attendance or failure, it shall neither be reflected in the grade sheet nor be considered for classification. Maximum number of credits enrolled in a semester (including SA, Honours and Minor) shall not exceed 30 (except online courses).

5.6 Choice of Professional Elective Courses

The professional Elective Courses are listed in the Curriculum in Table format as verticals (Specialisation groups). A student can choose all the Professional Elective Courses either from one of the verticals or a combination of courses from all verticals in a semester. However, students irrespective of enrolling for additional courses for B.E. / B. Tech. (Hons.) are not permitted to choose more than one course from a row. Students are permitted to enroll more than one elective course from the same vertical in a semester. In the subsequent semesters students are permitted to enroll one more course in a row, provided if he/she has cleared the earlier course of the same row. For a professional elective course and open elective course, minimum number of students enrolment permitted shall be 10. However, the minimum number is not applicable for students enrolling B.E. / B. Tech. (Hons) and B.E./B.Tech. Minor. For each professional elective course at least two choices shall be offered.

5.7 Redoing a Course

Redoing a course means reregistering for a course, attending all classes, fulfilling the attendance requirements as per clause 6, earning fresh Continuous Assessment marks and appearing for the End Semester Examinations. A student has to redo a course as per the following conditions.

- 5.7.1** If a student is prevented from writing end semester examination of any core course due to lack of attendance, the student has to register for that course again when offered next and redo the course.
- 5.7.2** If a student is prevented from writing the end semester examination of any professional/open elective course due to lack of attendance, the student can opt to register for the same course again when offered next and redo the course, or he/she can opt to register for a different professional/open elective course when it is offered, attend the classes, fulfill the attendance requirements as per clause 6, secure Continuous Assessment marks and appear for the End Semester Examinations.
- 5.7.3** If the course in which a student fails to secure a pass is a professional/open elective course, then the student can opt for a different professional/ open elective course, register for the same when it is offered, attend classes, fulfill the attendance requirements as per clause 6, secure Continuous Assessment marks and appear for End Semester Examinations.
- 5.7.4** A student who fails in Project work shall register for the course again, when offered next, and redo the course. In this case, the student shall attend the reviews and fulfill the attendance requirements as per clause 6.
- 5.7.5** A student who fails in Seminar / Case Study and Creative and Innovative project, where such other courses are evaluated through 100% continuous assessment, shall register for the same in the subsequent semester and redo the course. In this case, the student shall attend the classes and fulfill the attendance requirements as per clause 7 and earn continuous assessment marks.
- The student who fails in summer industrial training / internship shall attend the training / internship again and redo the course with the same organization or different organization with the approval of the HOD.

6.0 REQUIREMENTS FOR APPEARING FOR THE END SEMESTER EXAMINATION OF A COURSE

A student who has fulfilled the following conditions (vide clause 6.1 and 6.2) shall be deemed to have satisfied the attendance requirements for appearing for the end semester examination of a particular course.

- 6.1** Ideally every student is expected to attend all periods and earn 100% attendance. However, the student shall secure not less than 75% attendance, course wise, taking into account the number of periods required for that course, as specified in the curriculum.
- 6.2** If a student secures attendance between 65% and less than 75% in any course in the current semester, due to medical reasons (hospitalization / accident / specific illness) or due to participation in the College / University / State / National / International level Sports events, with prior permission from the Chairman of Sports Board and Head of the Department concerned, the student shall be given exemption from the prescribed attendance requirement (75%) and the student shall be permitted to appear for the end semester examination of that course. A maximum of 10% shall be allowed under On Duty (OD) / Medical leave category. In all such cases, the students should submit the required documents on joining after the absence to the Head of the Department through the Faculty Coordinator. The HOD shall inform the course instructor to provide necessary attendance at the end of semester before finalizing attendance. Producing such documents while finalizing attendance at the end of semester shall not be accepted.
- 6.3** A student shall normally be permitted to appear for the end semester examination of the course if the student has satisfied the attendance requirements (vide Clause 6.1 – 6.2) and has registered for the examination in those courses of that semester by paying the prescribed fee.
- 6.4** Students who do not satisfy clause 6.1 and 6.2 and who secure **less than 65%** attendance in a course will not be permitted to write the end semester examination of that course. The student has to register and redo the course when it is offered next as per Clause 5.4. If the course in which the student has been prevented is a professional/ open elective, the student can opt to redo the same course or opt for different professional/ open elective course as per Clause 5.7.2.
- 6.5** If a student has shortage of attendance in all the registered courses of the current semester as per curriculum, he/she would not be permitted to move to the higher semester and has to repeat the current semester in the subsequent year.

- 6.6** In the case of reappearance (Arrear) registration for a course (the courses for which redo is not required), the attendance requirement as mentioned in Clauses 6.1 - 6.3 is not applicable. However, the student has to register for the examination in that course by paying the prescribed fee.
- 6.7** A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear for the same course for improvement of letter grades / marks.

7.0 STUDENT COUNSELLING

To help students in planning their courses of study and for general advice on the academic programme and personal counselling, Faculty members are assigned.

7.1 MENTOR

To help the students in planning their courses of study and to render general advice regarding either the academic programme or any other activity, the Head of the Department concerned, will assign every year, a certain number of students from the first semester to a faculty member who will be called as Mentor. The set of students thus assigned will continue to be under the guidance of the Mentor till they complete the programme. Mentors will help the students on multiple exits, and also assess the proficiency of the student. Each student should have one-one interaction with the mentor at least once in a month.

7.2 FACULTY COORDINATOR

There is a Faculty Coordinator who will be the in-charge for a particular batch. He will coordinate with the mentors for assessing the proficiency of the batch and report to the Head of the Department. He will also collect the course registration forms from the students. He also ensures whether the student submitted feedback at the end of the semester for the courses he/she has taken.

8.0 CLASS COMMITTEE

a) Constitution of the Class Committee

For every class, a class committee shall be constituted by the Heads of Department, as given below:

Chairman	A faculty member not teaching that particular class
Members	<ul style="list-style-type: none">• Faculty of all the courses of study• Four student members from the class to be nominated by the

b) Functions of the Class Committee

- (i) The class committee shall meet thrice during the semester. The first meeting will be held within two weeks from the date of commencement of the semester in which the nature of the broad assessment procedure for the different courses will be discussed. The second and third meetings will be held six weeks and ten weeks respectively from the commencement of a semester to meaningfully interact and express opinions and suggestions to improve the effectiveness of teaching - learning process and analyze the performance of the students in the assessments. The chairperson of the class committee should send the minutes of the class committee meetings to the Dean through the Head of the Department, immediately after the meetings is over.
- (ii) During the first meeting of the class committee, all the faculty members shall give their course plan to the class committee chairperson/chairman for approval and uploading into the ERP.
- (iii) Any innovation in any course plan not agreed by the class committee or the HoD will be referred to the Dean for approval.

9.0 EXAMINATIONS AND ASSESSMENT

9.1 ASSESSMENTS

Continuous Assessment Examinations

Continuous evaluation system is strengthened with 40-60 percentage weightage system in place for internal and external examinations. Three Continuous internal assessment Examinations will be conducted as per the academic calendar posted in our institution website. Internal mark for every course is assigned based, on the performance in Continuous Assessment Examinations and assignments submitted on the performance in Continuous Assessment Examinations and assignments submitted.

9.1.1 Theory Courses

- There will be a minimum of Three continuous internal assessment tests (Assessment Test 1,2 and a Model Exam), for each theory course.

DISTRIBUTION OF CONTINUOUS INTERNAL ASSESSMENT (CIA) MARKS FOR A THEORY COURSE			
Evaluation Component	Syllabus coverage	Duration of the Exam	Max. Weightage (40 Marks)
CIA-1	First 1.5 Units of the syllabus	2.0 Hours	30 Marks (25% weightage for each CIA 1 & CIA 2 and 50% for Model Exam)
CIA-2	Second 1.5 Units of the syllabus	2.0 Hours	
Model Exam	Full syllabus	3 Hours	
Assignment/ Mini Project (or) Group Presentation	Two written assignments for each course / Written quiz (or) Presentation of a written Report (or) Case study / Multiple choice Objective Type Test or Technical Project involving not more than 3 students (or) any other Group Presentation related to the course.		10 Marks

- The continuous assessment marks obtained by the candidate in the first appearance shall be retained, considered and valid for all subsequent attempts, till the candidate secures a pass.

9.1.2 Practical Courses

S. No.	Category	Maximum Marks
1.	Record	15
2.	Observation work	10
3.	Model Examination	15
Total		40

- For practical courses, the student will be evaluated on a continuous basis for 25 Marks (which will include performing all experiments, submitting observation and record note book in scheduled format and time), 15 marks for model exam at the end of the semester.

- For practical courses, if a student has been absent for some practical classes or has performed poorly, then the student will have to get permission from the lab in-charge and year coordinator to do the experiments, so that he/she meets all the requirements for the course and thereby allowed to appear for model and end semester practical exams
- If a student has not done all the experiments assigned for that lab, before the scheduled date will not be allowed to appear for the model and end semester practical exam. Such students will have to register the course again by doing all the experiments in the next semester when the course is offered.

9.1.3 End Semester Examinations (ESE)

- The End Semester examinations shall normally be conducted after academic schedule for both theory and practical courses of all programmes.
- End semester Theory and Practical examinations will be conducted for a maximum of 60 marks.
- **Pattern of Question Paper (Theory) for Model and ESE**

Particulars	Remarks
Maximum Marks	60 Marks
Duration	3 Hours
Part – A	Short Answers (10x2=20)
Part – B	Medium Answers (Either or type) (5x8=40)

9.1.4 Project Work/ Semester long Internship

The student shall register for Project Work-I in pre-final semester and Project Work-II in final semester. Project work may be allotted to a single student or to a group of students not exceeding 4 per group. Project Work-II may/may not be a continuation of Project Work-I. If Project Work II is not a continuation of Project Work I, then the topic and constitution of the project team members need not be the same.

- The project review would be conducted by a review committee where the student/ team shall make a presentation on the progress made, before the committee. The Head of the department shall constitute the review committee for each branch in consultation with Director Academic, approved by CoE. The members of the review committee will evaluate the progress of the project and award marks.
- The guides would evaluate the students based on their performance and follow up.

- For Project work out of 100 marks, the maximum marks for Continuous Assessment are fixed as 40 and the End Semester Examination (project report evaluation and viva-voce examination) carries 60 marks.

There shall be **Three Continuous assessments** (each 100 marks) during the semester by a review committee. The student shall make presentation on the progress made before the committee. The Head of the Department shall constitute a review committee for each programme. There shall be a minimum of three members in the review committee. The committee shall consist of the supervisor, expert member from the department and a project co-ordinator from another department. The total marks obtained in the three Reviews shall be reduced to 40 marks.

Continuous Assessment (40 Marks)			End Semester Examinations (60 Marks)			
Review I	Review II	Review III	Project Report		Viva-Voce Examination	
10	10	20	Supervisor	External	Internal	Extern AI
			20	20	10	10

- A student is expected to attend all the project reviews conducted by the institution on the scheduled dates. It is mandatory for every student to attend the reviews, even if they are working on a project in an industry, which is outside Chennai city. If a student does not attend any of the project reviews, he / she shall not be allowed for the successive reviews and thereby not allowed to appear for the final viva voce.
- The candidate is expected to submit the project report as per the guidelines of the institution on or before the last day of submission. If a candidate fails to submit the project report on or before the specified deadline, he/she can be granted an extension of time up to a maximum limit of 5 days for the submission of project work, by the Head of the Department.
- If he/she fails to submit the project report, even beyond the extended time, then he/she is deemed to have failed in the project work and shall register for the same in the subsequent semester and re-do the project after obtaining permission from the HoD and Director Academic.

9.1.5 Assessment for Summer internship:

The summer Industrial / Practical Training/ summer internship/ summer project shall carry 100 marks and shall be evaluated through continuous assessment only. At the end of the summer Industrial / Practical Training/ summer internship/ summer project, the student shall submit a certificate from the organization where the student has undergone training and a brief report about the training. The evaluation will be made based on this report, presentation and a Viva-Voce Examination conducted by a three-member Departmental Committee constituted by the Head of the Department consisting of one co-ordinator and two faculty members. Certificates (issued by the Organization) submitted by the student shall be attached to the mark list and sent to the Controller of Examinations by the Head of the Department. The evaluation shall be carried out as per the procedure shown below.

Internship / Industrial Training		
Evaluation Marks (100)		
Report	Presentation	Viva Voce
50	30	20

9.1.6 Assessment For Online Courses

Students may be permitted to credit two online courses (which are provided with certificate), subject to a maximum of six credits. The online course of 3 credits can be considered instead of one elective course. These online courses shall be chosen from the SWAYAM platform, provided the offering organization conducts regular examination and provides marks. The credits earned shall be transferred and the marks earned shall be converted into grades and transferred, provided the student has passed in the examination as per the norms of the offering organization. The details regarding online courses taken up by the student and marks/credits earned and the approval for the course from Concerned Head of the Department shall be sent to the Controller of Examinations, in the subsequent semester(s) along with the details of the elective(s) to be dropped.

9.2 ASSESSMENT WEIGHTAGES:

There will be Continuous Assessment Examination and End Semester Examination for courses of all programmes.

(i) Theory courses

Continuous Internal Assessment : 40 Marks

End Semester Exams : 60 Marks

(ii) Practical courses

Continuous Internal Assessment : 40 Marks

End Semester Exams : 60 Marks

(iii) Theory + Practical courses

Continuous Internal Assessment (Average of Theory and Practical) : 40 Marks

End Semester Exams (Average of Theory and Practical) : 60 Marks

10.0 EXAMINATIONS

10.1 RE-EXAMINATION

Re-examination requests shall be considered only for the Continuous Assessment Examinations in the last instructional week of the semester based on medical reasons.

10.2 REVALUATION

A candidate can apply for revaluation of his/her End semester examination answer paper in a theory course, immediately after the declaration of results, on payment of a prescribed fee through the ERP. The Controller of Examinations will arrange for the revaluation and the result will be intimated to the candidate through website.

Revaluation is not permitted for practical courses and for project work.

10.3 SCRIBE FOR EXAMINATION

Divyangjan students or students with temporary physical disability or injury due to

accident or illness can apply for a scribe (writer) with proof of disability as a medical certificate obtained from a Registered Medical Officer. The student shall be assigned a scribe by CoE to such student. The application for the scribe should be submitted in the CoE office well in advance or at least 2 days before the examination, to make necessary arrangements (Scriber, Separate Examination Hall etc.). The scribe assigned shall neither be a student nor a degree holder of any technical programme having similar competency.

Divyangjan students/ students with reading or writing disability, who can write at a slower speed as compared to a normal student would be allowed an extra time of 30 minutes to write the examination for each course. The proof of disability and application of extra time has to be submitted to the CoE office well in advance or 3 days before the start of the examination.

10.4 ACADEMIC MALPRACTICE

Academic malpractice would be strictly prohibited and any student who is found indulging in such activity would be penalized as per the recommendations of the Malpractice Committee constituted by the CoE with the approval of the Director Academic. The Committee would inquire and decide on the action based on the norms and policy listed in the Examination Manual.

10.5 SUPPLEMENTARY EXAMINATION

Supplementary examination will be conducted only for the final semester students within 10 days from the date of publication of revaluation results for students who have backlogs to complete the programme. Only such students shall apply with the prescribed fee to the Controller of Examinations within the stipulated time.

11.0 REQUIREMENTS FOR APPEARING FOR UNIVERSITY EXAMINATIONS

A student shall normally be permitted to appear for the University Examinations for all the courses registered in the current semester if he/she has satisfied the semester completion requirements. Further, examination registration by a student is mandatory for all the courses in the current semester and all arrear(s) course(s) for the University examinations failing which, the student will not be permitted to move to the higher semester. A student who has already appeared for any course in a semester and passed the examination is not entitled to reappear in the same

subject for improvement of grades.

12.0 PASSING REQUIREMENTS FOR COMPLETION OF A COURSE

- A candidate who secures not less than 50% of total marks prescribed for the courses (Continuous Assessment + End semester examination) with a minimum of 40% of the marks prescribed for the end-semester Examination in theory, theory with practical components (40% individually in theory and laboratory) and practical courses (including Project work), shall be declared to have passed in the Examination. However, if a student fails in any integrated theory and practical course, he/she should register and appear for the End semester examination in both theory and practical components of this course.

- If a student fails to secure a pass in a theory course / theory with laboratory/laboratory course (except electives), the student shall register and appear only for the end semester examination in the subsequent semester. In such case, the continuous assessment marks obtained by the candidate in the first appearance shall be retained and considered valid for all subsequent attempts till the candidate secure a pass. However, from the third attempt (current semester's end semester examination is considered as the first attempt) onwards if a candidate fails to obtain pass marks (IA + End Semester Examination), then the candidate shall be declared to have passed the examination if he/she secure a minimum of 50% marks prescribed for the university end semester examinations alone.

- If a student has submitted the project report but absent in the end semester examination of project work, the student is deemed to be failed. In this case and also if a student attends and fails in the End semester examination of Project work of B.E. / B.Tech, he/she shall attend end semester examination again within 60 days from the date of declaration of the results. The subsequent viva-voce examination will be considered as reappearance with payment of exam fee. In case, the student fails in the subsequent viva-voce examination also, the student shall redo the course again, when offered next.

- If a student is absent during the viva - voce examination, it would be considered as fail. If a student fails to secure a pass in Project Work-I, the student shall register for the course again in the subsequent semester and can-do Project Work-I and II together.
- The passing requirement for the courses which are assessed only through continuous assessment, shall be fixed as minimum 50%.

13.0 WITHDRAWAL FROM EXAMINATIONS

- A candidate may, for valid reasons, (medically unfit / unexpected family situations) be granted permission to withdraw from appearing for the examination in any course or courses in any one of the semester examination during the entire duration of the degree programme.
- Withdrawal application shall be valid only if the candidate is otherwise normally eligible (if he/she satisfies Attendance requirements and should not be involved in Disciplinary issues or Malpractice in Exams) to write the examination and if it is made within FIVE days before the commencement of the examination in that course or courses and also recommended by the Director Academic through HoD.
- Notwithstanding the requirement of mandatory FIVE days' notice, applications for withdrawal for special cases under extraordinary conditions will be considered based on the merit of the case.
- Withdrawal shall not be considered as an appearance for deciding the eligibility of a candidate for the purpose of Classification of Degree.
- Withdrawal is NOT permitted for arrears examinations of the previous semesters.

14.0 AUTHORIZED BREAK OF STUDY

- This shall be granted by the Institution, only once during the full duration of study, for valid reasons for a maximum of one year during the entire period of study of the degree programme.

- A candidate is normally not permitted to temporarily break the period of study. However, if a candidate would like to discontinue the programme temporarily in the middle of duration of study for valid reasons (such as accident or hospitalization due to prolonged ill health), he / she shall apply through the Director Academic in advance (Not later than the Reopening Day of that semester) through the Head of the Department stating the reasons. He /She should also mention clearly, the Joining date and Semester for Continuation of Studies after completion of break of Study. In such cases, he/she will attend classes along with the Junior Batches. A student who availed break of study has to rejoin only in the same semester from where he/she left.
- The total period for completion of the programme shall not exceed more than 10 consecutive semesters from the time of commencement of the course irrespective of the period of break of study in order that he / she may be eligible for the award of the degree.
- If any student is not allowed to appear for End Semester Examinations for not satisfying Academic requirements and Disciplinary reasons, (Except due to Lack of Attendance), the period spent in that semester shall NOT be considered as permitted 'Break of Study' and is NOT applicable for Authorized Break of Study.
- In extraordinary situations, a candidate may apply for additional break of study not exceeding another one Semester by paying prescribed fee for break of study. Such extended break of study shall be counted for the purpose of classification of First Class Degree.
- If the candidate has not reported back to the department, even after the extended Break of Study, the name of the candidate shall be deleted permanently from the institution enrolment. Such candidates are not entitled to seek readmission under any circumstances.
- This shall be granted by the Institution, only once during the full duration of study, for valid reasons for a maximum of one year during the entire period of study of the degree programme.

15.0 PURSUING COURSES IN OTHER INDIAN INSTITUTIONS AND ABROAD

- A student can be selected, to get Professional Exposure in his/her area of Expertise in any Reputed Research Organization or Educational Institution of repute or any Universities in India and abroad.
- This is possible only with the List of Research Organizations, Educational Institutions in India and abroad approved by the Academic Council.
- The student can have the option of spending not more than three to Six months in the Final year or Pre - final year of his/her Degree. During this period, the student can do his/her Project work or register for courses which will be approved by the Class Committee and Director Academic, under the Guidance of a Project Supervisor who is employed in the Organization and Co-guided by a staff member from our Institution.
- Credit Transfer can be done by the CoE on submission of certificate through the HoD and Director Academic within 15 days of completion.
- The students who undergo training outside the Institution (either in India or Abroad) is expected to abide by all Rules and Regulations to be followed as per Indian and the respective Country Laws, and also should take care of Financial, Travel and Accommodation expenses.

16.0 AWARD OF LETTER GRADES

All assessments of a course will be done on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the candidate in each course as detailed below:

RANGE OF MARKS FOR GRADES

Range of Marks	Letter Grade	Grade Point
90 -100	O	10
80 – 89	A+	9
70 – 79	A	8
60 – 69	B+	7
50 – 59	B	6
00-49 (Reappear)	F	0

ABSENT	AAA	0
Withdrawal	W	0
Authorised Break of Study	ABS	0

16.1 CUMULATIVE GRADE POINT AVERAGE CALCULATION

The CGPA calculation on a 10 Point scale is used to describe the overall performance of a student in all courses from first semester to the last semester. RA, AAA and W grades will be excluded for calculating GPA and CGPA.

$$\text{GPA} = \frac{\sum_{i=1}^N C_i \text{GP}_i}{\sum_i C_i} \qquad \text{CGPA} = \frac{\sum_{i=1}^N C_i \text{GP}_i}{\sum_i C_i}$$

Where

C_i – Credits for the course

GP_i – Grade Point for the course

i – Sum of all courses successfully cleared during all the semesters

n - Number of all courses successfully cleared during the particular semester in the case of GPA and during all the semesters in the case of CGPA

16.2 GRADE SHEET

After revaluation results are declared in each semester, Grade Sheets will be issued to each student. At the end of programme a consolidated grade sheet also will be issued to each student. The grade sheet and consolidated grade sheet will contain the following details:

- The programme and degree in which the candidate has studied
- The list of courses enrolled during the semester and the grade secured
- The Grade Point Average (GPA) for the semester.

16.3 CLASSIFICATION OF DEGREE AWARDED

Final Degree is awarded based on the following

Range of CGPA	Classification of Degree
≥ 7.50	First Class with Distinction
≥ 6.00 <7.50	First Class
≥ 5.00 < 6.0	Second Class

Minimum requirements for award of Degree: A student should have obtained a minimum of 5.0 CGPA.

- A candidate who qualifies for the award of the Degree having passed the examination in all the courses of all the 8 semesters in his/her first appearance within a maximum of 10 consecutive semesters securing a overall CGPA of not less than 7.5 (Calculated from 1st semester) shall be declared to have passed the examination in **First Class with Distinction**. Authorized Break of Study vide Clause 14, will be considered as an Appearance for Examinations, for award of First Class with Distinction. Withdrawal shall not be considered as an appearance for deciding the eligibility of a candidate for First Class with Distinction
- A candidate who qualifies for the award of the Degree having passed the examination in all the courses of all the 8 semesters within a maximum period of 10 consecutive semesters after his/her commencement of study securing a overall CGPA of not less than 6.0 (Calculated from 1st semester), shall be declared to have passed the examination in **First Class**. Authorized break of study vides Clause 14 (if availed of) or prevention from writing End semester examination due to lack of attendance will not be considered as Appearance in Examinations. For award of First class, the extra number of semesters than can be provided (in addition to four years for Normal UG programme) will be equal to the Number of semesters availed for Authorized Break of Study or Lack of Attendance. Withdrawal shall not be considered as an appearance for deciding the eligibility of a candidate for First Class.
- All other candidates who qualify for the award of the Degree having passed the examination in all the courses of all the 8 semesters within a maximum period of 10 consecutive semesters after his/her commencement of study securing a overall CGPA of not less than 5.0, (Calculated from 1st semester) shall be declared to have passed the examination in **Second Class**.

- A candidate who is absent in semester examination in a course/project work after having registered for the same, shall be considered to have appeared in that examination for the purpose of classification.

17.0 ELIGIBILITY FOR THE AWARD OF DEGREE

A student shall be declared to be eligible for the award of the Certificate / Diploma / UG Degree / UG Honours degree, provided the student has successfully completed all the requirements of the programme, and has passed all the prescribed examinations in all the I/II/III/IV year respectively within the maximum period specified in clause 2.7.

- i) Successfully gained the required number of total credits as specified in the curriculum corresponding to his/her programme within the stipulated time.
- ii) Successfully completed the programme requirements and has passed all the courses prescribed in all the semesters within a maximum period of 5 years reckoned from the commencement of the first semester to which the candidate was admit
- iii) Successfully completed any additional courses prescribed by the Institution.
- iv) has earned a CGPA of not less than 5
- v) has no dues to the Institution, Library, Hostels, etc.,
- vi) has no disciplinary action pending against him / her.

18.0 RANKING

- A candidate who qualifies for the UG degree programme passing all the examinations in the first attempt, within the minimum period prescribed for the programme of study from semester I through semester VIII to the programme shall be eligible for ranking. Such ranking will be confirmed to 10 percent of the total number of candidates qualified in that particular programme of study subject to a maximum of 10 ranks.

19.0 DISCIPLINE

- Every student is required to observe disciplined and decorous behavior both inside and outside the Institution and not to indulge in any activity which will tend to bring down the prestige of the Institution. If a student indulges in malpractice in any of the end semester theory / practical examination, continuous assessment examinations he/she shall will be liable for disciplinary action as prescribed by the Institution from time to time.

20.0 STUDENT APPRAISAL

- It is mandatory for every student to submit the feedback on each and every course, he/she has undergone, at the end of every semester.

21.0 DECLARATION OF RESULTS

- The End Semester Examination results will be declared in institution website and the same is shared with the Head of the Department. In general, the results will be declared within 15 days from the date of last examination.

22.0 ACADEMIC BANK OF CREDITS (ABC)

- All the students who admitted in any one of the above programmes are mandatory to register in the Academic Bank of Credits (ABC) portal provided by the Ministry of Education (MoE), Government of India.

23.0 REVISION OF REGULATIONS / POWER TO MODIFY

- St. Peter's Institute of Higher Education and Research (Deemed to be University) may, time to time revise, amend or change the regulations, scheme of examinations and syllabi if found necessary.

Notwithstanding all that has been stated above, the Academic Council is vested with powers to modify any or all of the above regulations from time to time, if required, subject to the approval by the Executive Council.

Director Academic

Registrar



St. PETER'S INSTITUTE OF HIGHER EDUCATION AND RESEARCH

(Deemed to be University U/S 3 of the UGC Act, 1956)

AVADI, Chennai – 600 054. Tamil Nadu.

Phone: 044-26558080-84

E-mail: registrar@spiher.ac.in

Website: www.spiher.ac.in

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Vision

To achieve technical excellence in Computer Science and Engineering education, imbued with moral values that will enable the students to meet the societal needs scientifically and ethically.

Mission

- To impart quality education in the domain of Computer Science and Engineering at the Undergraduate and Postgraduate levels.
- To foster Entrepreneurship and innovative skills integrated with moral values among the students to make them successful engineers.
- To encourage quality Research and Development activities that would benefit society.

Program Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7)

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community at large, such as being able to comprehend and write effective reports and design documentation, make presentations considering cultural, language, and learning differences.

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broad technological change. (WK8)

Program Educational Objectives (PEOs)

PEO1: Apply theoretical and practical knowledge to analyze complex real-world industry problems and offer innovative technical solutions.

PEO2: Embrace and adapt to emerging technologies and industry trends to remain effective and relevant in the professional world.

PEO3: Communicate effectively and perform responsibilities efficiently as an individual, a team member, or an entrepreneur in diverse professional settings.

PEO4: Pursue continuous learning and research to build a successful career, and actively contribute through teaching, mentoring, and knowledge sharing.

PEO5: Evaluate the societal and environmental impact of technical solutions to promote sustainable development and contribute to the nation's economic growth.(WK1 to WK4)

Program Specific Outcomes (PSOs)

PSO1: Apply theoretical and practical knowledge gained in the emerging areas of computing to develop innovative and effective solutions.

PSO2: Uphold ethical values while contributing effectively in professional settings and promote social well-being.

Contribution

1:Reasonable

2:Significant

3:Strong

St. Peter's Institute of Higher Education and Research
Department of Computer Science and Engineering
Curriculum and Syllabi 2023

Semester I								
S.no	Course Code	Course type	Category	Course Name	L	T	P	C
1	BMA121	Theory	BSC	Algebra and Calculus	3	2	0	4
2	BPH121	Theory + Lab	BSC	Engineering Physics	3	0	2	4
3	BCY121	Theory+Lab	BSC	Engineering Chemistry	3	0	2	4
4	BEN121	Theory+Lab	HSC	English for Engineers	3	0	2	4
5	BME121	Theory	ESC	Engineering Graphics	2	2	0	3
6	BCS121	Theory	PCC	Fundamentals of Computing and Python Programming	3	0	0	3
7	BCS107	Practical	PCC	Python Programming Laboratory	0	0	4	2
Total Credits					17	4	10	24

Semester II								
S.No.	Course Code	Course type	Category	Course Name	L	T	P	C
1	BMA131	Theory	BSC	Partial Differential Equations and Transforms	3	2	0	4
2	BEE131	Theory	ESC	Basic Electrical and Instrumentation Engineering	3	0	0	3
3	BBO131	Theory	BSC	Environmental Science	2	0	0	2
4	BCS111	Theory+Lab	PCC	Programming in C and C++	3	0	2	4
5	BCS112	Theory+Lab	PCC	Data Structures	3	0	2	4
6	BEC131	Theory+Lab	ESC	Digital Principles and Microprocessors	2	0	2	3
7	BME117	Practical	ESC	Engineering Practices	0	0	4	2
8	BEO131	Theory	MAC	Indian Constitution and Human Values	1	0	0	0
9		Theory	VAC	Value added Course-1	1	0	2	0
Total Credits					18	2	12	22

Semester III								
S.No.	Course Code	Course type	Category	Course Name	L	T	P	C
1	BMG246	Theory + Project	HSC	Humanities Elective 1	2	0	2	3
2	BMA245	Theory	BSC	Mathematics Elective	3	2	0	4
3	BCS201	Theory + Lab	PCC	Operating Systems	3	0	2	4
4	BCS202	Theory	PCC	Computer Architecture	3	0	0	3
5	BCS203	Theory	PCC	Database Management Systems	3	0	0	3
6	BEC221	Theory	ESC	Embedded Systems and IoT	3	0	0	3
7	BEN221	Skill	EEC	Essential skills and Aptitude for Engineers	0	0	2	1
8	BCS207	Practical	PCC	Database Management Systems Laboratory	0	0	4	2
Total Credits					17	2	10	23

Semester IV								
S.No.	Course Code	Course type	Category	Course Name	L	T	P	C
1	BCS211	Theory	PCC	Artificial Intelligence	3	0	0	3
2	BCS212	Theory	PCC	Computer Networks	3	0	0	3
3	BCS213	Theory	PCC	Fundamentals of Data Science	3	0	0	3
4	BCS214	Theory + Lab	PCC	Design and Analysis of Algorithms	3	0	2	4
5	BEE231	Theory	ESC	Robotics and Industry 4.0	3	0	0	3
6	BCS217	Practical	PCC	Computer Networks Laboratory	0	0	4	2
7	BCS218	Practical	PCC	Artificial Intelligence and Data Science Laboratory	0	0	4	2
8	BEN231	Skill	EEC	Communication Skills for Career Success	0	0	2	1
9	IKS101	Theory	MAC	Indian Knowledge System	2	0	0	2
10		Theory	VAC	Value added Course-2	1	0	2	0
Total Credits					18	0	14	23
<p>Summer Internships (4-6 weeks) are mandatory during the summer vacation in between semesters IV and V for each student to continue the program and the corresponding valuation will take place in the next semester (semester V).</p>								

Semester V								
S.No.	Course Code	Course type	Category	Course Name	L	T	P	C
1	BCS301	Theory + Project	PCC	Object Oriented Software Engineering	2	0	4	4
2	BCS302	Theory + Lab	PCC	Automata Theory and Compiler Design	3	0	2	4
3	BCS303	Theory + Lab	PCC	Computer Graphics and Multimedia	3	0	2	4
4		Theory	PEC	Professional Elective 1	3	0	0	3
5		Theory	PEC	Professional Elective 2	3	0	0	3
6		Theory	OEC	Open Elective 1	3	0	0	3
7	BCS309	Skill	EEC	Internship 1	0	0	0	1
8	BEN321	Skill	EEC	Leadership skills and Personality Development	0	0	2	1
Total Credits					17	0	10	23

Semester VI								
S.No.	Course Code	Course type	Category	Course Name	L	T	P	C
1	BCS311	Theory + Lab	PCC	Internet Programming	3	0	2	4
2	BCS312	Theory	PCC	Mobile Application Development	3	0	0	3
3		Theory	PEC	Professional Elective-3	3	0	0	3
4		Theory	PEC	Professional Elective-4	3	0	0	3
5		Theory	OEC	Open Elective 2	3	0	0	3
6	BCS317	Practical	PCC	Mobile Application Development Laboratory	0	0	4	2
7		Theory		Value Added Course -3				0
8	BCS318	Practical		Competitive Coding			2	1
9	BCS310	Project		Design Thinking and Innovations			4	2
Total Credits					15	0	12	21

Semester VII								
S.No.	Course Code	Course type	Category	Course Name	L	T	P	C
1	BCS401	Theory + Lab	PCC	Cryptography and Cyber Security	3	0	2	4
3		Theory	PEC	Professional Elective 5	3	0	0	3
3		Theory	HSC	Humanities Elective 2	2	0	0	2
4	BCS409	Skill	EEC	Internship-2	0	0	0	1
5	BCS410	Project	EEC	Project Work (Phase-I)	0	0	12	6
6		Theory	VAC	Value Added Course-4	1	0	2	0
7	BMCX01	Skill	EEC	NCC/YRC/NSS/Rotary Club	0	0	2	1
Total Credits					9	0	18	17

Semester VIII								
S.No.	Course Code	Course type	Category	Course Name	L	T	P	C
1	BCS420	Project	EEC	Project Work (Phase-II)	0	0	24	12
2		Theory	OEC	MOOC course*	3	0	0	3
Total Credits					3	0	24	15

TOTAL CREDITS: 168

PROGRAM ELECTIVE COURSES (PE)

PROGRAM ELECTIVE				
S.No	COURSE CODE	COURSE TITLE	PREREQUISITE COURSE	CREDITS
PROGRAM ELECTIVE-I				
1	BCS341	Soft Computing	Nil	3
2	BCS342	Social Network Security	BCS401	3
3	BCS343	Grid and Cloud Computing	Nil	3
4	BCS344	Multimedia and Animation	BCS303	3
5	BCS345	Data Visualization Techniques	Nil	3
6	BCS346	Application Development	Nil	3
PROGRAM ELECTIVE-II				
8	BCS348	Machine Learning for Real World Applications	Nil	3
9	BCS349	Digital Forensics	Nil	3
10	BCS350	Software Defined Networks	Nil	3
11	BCS351	Augmented Reality and Virtual Reality	BCS303	3
12	BCS352	Recommender Systems	Nil	3
13	BCS353	Agile Development and Scrum	Nil	3
14	BCS354	Nano Science and Technology	NIL	3
PROGRAM ELECTIVE-III				
15	BCS355	Deep Learning	BCS211	3
16	BCS356	Ethical Hacking	Nil	3
17	BCS357	Storage Technologies	Nil	3
18	BCS358	Video and Audio Editing	Nil	3
19	BCS359	Social Network Analysis	Nil	3
20	BCS360	Automation and Testing	Nil	3
21	BCS361	Robotics	Nil	3
PROGRAM ELECTIVE-IV				
22	BCS362	Natural Language Processing	Nil	3
23	BCS363	Intellectual Property Rights	Nil	3
24	BCS364	Security and Privacy in Cloud	Nil	3
25	BCS365	UI and UX Design	Nil	3
26	BCS366	Business Analytics	Nil	3

27	BCS367	Quantum Computing	Nil	3
PROGRAM ELECTIVE-V				
28	BCS441	Cognitive Science	Nil	3
29	BCS442	Cryptocurrency and Blockchain Technologies	Nil	3
30	BCS443	Data Mining and Warehousing	Nil	3
31	BCS444	Game Development	Nil	3
32	BCS445	Big Data Analytics	Nil	3
33	BCS446	Full Stack Web Development using GenAI	Nil	3
34	BCS447	Digital Marketing	Nil	3

HUMANITIES ELECTIVE – I

Sl.no	Cate gory	Course Code	Course Title	Periods per week			Credits
				L	T	P	
1.	HS	BMG241	Engineering Economics and Management	2	0	2	3
2.	HS	BMG242	Sociology of Science and Technology	2	0	2	3
3.	HS	BMG243	Industrial Economics and Management	2	0	2	3
4.	HS	BMG244	Dynamics of Indian Social Structure	2	0	2	3
5	HS	BMG245	Management for Engineers	2	0	2	3
6	HS	BMG246	Human Values and Ethics	2	0	2	3

HUMANITIES ELECTIVE – II

Sl.no	Cate gory	Course Code	Course Title	Periods per week			Credits
				L	T	P	
1.	HS	BMG441	Economics of Sustainable Development	2	0	0	2
2.	HS	BMG442	Sociology of Industrial Relations.	2	0	0	2
3.	HS	BMG443	Professional Ethics and Human Values	2	0	0	2
4.	HS	BMG444	Gender, Technology and Development	2	0	0	2
5	HS	BMG445	Professional Ethics for Engineers	2	0	0	2

OPEN ELECTIVES

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1.		Satellite Communication and Satellite Technology	3	0	0	3
2.		Drone Design and Technology	3	0	0	3
3.		Space Vehicle Design and Simulation	3	0	0	3
4.		Information Technology Law	3	0	0	3
5.		Intellectual Property Law	3	0	0	3
6.		International Human Rights	3	0	0	3
7.		Penology and Victimology	3	0	0	3
8.		Land Laws Including Tenure and Tenancy System	3	0	0	3
9.		Telehealth Technology	3	0	0	3
10.		Embedded systems for Biomedical Applications	3	0	0	3
11.		Human factors in Engineering and Design	3	0	0	3
12.		Biometric System	3	0	0	3
13.		Forensic Science	3	0	0	3
14.		Biology for Engineers	3	0	0	3
15.		Entrepreneurship in Biotechnology	3	0	0	3
16.		Organic Agriculture	3	0	0	3
17.		Ornamental Aquaculture	3	0	0	3
18.		Energy Engineering	3	0	0	3
19.		Industrial Pollution Prevention and Cleaner Production	3	0	0	3
20.		Air Pollution and Control Engineering	3	0	0	3
21.		Industrial Wastewater Treatment	3	0	0	3
22.		Process Safety Management	3	0	0	3
23.		Sustainable Engineering	3	0	0	3
24.		Corrosion Engineering	3	0	0	3
25.		Disaster Management	3	0	0	3
26.		Public Health Engineering	3	0	0	3
27.		5G Networks	3	0	0	3
28.	BCS343	Grid and Cloud Computing	3	0	0	3

29.	BCS348	Machine Learning for Real World Applications	3	0	0	3
30.	BCS368	Fundamentals of DevOps	3	0	0	3
31.	BCS356	Ethical Hacking	3	0	0	3
32.	BCS445	Big Data Analytics	3	0	0	3
33.	BCS312	Mobile Application Development	3	0	0	3

SEMESTER I

BMA121	ALGEBRA AND CALCULUS	L	T	P	C	TOTAL MARKS
		3	2	0	4	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Develop the uses of matrix algebra techniques that is needed by engineers for practical applications.					
2	Familiarize the students with theory of equations.					
3	Familiarize the students with differential calculus.					
4	Familiarize the student with functions of several variables. This is required in many branches of engineering.					
5	Acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.					
UNIT 1: MATRICES						9+3
Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigen vectors – Cayley - Hamilton theorem– Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.						
UNIT 2: THEORY OF EQUATIONS						9+3
Polynomial equations with real coefficients, irrational roots, complex roots, symmetric functions of roots, transformation of equation by increasing or decreasing roots by a constant, reciprocal equation. Newton’s method to find a root approximately – simple problems.						
UNIT 3: DIFFERENTIAL CALCULUS						9+3
Representation of functions-Limit of a function-Continuity-Derivatives-Differentiation rules (sum, product, quotient, chain rules)- Implicit differentiation -Logarithmic differentiation - Applications: Maxima and Minima of functions of one variable.						
UNIT 4: FUNCTIONS OF SEVERAL VARIABLES						9+3
Partial differentiation–Homogeneous functions and Euler’s theorem–Total derivative–Change of variables–Jacobians–Partial differentiation of implicit functions – Taylor’s series for functions of two variables – Applications: Maxima and minima of functions of two variables and Lagrange’s method of undetermined multipliers.						
UNIT 5: MULTIPLE INTEGRALS						9+3
Double integrals–Change of order of integration–Double integrals in polar co-ordinates - Area enclosed by plane curves – Triple integrals – Volume of solids –Change of variables in double and triple integrals – Applications: Moments and centres of mass, moment of inertia.						
						60 PERIODS
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	Use the matrix algebra methods for solving practical problems.					
CO2:	Apply the concept of theory of equations in solving various application problems.					
CO3:	Able to use differential calculus ideas on several variable functions.					
CO4:	Apply the concept of several variable functions in calculus.					
CO5:	Apply multiple integral ideas in solving areas, volumes and other practical problems.					
						TOTAL:60 PERIODS
TEXT BOOKS & REFERENCES						
1.	Kreyszig. E, "Advanced Engineering Mathematics", John Wiley and Sons, 10 th Edition, New Delhi, 2016.					
2.	Grewal. B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 44 th Edition, 2018.					

3.	Bali.N.,Goyal.M.and Watkins.C., “Advanced Engineering Mathematics”, Firewall Media(An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi,7 th Edition, 2009.
4.	Jain.R.K. and Iyengar. S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5 th Edition, 2016.
5.	Narayanan. S. and Manicavachagom Pillai. T.K., “Calculus” Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	2	2	2	1	2	1	3	2	1	2	3	2	1	2
CO2:	2	2	2	2	2	3	3	2	3	2	2	2	2	2
CO3:	2	2	3	2	2	2	2	1	3	3	2	3	1	2
CO4:	3	2	2	2	2	3	3	2	2	3	2	2	3	3
CO5:	3	2	2	3	3	1	1	2	2	1	3	1	3	3
AVG	2.4	2.0	2.2	2.0	2.2	2.0	2.4	1.8	2.2	2.2	2.4	2.0	2.0	2.4

1 - low, 2 - medium, 3 – high

BPH121	ENGINEERING PHYSICS	L	T	P	C	TOTAL MARKS
		3	0	2	4	100
PREREQUISITES: NONE						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Gain knowledge on the basics of mechanics and properties of matter and its applications					
2	Acquire knowledge on the concepts of waves and optical devices and their applications in fiber optics					
3	Understand the basics of electrical properties of materials and the classification of materials based on band theory.					
4	Have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion of joints and heat exchangers					
5	Get an insight on advanced physics concepts of quantum theory and its applications in tunnelling microscopes					
UNIT 1:	MECHANICS & PROPERTIES OF MATTER					9
Forces in Nature; Newton's laws and its completeness in describing particle motion; Form invariance of Newton's Second Law; Solving Newton's equations of motion in polar coordinates; Equation of motion in central force, Planetary motion and Kepler's Law, Elasticity – Stress-strain diagram and its uses – twisting couple - torsion pendulum: theory and experiment						
UNIT 2:	WAVES AND FIBER OPTICS					9
Oscillatory motion – forced and damped oscillations Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance. Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Solid state ,Gas laser, Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – Application in Communication						
UNIT 3:	ELECTRICAL PROPERTIES OF MATERIALS					9
Classical free electron theory-Expression for Electrical conductivity-thermal conductivity- expression- Wiedmann Franz law- success and failure-electrons in metals-Particle in three dimensional box- degenerate state- Fermi Dirac Statistics-Density of Energy states-Electron in periodic potential-Bloch Theorem- Metals and Insulators-Energy bands in solids-Effective mass of electron- Concept of holes						
UNIT 4:	THERMAL PHYSICS					9
Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity - Forbe's and Lee's disc method: theory and experiment – conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.						
UNIT 5:	QUANTUM PHYSICS					9
Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunnelling (qualitative) - scanning tunneling microscope.						
						45 PERIODS
PRACTICAL EXERCISES:						15 PERIODS
1.	Torsional Pendulum-Determination of Moment of Inertia and Rigidity Modulus with equal masses					
2.	(a) Determination of wavelength, and particle size using Laser (b) Determination of acceptance angle in an optical fiber					
3.	Determination of Young's modulus by non-uniform bending method					
4.	Determination of thermal conductivity of a bad conductor – Lee's Disc method					

5.	Ultrasonic Interferometer-Determination of Velocity of Ultrasonic waves and Compressibility of the given liquid
6.	Determination of band gap of a semiconductor
7.	LC circuit and LCR circuit
COURSE OUTCOMES:	
Upon successful completion of the course, students will be able to:	
CO1:	The students will gain knowledge on the basics of mechanics and properties of matter and its applications,
CO2:	The students will acquire knowledge on the concepts of waves and optical devices and their applications in fiber optics
CO3:	The students will understand the basics of electrical properties of materials and the classification of materials based on band theory
CO4:	The students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion of joints and heat exchangers
CO5:	The students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes
60 PERIODS	
TEXT BOOKS	
1.	Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2.	Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 12.
3.	Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.
4.	Brij Lal and Subramaniam, S, "Properties of Matter", Chand & Co., New Delhi (1994).
REFERENCES	
1.	Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2.	Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3.	Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics". W.H.Freeman, 2007.

BCY121	ENGINEERING CHEMISTRY	L	T	P	C	TOTAL MARKS
		3	0	2	4	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	To inculcate sound understanding of water quality parameters and water treatment techniques.					
2	To impart knowledge on the basic principles and preparatory methods of nano-materials.					
3	To introduce the basic concepts and applications of phase rule and composites.					
4	To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.					
5	To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.					
UNIT 1:	WATER AND ITS TREATMENT					9
Water: Sources and impurities, Water quality parameters: Definition and significance of-color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. Domestic water treatment: Steps involved -primary treatment and disinfection (UV, Ozonation, breakpoint chlorination). Desalination of brackish water: Electro dialysis- Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming and foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralization process and zeolite process.						
UNIT 2:	NANOCHEMISTRY					9
Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube-Single walled and Multiwalled Nanotubes-Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.						
UNIT 3:	PHASE RULE AND COMPOSITES					9
Phase rule: Introduction, definition of terms with examples. One component system – water system; Reduced phase rule; Construction of a simple eutectic phase diagram – Thermal analysis; Two component system: lead-silver system – Pattinson process. Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of Metal matrix composites (MMC), Ceramic matrix composites (CMC) and Polymer matrix composites (PMC). Hybrid composites –definition and examples.						
UNIT 4:	FUELS AND COMBUSTION					9
Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Fractional distillation of Petroleum- Manufacture of synthetic petrol (Fischer – Tropsch and Bergius process), Knocking – octane number, diesel oil – cetane number; Power alcohol and biodiesel. Combustion of fuels: Introduction: Calorific value higher and lower calorific values, Theoretical calculation of calorific value; ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis –ORSAT Method. CO ₂ emission and carbon foot print.						
UNIT 5:	ENERGY SOURCES AND STORAGE DEVICES					9
Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery – dry cell, Secondary battery – NICAD battery, lead acid battery and lithium-ion battery; Electric vehicles – working principles; Fuel cells: H ₂ -O ₂ fuel cell, microbial fuel cell; Super capacitors: Storage principle, types and examples.						

45 PERIODS	
PRACTICAL EXERCISES:	
15 PERIODS	
1.	Determination of hardness of water by EDTA method.
2.	Determination of chloride content of water sample by argento metric method.
3.	Determination of alkali content of water sample.
4.	Determination of strength of given hydrochloric acid using pH meter.
5.	Determination of strength of acids in a mixture using conductivity meter.
6.	Conductometric titration of strong acid Vs strong base.
7.	Estimation of copper by EDTA method.
8.	Estimation of iron content by Potentiometry.
9.	Determination of molecular weight of polymer using Ostwald viscometer.
10.	Adsorption of acetic acid by charcoal.
60 PERIODS	
COURSE OUTCOMES:	
Upon successful completion of the course, students will be able to:	
CO1:	Understand the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
CO2:	Identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
CO3:	Apply the knowledge of phase rule and composites for material selection requirements
CO4:	Understand the suitable fuels for engineering processes and applications
CO5:	Acquire knowledge on different forms of energy resources and apply them for suitable applications in energy sectors.
REFERENCE BOOKS	
1.	P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2.	Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3.	S.S. Dara, "A Text book of Engineering Chemistry", S. Chand Publishing, 12 th Edition, 2018.
4.	Dr. Sayeeda Sultana," Engineering Chemistry", R.K.Publishers, Coimbatore, 2016.
5.	B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, " Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
6.	Dr. Sayeeda Sultana," Practical Engineering Chemistry laboratory manual", R.K.Publishers, Coimbatore, 2016.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	2	2	1	-	-	-	-	-	-	-	-	2	3	3
CO2:	2	2	1	-	-	-	-	-	-	-	-	2	3	3
CO3:	2	2	1	-	-	-	-	-	-	-	-	2	2	3
CO4:	2	2	1	-	-	-	-	-	-	-	-	2	3	3
CO5:	2	2	1	-	-	-	-	-	-	-	-	2	3	3
AVG	2.0	2.0	1.0									2.0	2.8	3.0

1 - low, 2 - medium, 3 - high

BEN121	ENGLISH FOR ENGINEERS	L	T	P	C	TOTAL MARKS
		3	0	2	4	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Improve the communicative competence of learners.					
2	Help learners use language effectively in academic/work contexts.					
3	Build on students 'English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.					
4	Develop analytical thinking skills for problem solving in communicative contexts.					
5	Equip them with writing skills needed for academic as well as work place contexts.					
UNIT 1:						9
<p>Listening–for general information-specific details-conversation: Introduction to classmates. Speaking - Self Introduction; Introducing a friend; Conversation - politeness strategies; Telephone conversation. Reading - Reading brochures (technical context). Writing-Writing emails/letters introducing oneself, Paragraph Writing. Grammar – Parts of Speech, Sentence kinds. Wh-Questions forms and Tags. Vocabulary-Synonyms; One word substitution; Abbreviations &Acronyms (as used in technical Contexts).</p>						
UNIT 2:						9
<p>Listening- Listening to podcast, anecdotes/stories/event narration; documentaries and Interviews. Speaking- Narrating personal experiences/events; Interviewing a celebrity; Reporting and summarizing of documentaries/podcasts/interviews. Reading- Reading biographies, travelogues, news paper reports, Excerpts from literature, travel and technical blogs. Writing – Report Writing - Short Report on an event. Grammar- Transformation of Sentences - Active & Passive Voice, The Impersonal Passive, Subject-Verb Agreement; Infinitive and Gerunds Vocabulary– Antonyms, Word Formation (prefixes & suffixes).</p>						
UNIT 3:						9
<p>Listening- Listen to a classroom lecture. Speaking–Picture description; Giving instruction to use the product; Presenting a product and Summarizing a lecture. Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; Instructions and Product/ Process description. Grammar- Sentence Structures, Tenses. Vocabulary -Compound Words, Homonyms; and Homophones.</p>						
UNIT 4:						9
<p>Listening – Listening to TED Talks; Scientific lectures and educational videos. Speaking – Small Talk; Mini presentations and making recommendations. Reading–News paper articles; Journal reports–and Non Verbal Communication (tables, pie charts etc.) Writing–Writing recommendations; Transferring information from non verbal (chart, graph etc, to verbal mode), Checklists Grammar–Error correction; If conditional sentences. Vocabulary- Discourse markers, Connectives and Sequence words.</p>						
UNIT 5:						9
<p>Listening–Listening to debates/discussions; different view points on an issue; and panel discussions. Speaking–Group discussions, Debates, and Expressing opinions through Simulations &Role play. Reading – Reading Editorials and Opinion Blogs.</p>						

Writing – Note-making/ Note-taking; Job/Internship application–Cover letter& Resume.	
Grammar –Numerical adjectives, Punctuation.	
Vocabulary - Cause & Effect Expressions	
45 PERIODS	
PRACTICAL EXERCISES: 15 PERIODS	
1.	Group Discussion: Practical based on Accurate and Current Grammatical Patterns.
2.	Conversational Skills for Interviews under suitable Professional Communication Lab conditions with emphasis on Kinesics.
3.	Communication Skills for Seminars/Conferences/Workshops with emphasis on Paralinguistics / Kinesics. Presentation Skills for Technical Paper/Project Reports/ Professional Reports based on proper Stress and Intonation Mechanics.
4.	Official/Public Speaking based on suitable Rhythmic Patterns.
5.	Argumentative Skills/Role Play Presentation with Stress and Intonation.
6.	Comprehension Skills based on Reading and Listening Practical's on a model Audiovisual Usage
60 PERIODS	
COURSE OUTCOMES:	
Upon successful completion of the course, students will be able to:	
CO1:	Listen and comprehend complex academic texts.
CO2:	Read and infer the denotative and connotative meanings of technical texts.
CO3:	Write definitions, descriptions narrations and essays on various topics.
CO4:	Speak fluently and accurately and informal communicative contexts.
CO5:	Express their opinions effectively in both oral and written medium of communication.
TEXT BOOKS	
1.	English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University,(2020 edition).
2.	English for Science & Technology Cambridge University Press, 2021. Authored by Dr.Veena Selvam, Dr.Sujatha Priyadarshini, Dr.Deepa Mary Francis, Dr.K N.Shoba, and Dr.Lourdes Joevani, Department of English, Anna University.
REFERENCES	
1.	Technical Communication–Principles And Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ.Press,2016,NewDelhi.
2.	Dr.S.Uma Maheswari. “English Workbook for Engineers and Technologists”, Eleventh Edition, Uma Publications, July 2014.
3.	A Course Book on Technical English by Lakshmi narayanan, Scitech Publications (India) Pvt. Ltd.
4.	English for Technical Communication (With CD) by Aysha Viswamohan, Mcgraw Hill Education, ISBN: 0070264244.
5.	Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.
6.	Learning to Communicate– Dr.V.Chellammal, Allied Publishing House, New Delhi, 2003.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	2	2	2	0	2	0	0	0	0	3	3	3	3
CO2:	0	0	0	0	0	0	0	0	0	0	2	1	2	3
CO3:	0	3	3	2	0	2	0	0	0	0	2	2	3	3
CO4:	0	0	1	0	0	0	0	0	0	0	3	2	3	3
CO5:	0	3	3	3	0	0	0	0	0	0	2	2	2	3
AVG	0.6	1.6	1.8	1.4	0	0.8	0	0	0	0	2.4	2.0	2.6	3

1 - low, 2 - medium, 3 - hig

BME121	ENGINEERING GRAPHICS	L	T	P	C	TOTAL MARKS
		2	2	0	3	100
PREREQUISITES: School Mathematics						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Communicate the concepts, ideas and design of Engineering products through graphic skills.					
2	Acquaint the national standards related to technical drawings.					
3	Comprehend Orthographic, Isometric and perspective projection to represent the objects in two and three-dimensions.					
UNIT 1:	PLANE CURVES AND FREE HAND SKETCHING					6+3
Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves, Scales: Construction of Diagonal and Vernier scales. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects.						
UNIT 2:	PROJECTION OF POINTS, LINES AND PLANE SURFACES					6+3
Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.						
UNIT 3:	PROJECTION OF SOLIDS					6+3
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method.						
UNIT 4:	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES					6+3
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes.						
UNIT 5:	ISOMETRIC AND PERSPECTIVE PROJECTIONS					6+3
Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method. COMPUTER AIDED DRAFTING (Demonstration Only) Introduction to drafting packages and demonstration of their use.						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Understand the specifications and standards of technical drawing and draw free hand sketching of basic geometrical shapes and objects.					
CO2:	Apprehend and draw the Orthographic Projection of Points, Lines and Planes.					
CO3:	Develop the Orthographic views of Simple Solids.					
CO4:	Draw and interpret the Sections of Solids and Development of Solid surfaces.					
CO5:	Perceive and draw the Isometric and Perspective projection of simple solids and components.					
TEXT BOOKS						
1.	Parthasarathy,N.S.and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015.					
2.	Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53rd Edition,2014.					
3.	Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore,(2017).					

REFERENCES

1.	Venugopal K. and Prabhu Raja V., “Engineering graphics”, New Age International (P) Limited,(2008).
2.	Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai,(2012).

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	2	3	1	2	1	1	1	1	2	2	2	2	2
CO2:	3	2	2	1	2	1	1	1	1	2	2	2	2	2
CO3:	3	2	2	1	2	1	1	1	1	2	2	2	2	2
CO4:	3	2	2	1	2	1	1	1	1	2	2	2	2	2
CO5:	3	2	2	1	2	1	1	1	1	2	2	2	2	2
AVG	3.0	2.0	2.0	1.0	2.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0

1 - low, 2 - medium, 3 - high

BCS121	FUNDAMENTALS OF COMPUTING AND PYTHON PROGRAMMING	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES:NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Introduce the fundamentals of computing devices, peripheral devices, fundamentals of OS and computer networks					OS
2	Provide hands-on use of databases, Microsoft Office applications: Word, Excel and Power Point					Power Point
3	Gain familiarity with the basics of computer programming in Python					
4	Write Arithmetic Expressions and understand array data structures and strings					
5	Understand files, modules and packages					
UNIT 1:	BASICS OF COMPUTER					9
Components of a Computer, Types of software, types of memory and memory devices, peripheral devices, fundamentals of Operating System and basics of Computer Networks						
UNIT 2:	WORD PROCESSING AND DESKTOP PUBLISHING					9
Overview of Database Management System, Word Processing: Editing and Reviewing, Drawing, Tables, Graphs, Templates, Worksheet Management: Formulas, Functions, Charts, designing powerful power-point presentations.						
UNIT 3:	INTRODUCTION TO PYTHON PROGRAMMING					9
The idea of Algorithm, Representation of Algorithm: Flowchart/Pseudo code with examples, Python interpreter and interactive mode, debugging; values and types: int, float, Boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments						
UNIT 4:	ARITHMETIC EXPRESSIONS, ARRAYS AND STRINGS					9
Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching Iteration and Recursion - Arrays (1-D, 2-D), Character arrays and Strings, List, Tuple, Dictionary						
UNIT 5:	FILES, MODULES AND PACKAGES					9
Files and exception: text files, reading and writing files, format operator; Command line arguments, errors and exceptions, handling exceptions, modules, packages.						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Bridge the fundamental concepts of computers with the present level of knowledge of the students, Familiarize the basic concepts of operating systems and computer networks					
CO2:	Understand the fundamentals of word processing, excel and power point presentation applications					
CO3:	Formulate simple algorithms, and write and debug programs in Python for arithmetic and logical problems.					
CO4:	Implement conditional branching, iteration, and recursion in Python					
CO5:	Gain knowledge of files, modules and packages in Python					
TEXT BOOKS						
1.	August E Grant, Jennifer H. Meadows, "Communication Technology Update and Fundamentals", Apress, 2018.					
2.	Reema Thareja, "Fundamentals of Computers", Oxford University Press, 2015.					
3.	Florian Dedov, "Python Bible for Beginners", Kindle Edition, 2019.					
4.	Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python"- Revised and updated for Python 3.2", Network Theory Ltd., 2011.					
REFERENCES						
1.	Anita Goel, "Computer Fundamentals", Pearson Education, 2010.					
2.	Joiner Associates Staff, "Flowcharts: & Simple: Learning & Application Guide", Oriel Inc, 2002.					

3.	Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd.,2016.
4.	Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd.,2015.
5.	John V Guttag, "Introduction to Computation and Programming Using Python", MITPress, 2013

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	2	1	1	3	1	1	2	1	1	0	1	3	2
CO2:	3	2	2	3	3	2	2	2	3	3	2	3	3	2
CO3:	3	3	3	3	3	3	3	2	3	1	3	3	3	3
CO4:	3	3	3	3	3	3	3	2	3	1	3	3	3	3
CO5:	3	3	3	3	3	3	3	2	3	1	3	3	3	3
AVG	3	2.6	2.4	2.6	3	2.4	2.4	2	2.6	1.4	2.2	2.2	3	2.6

1- low, 2 - medium, 3 - high,

BCS107	PYTHON PROGRAMMING LABORATORY	L	T	P	C	TOTAL MARKS
		0	0	4	2	100
PREREQUISITES: NONE						
COURSE OBJECTIVES						
The main objectives of this course are to:						
1	Understand the problem-solving approaches.					
2	Learn the basic programming constructs in Python					
3	Practice various computing strategies for Python-based solutions to real-world problems.					
4	Use Python data structures - lists, tuples, dictionaries					
5	Do input/output with files in Python.					
PRACTICAL EXERCISES:					30 PERIODS	
1.	Identification and solving of simple real-life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)					
2.	Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).					
3.	Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)					
4.	Implementing real-time/technical applications using Lists and tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)					
5.	Implementing real-time/technical applications using Sets and dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets and dictionaries)					
6.	Implementing programs using Functions. (Factorial, largest number in a list, area of shape)					
7.	Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)					
8.	Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)					
9.	Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)					
10.	Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)					
11.	Exploring Pygame tool.					
12.	Developing a game activity using Pygame like bouncing ball, car race etc.					
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	Develop algorithmic solutions to simple computational problems					
CO2:	Develop and execute simple Python programs.					
CO3:	Implement programs in Python using conditionals and loops for solving problems.					
CO4:	Deploy functions to decompose a Python program.					
CO5:	Process compound data using Python data structures and utilize Python packages					
REFERENCES						
1.	Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.					
2.	G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.					
3.	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021					

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	3	2	2	2	1	2	1	2	1	2	2	2
CO2:	2	3	2	3	2	1	1	2	2	2	1	2	3	2
CO3:	3	2	3	2	2	2	1	2	1	2	1	2	2	3
CO4:	2	2	3	3	3	1	1	2	2	1	1	2	2	2
CO5:	3	3	2	3	2	1	1	2	1	2	1	2	3	3
AVG	2.6	2.6	2.6	2.6	2.2	1.4	1	2	1.4	1.8	1	2	2.4	2.4

1 - low, 2 - medium, 3 - high

SEMESTER II

BMA131	PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS	L	T	P	C	TOTAL MARKS
		3	2	0	4	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Introduce the Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.					
2	Acquaint the student with Fourier transform techniques used in wide variety of situations.					
3	Introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes.					
4	Develop Z-transform techniques for discrete time systems.					
5	Familiarize the student with functions of several variables. These are required in many branches of engineering.					
UNIT 1:	PARTIAL DIFFERENTIAL EQUATIONS					9+3
Formation of partial differential equations Solutions of standard types of first order partial differential equations–Lagrange’s linear equation-Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.						
UNIT 2:	FOURIER-SERIES					9+3
Dirichlet’s conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series–Root mean square value–Parseval’s identity– Harmonic analysis.						
UNIT 3:	APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS					9+3
Classification of PDE – Method of separation of variables –Fourier Series-Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction(excluding insulated edges)						
UNIT 4:	FOURIERTRANSFORMS					9+3
Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval’s identity.						
UNIT 5:	Z-TRANSFORMSAND LAPLACE TRANSFORMS					9+3
Z-transforms- Elementary properties–Convergence of Z transform-Initial and final value theorem-Inverse Z -transform using partial fraction and residues.Laplace transforms of standard functions-Transforms properties-Transforms of derivatives and Integrals-Periodic Functions-Inverse Laplace Transforms-Convolution theorem-Applications of Laplace transforms for solving Linear ordinary Differential Equations up to second order with constant coefficients.						
						60 PERIODS
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	Understand the methods of solving Partial differential equations.					
CO2:	Understand and apply the concepts in Fourier series.					
CO3:	Apply the Partial derivative one-two dimensional concept in solving the Heat flow equations.					
CO4:	Understand the concepts of Fourier transforms.					
CO5:	Identify, understand and to apply Z-transform and Laplace-transform concepts in Problem solving.					
TEXT BOOKS & REFERENCES						
1.	Kreyszig. E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.					
2.	Grewal. B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44 th					

	Edition, 2018.
3.	Bali .N., Goyal. M. and Watkins. C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7 th Edition,. 2009

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	3	2	2	2	3	2	2	3	3	2	2	2
CO2:	3	2	2	3	2	3	2	2	3	3	3	2	3	2
CO3:	1	2	3	2	3	2	3	2	3	2	2	3	2	2
CO4:	2	3	2	3	3	2	2	2	2	3	2	2	3	3
CO5:	3	2	1	2	3	2	2	2	2	1	3	1	3	3
co	2.6	2.6	2.6	2.6	2.2	1.4	1	2	1.4	1.8	1	2	2.4	2.4

1 - low, 2 - medium, 3 – high

BEE131	BASIC ELECTRICAL AND INSTRUMENTATION ENGINEERING	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: NIL						
COURSE OBJECTIVES						
The main objectives of this course are to:						
1	Make the students understand the basic calculations and measurements in DC circuits.					
2	Provide the basic knowledge on AC circuit calculations and measurements.					
3	Familiarize with working and characteristics of different DC and AC machines.					
4	Impart knowledge on the fundamentals of measuring electrical quantities					
5	Expose the students to various sensors and transducers to measure non-electrical quantities.					
UNIT 1:	DC CIRCUITS AND MEASUREMENTS					9
The concept of voltage and current-Electric circuit elements: R, L, C – Independent and dependent sources – Ohm’s law- Kirchhoff’s law- series and parallel resistive circuits – Voltage and current division – Star-delta transformation - Mesh and nodal analysis of resistive circuits – simple problems - Measurement of voltage, current and power in DC circuits.						
UNIT 2:	AC CIRCUITS AND MEASUREMENTS					9
Sinusoidal voltage - RMS, average, peak value, peak factor and form factor - single phase RL, RC and RLC circuits –phasor representation - complex power – power factor – simple problems - Resonance in RLC circuits – 3 phase balanced circuit calculations– star and delta connections - Principles of measurement of AC voltage, current, power and energy - Measurement of three phase power - Protection of AC circuits: Fuse and Miniature Circuit Breakers (MCB).						
UNIT 3:	ELECTRICAL MACHINES					9
Construction, principle of operation, basic equations, characteristics and applications of DC generators, DC motors, single phase transformers and three phase induction motors. Working principle of BLDC Motor and its applications in home appliances.						
UNIT 4:	ELECTRICAL MEASUREMENTS					9
Functional blocks of a measurement system - types of measurements - Direct and indirect measurements – Classification of instruments – Induction type – dynamometer type wattmeters - Types of indicating Instruments Principles of Electrical Instruments – Multimeters, Oscilloscopes - Static and Dynamic characteristics of an instrumentation system – Errors in Measurement – Calibration and Standards..						
UNIT 5:	TRANSDUCERS AND SENSORS					9
Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect – electromagnetic flow transducers - Level transducers – Ultrasonic and fiber optic transducers – Smart transducers - Types of sensors – elastic sensors – viscosity – moisture and pH sensors – sensors based on semiconductor junctions – charge coupled and CMOS image sensors – Biosensors.						
						45 PERIODS
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	Perform the basic calculations in DC circuits and measure the various quantities associated with DC circuits.					
CO2:	Measure and compute the rms current and voltage, power, power factor and energy in AC circuits.					
CO3:	Choose appropriate motor for specific applications based on the motor characteristics.					
CO4:	Use the CRO and other measuring devices for measuring electrical quantities.					
CO5:	Select appropriate transducer or sensor for applications involving non electrical quantities.					
TEXT BOOKS & REFERENCES						
1.	D P Kothari and I.J Nagarath, “Basic Electrical and Electronics Engineering”, McGraw Hill Education (India) Private Limited, Third Reprint, 2016.					
2.	Giorgio Rizzoni, “Principles and Applications of Electrical Engineering”, McGraw Hill					

	Education (India) Private Limited, 2010.
3.	S.K.Bhattacharya, “Basic Electrical and Electronics Engineering”, Pearson India, 2011.
4.	Del Toro, “Electrical Engineering Fundamentals”, Pearson Education, New Delhi, 2015.
5.	Leonard S Bobrow, “Foundations of Electrical Engineering”, Oxford University Press, 2013.
6.	Rajendra Prasad, “Fundamentals of Electrical engineering”, Prentice Hall of India, 2006.
7.	Mittle N., “Basic Electrical Engineering”, Tata McGraw Hill Edition, 24th reprint 2016.
8.	Sawhney, A. K., and Puneet Sawhney “A Course in Electrical and Electronic Measurements and Instrumentation” Dhanpat Rai & Company, 2016.

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	2	3	1	1	1	2	1	1	1	2	1	2	2
CO2:	3	1	3	1	1	1	2	1	1	1	2	1	2	3
CO3:	3	2	3	1	1	1	2	1	1	1	2	1	3	2
CO4:	3	2	3	1	1	1	2	1	1	1	2	1	2	3
CO5:	3	2	3	1	1	1	2	1	1	1	2	1	3	2
AVG	2.6	2.6	2.6	2.6	2.2	1.4	1	2	1.4	1.8	1	2	2.4	2.4

1 - low, 2 - medium, 3 - high

BBO131	ENVIRONMENTAL SCIENCE	L	T	P	C	TOTAL MARKS
		2	0	0	2	100
PREREQUISITES: NIL						
COURSE OBJECTIVES						
The main objectives of this course are to:						
1	To create awareness among students about the basic concepts of environment and ecosystems					
2	To understand about the biodiversity and emphasize on the biodiversity of India and its conservation					
3	To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters					
4	To facilitate the understanding of global and Indian scenario of renewable resources, causes of their degradation and measures to preserve them					
5	To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability					
UNIT 1:	ENVIRONMENT AND ECOSYSTEM					6
Environment – Definition, scope and significance - Public awareness: Risk and hazards - Chemical hazards, Physical hazards, Biological hazards in the environment. Ecosystem - concept -structure and function - producers, consumers and decomposers - Food chain - Food web - Ecological pyramids - Energy flow - Forest, Grassland, desert and aquatic ecosystem						
UNIT 2:	BIODIVERSITY AND ITS CONSERVATION					6
Introduction to Biodiversity - Definition - genetic, species and ecosystem diversity - Values and uses of biodiversity - biodiversity at global, national (India) and local levels - Hotspots, threats to biodiversity - Endangered and endemic species of India - conservation of biodiversity - Insitu & Exsitu.						
UNIT 3:	ENVIRONMENTAL POLLUTION AND MANAGEMENT					6
Definition, Causes - Effects and control measures of Air, Water, Marine, soil, Noise, thermal and nuclear hazards, Solid waste Management : Causes, effects and control measures of urban and industrial wastes- Role of an individual in prevention of pollution- Pollution case studies- Disaster management : floods, earthquake, cyclone and landslides						
UNIT 4:	RENEWABLE SOURCES OF ENERGY					6
Role and potential of new and renewable source- Energy management and conservation, New Energy Sources: Need of new sources. Different types of new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.						
UNIT 5:	SUSTAINABILITY AND MANAGEMENT: PRACTICES					6
Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability -millennium development goals, and protocols-Climate change- Global, Regional and local environmental issues. Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable urbanization- Socio economical and technological change.						
						30 PERIODS
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	Understand the functions of environment, eco systems and biodiversity and their conservation.					
CO2:	Understand the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.					
CO3:	Acquire the knowledge of renewable resources and contribute to the sustainable measures to preserve them for future generations					
CO4:	Get the knowledge of the different goals of sustainable development and apply them for suitable technological advancement and societal development.					

CO5:	Demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.
TEXT BOOKS & REFERENCES	
1.	Gilbert M.Masters "Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education (2004).
2.	Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi (2006).
3.	Trivedi.R.K., "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media, 3rd edition, BPB publication (2010).
4.	Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers, 2018.
5.	Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
6.	Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
7.	Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
8.	Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.
9.	Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
10.	Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005
11.	Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	2	1	3	1	2	2	2	1	1	1	1	1	3	2
CO2:	3	2	3	1	2	2	2	1	1	1	1	1	2	3
CO3:	2	2	3	1	2	1	2	1	1	1	1	1	3	2
CO4:	3	1	2	1	2	2	2	1	1	1	1	1	2	3
CO5:	3	2	3	1	1	1	2	1	1	1	1	1	3	2
AVG	2.6	1.6	2.8	1.0	1.8	1.6	2.0	1.0	1.0	1.0	1.0	1.0	2.6	2.4

1 - low, 2 - medium, 3 – high

BCS111	PROGRAMMING IN C AND C++	L	T	P	C	TOTAL MARKS
		3	0	2	4	100
PREREQUISITES: NIL						
COURSE OBJECTIVES						
The main objectives of this course are to:						
1	Understand the constructs of C Language and develop C programs using arrays and strings					
2	Develop modular applications in C using functions, pointers and structures					
3	Understand and implement file-handling operations in C					
4	Understand Object Oriented Programming concepts of C++					
5	Develop programs in Inheritance, Virtual Functions and Exception Handling using C++					
UNIT 1:	BASICS OF C PROGRAMMING, ARRAYS AND STRINGS					9
Introduction to programming paradigms – Structure of C program - Data Types - Constants – Enumeration Constants - Keywords – Operators - Expressions - Input/Output statements, Assignment statements – Decision-making statements - Switch statement - Looping statements – Preprocessor directives - Compilation process - Introduction to Arrays: Declaration, Initialization – One-dimensional array – Two -dimensional arrays - String operations: length, compare, concatenate, copy – Selection sort, linear and binary search.						
UNIT 2:	FUNCTIONS, POINTERS AND STRUCTURES					9
Modular programming - Function prototype, function definition, function call, Built-in functions – Recursion – Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Parameter passing: Pass by value, Pass by reference - Structure - Nested structures – Pointer and Structures – Array of structures – Self-referential structures – Dynamic memory allocation - Singly linked list – typedef – Union - Storage classes and Visibility.						
UNIT 3:	FILE PROCESSING					9
Files – Types of file processing: Sequential access, Random access – Sequential access file - Random access file - Command line arguments.						
UNIT 4:	FUNDAMENTAL CONCEPTS OF OOP					9
Object-Oriented Paradigm - Elements of Object Oriented Programming – Structure of C++ program – Classes and Objects - Defining member functions - Passing and returning objects – Array of objects - Inline functions - Constructors - Parameterized Constructors - Constructor Overloading. Copy Constructor, Destructors, Default arguments - new, delete operators - “this” pointer, Friend classes and Friend functions - Function Overloading – Operator Overloading - Generic programming with templates-Function templates - Class templates						
UNIT 5:	INHERITANCE, VIRTUAL FUNCTIONS AND EXCEPTION HANDLING					9
Inheritance - Base class and derived class relationship - Forms of inheritance - Inheritance and member accessibility - constructors in derived class, abstract class, virtual functions, pure virtual function - Files and Streams - Opening and Closing a file- file modes- file pointers and their manipulation, sequential access to a file-random access to a file-Reading and Writing – Exception handling						
						45 PERIODS
PRACTICAL EXERCISES:						15 PERIODS
1.	Write a C++ Program to display Names, Roll No., and grades of 3 students who have appeared in the examination. Declare the class of name, Roll No. and grade. Create an array of class objects. Read and display the contents of the array.					
2.	Write a C++ program to declare Struct. Initialize and display contents of member variables.					
3.	Write a C++ program to declare a class. Declare pointer to class. Initialize and display the contents of the class member					
4.	Given that an EMPLOYEE class contains following members: data members: Employee					

	number, Employee name, Basic, DA, IT, Net Salary and print data members.
5.	Write a C++ program to read the data of N employee and compute Net salary of each employee (DA=52% of Basic and Income Tax (IT) =30% of the gross salary)
6.	Write a C++ to illustrate the concepts of console I/O operations
7.	Write a C++ program to use scope resolution operator. Display the various values of the same variables declared at different scope levels.
8.	Write a C++ program to allocate memory using new operator.
9.	Write a C++ program to create multilevel inheritance. (Hint: Classes A1, A2, A3)
10.	Write a C++ program to create an array of pointers. Invoke functions using array objects.
11.	Write a C++ program to use pointer for both base and derived classes and call the member function. Use Virtual keyword
60 PERIODS	
COURSE OUTCOMES	
At the end of this course, the students will be able to:	
CO1:	Demonstrate knowledge of C Programming constructs and implement applications using arrays and strings
CO2:	Develop and implement modular applications in C using functions, structures and pointers.
CO3:	Design applications using sequential and random-access file processing.
CO4:	Acquire a full Object-Oriented perspective for analyzing real-world problems and understanding Overloading problems.
CO5:	Gain knowledge in Inheritance, Virtual Functions and Exception Handling
TEXT BOOKS	
1.	Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2.	Herbert Schildt, "The Complete Reference C++", Tata McGraw Hill, 2017.
REFERENCES	
1.	Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
2.	Kernighan, B.W and Ritchie. D. M, "The C Programming language", Second Edition, Pearson Education, 2015.
3.	Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
4.	E. Balagurusamy, "Object-oriented programming with C++", Tata McGraw Hill, 2017.
5.	Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	2	1	3	1	2	2	2	1	1	1	1	1	3	2
CO2:	3	2	3	1	2	2	2	1	1	1	1	1	2	3
CO3:	2	2	3	1	2	1	2	1	1	1	1	1	3	2
CO4:	3	1	2	1	2	2	2	1	1	1	1	1	2	3
CO5:	3	2	3	1	1	1	2	1	1	1	1	1	3	2
AVG	2.6	1.6	2.8	1.0	1.8	1.6	2.0	1.0	1.0	1.0	1.0	1.0	2.6	2.4

1 - low, 2 - medium, 3 – high

BCS112	DATA STRUCTURES	L	T	P	C	TOTAL MARKS
		3	0	2	4	100
PREREQUISITES:NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Understand the concepts of ADTs.					
2	Learn linear data structures – lists, stacks, and queues.					
3	Understand non-linear data structures – trees and graphs.					
4	Understand sorting, searching and hashing algorithms.					
5	Apply Tree and Graph structures.					
UNIT 1:	LISTS					9
Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade-off Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list implementation – Singly-linked lists – Circularly linked lists – Doubly-linked lists – Applications of lists – Polynomial ADT – Radix Sort – Multilists						
UNIT 2:	STACKS AND QUEUES					9
Stack ADT – Operations – Applications – Balancing Symbols – Evaluating arithmetic expressions- Infix to Postfix conversion – Function Calls – Queue ADT – Operations – Circular Queue – DeQueue – Applications of Queues.						
UNIT 3:	TREES					9
Tree ADT – Tree Traversals - Binary Tree ADT – Expression trees – Binary Search Tree ADT – AVL Trees B-Tree – B+ Tree – Priority Queue (Heaps) – Binary Heap.						
UNIT 4:	GRAPHS					9
Graph Definition – Representation of Graphs – Types of Graphs - Breadth-first traversal – Depth-first traversal — Bi-connectivity – Euler circuits – Topological Sort – Dijkstra's algorithm – Minimum Spanning Tree – Prim's algorithm – Kruskal's algorithm						
UNIT 5:	SEARCHING, SORTING AND HASHING TECHNIQUES					9
Searching – Linear Search – Binary Search. Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Merge Sort – Quick Sort - Hashing – Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.						
45 PERIODS						
PRACTICAL EXERCISES:					15 PERIODS	
1.	Implementation of Stack, Queue and Circular Queue ADTs using Arrays					
2.	Implementation of Singly Linked List					
3.	Implementation of Stack and Linear Queue ADTs using Linked List					
4.	Implementation of Polynomial Manipulation using Linked list					
5.	Implementation of Evaluating Postfix Expressions, Infix to Postfix conversion					
6.	Implementation of Binary Search Trees					
7.	Implementation of AVL Trees					
8.	Implementation of Heaps using Priority Queues					
9.	Implementation of Dijkstras Algorithm					
10.	Implementation of Prims Algorithm					
11.	Implementation of Linear Search and Binary Search.					
12.	Implementation of Insertion Sort and Selection Sort					
13.	Implementation of Merge Sort					

14.	Implementation of Open Addressing (Linear Probing and Quadratic Probing)
	60 PERIODS
COURSE OUTCOMES:	
Upon successful completion of the course, students will be able to:	
CO1:	Define linear and non-linear data structures.
CO2:	Implement linear and non-linear data structure operations.
CO3:	Use appropriate linear/non-linear data structure operations for solving a given problem.
CO4:	Apply appropriate graph algorithms for graph applications.
CO5:	Analyze the various searching and sorting algorithms
TEXT BOOKS	
1.	Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2005.
2.	Kamthane, Introduction to Data Structures in C, 1st Edition, Pearson Education, 2007
REFERENCE BOOKS	
1.	Langsam, Augenstein and Tanenbaum, Data Structures Using C and C++, 2nd Edition, Pearson Education, 2015.
2.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms", Fourth Edition, Mcgraw Hill/ MIT Press, 2022.
3.	Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, Data Structures and Algorithms, 1st edition, Pearson, 2002.
4.	Kruse, Data Structures and Program Design in C, 2nd Edition, Pearson Education, 2006.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	2	1	3	1	2	2	2	1	1	1	1	1	3	2
CO2:	3	2	3	1	2	2	2	1	1	1	1	1	2	3
CO3:	2	2	3	1	2	1	2	1	1	1	1	1	3	2
CO4:	3	1	2	1	2	2	2	1	1	1	1	1	2	3
CO5:	3	2	3	1	1	1	2	1	1	1	1	1	3	2
AVG	2.6	1.6	2.8	1.0	1.8	1.6	2.0	1.0	1.0	1.0	1.0	1.0	2.6	2.4

1 - low, 2 - medium, 3 - high

BEC131	DIGITAL PRINCIPLES AND MICROPROCESSORS	L	T	P	C	TOTAL MARKS
		2	0	2	3	100
PREREQUISITES: PHYSICS						
COURSE OBJECTIVES						
The main objectives of this course are to:						
1	Present the Digital fundamentals, Boolean algebra and its applications in digital systems.					
2	Familiarize with the design of various combinational digital circuits using logic gates.					
3	Introduce the analysis and design procedures for synchronous and asynchronous sequential circuits.					
4	Study the Architecture of 8051 microcontroller					
5	Learn the design aspects of I/O and Memory Interfacing circuits.					
UNIT 1:	DIGITAL FUNDAMENTALS					6
Number Systems – Decimal, Binary, Octal, Hexadecimal, 1’s and 2’s complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.						
UNIT 2:	COMBINATIONAL & SYNCHRONOUS SEQUENTIAL CIRCUITS					6
Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder -Multiplexer, Demultiplexer, Decoder, Priority Encoder. Flip flops – SR, JK, T, D, design of clocked sequential circuits – Design of Counters- Shift registers, Universal Shift Register.						
UNIT 3:	ASYNCHRONOUS SEQUENTIAL CIRCUITS AND MEMORY DEVICES					6
Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits. Basic memory structure –ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA).						
UNIT 4:	BASICS OF MICROPROCESSOR AND 8051 MICROCONTROLLERS					6
Microprocessor, microcomputers and microcontrollers (basic introduction and comparison) – Types of buses, address bus, data bus and control bus - Harvard and Von neuman architecture - 8051 microcontroller architecture, Pin organization, stack, memory organization - Boolean Processor – power saving options – idle and power down mode – Comparison between derivatives of 8051 (8951, 8952, 8031, 8751). Addressing modes- Instruction set (Data transfer, Logical, Arithmetic, Branching, Machine control, Stack operation, Boolean)						
UNIT 5:	8051 PROGRAMMING, INTERFACING AND APPLICATIONS					6
Assembly language programming (ALP) - Software development cycle: editor, assembler, cross-compiler, linker, locator, compiler - Assembler Directives: ORG, DB, EQU, END, CODE, DATA - Memory interfacing: Program and data memory - I/O Interfacing: -LED, relays, keyboard, LCD, seven segment display, Stepper motor. Square wave generation using port pins of 8051- Water level controller - Stepper motor control for clock wise, anticlock wise rotation - Traffic light controller.						
						30 PERIODS
PRACTICAL EXERCISES:						15 PERIODS
1.	Design of adders and subtractors & code converters					
2.	Design of Multiplexers & Demultiplexers					
3.	Design of Encoders and Decoders					
4.	Design of Magnitude Comparators					
5.	Design and implementation of counters using flip-flops					
6.	Design and implementation of shift registers					

7.	Programming Arithmetic and Logical Operations in 8051
8.	Generation of Square waveform using 8051.
9.	Programming using Serial Ports in 8051
10.	Design of a Digital Clock using Timers/Counters in 8051
60 PERIODS	
COURSE OUTCOMES	
At the end of this course, the students will be able to:	
CO1:	Use Boolean expressions to realize logic circuits
CO2:	Build simple combinational and sequential circuits
CO3:	Analyze and design synchronous and asynchronous sequential circuits.
CO4:	Analyze the architecture of microcontroller ICs and Write programs in assembly language for micro controllers.
CO5:	Interface the memory and I/O devices to microcontrollers
TEXT BOOKS	
1.	M. Morris Mano and Michael D. Ciletti, “Digital Design”, 5th Edition, Pearson, 2014.
2.	Krishna Kant, “Microprocessor and Microcontrollers”, Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.
3.	Kenneth, Ayala, “8051 Microcontroller Architecture Programming and Application EEE/ Prentice Hall of India, New Delhi, 2004, ISBN: 978-1401861582.
4.	Mazidi, Mohmad Ali; Mazidi, Janice Gelispe; Mckinlay Roline D “The 8051 Microcontroller and Embedded system”, Pearson Education, Delhi,2008, ISBN 978-8177589030.
REFERENCES	
1.	Charles H.Roth. “Fundamentals of Logic Design”, 6th Edition, Thomson Learning, 2013.
2.	Thomas L. Floyd, “Digital Fundamentals”, 10th Edition, Pearson Education Inc, 2011.
3.	Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely ‘The 8051 Micro Controller and Embedded Systems’, PHI Pearson Education, 5th Indian reprint, 2003.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	2	2	3	1	2	1	1	1	3	1	1	2	3	2
CO2:	3	3	2	1	2	1	1	1	2	1	1	2	3	2
CO3:	3	2	3	1	2	1	1	1	2	1	1	2	3	2
CO4:	2	2	3	1	2	1	1	1	3	1	1	2	2	1
CO5:	3	3	3	2	3	1	1	1	3	1	1	2	3	1
AVG	2.6	2.6	2.4	2.8	2.4	2.4	2.2	2	2.6	1.4	2.2	2.0	2.8	2.6

1 - low, 2 - medium, 3 - high

BME117	ENGINEERING PRACTICES	L	T	P	C	TOTAL MARKS
		0	0	4	2	100
PREREQUISITES: NIL						
COURSE OBJECTIVES						
The main objectives of this course are to:						
1	To provide exposure to the students with hands on experience on various basic engineering practices in Civil and Mechanical Engineering.					
2	To provide exposure to the students with hands on experience on various basic engineering practices in Electrical and Electronics Engineering.					
PRACTICAL EXERCISES:						
1.	<u>GROUP A (CIVIL & MECHANICAL)</u>					
	<p>I CIVIL ENGINEERING PRACTICE Buildings: (a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects. Plumbing Works: (a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings. (b) Study of pipe connections requirements for pumps and turbines. (c) Preparation of plumbing line sketches for water supply and sewage works. (d) Hands-on-exercise: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components. (e) Demonstration of plumbing requirements of high-rise buildings. Carpentry using Power Tools only: (a) Study of the joints in roofs, doors, windows and furniture. (b) Hands-on-exercise: Wood work, joints by sawing, planing and cutting.</p> <p>II MECHANICAL ENGINEERING PRACTICE Welding: (a) Preparation of arc welding of butt joints, lap joints and teejoints. (b) Gas welding practice Basic Machining: (a) Simple Turning and Taper turning (b) Drilling Practice Sheet Metal Work: (a) Forming & Bending: (b) Model making – Trays, funnels, etc. (c) Different type of joints. Machine assembly practice: (a) Study of centrifugal pump (b) Study of air conditioner Demonstration on: (a) Smithy operations, upsetting, swaging, setting down and bending. Example –Exercise – Production of hexagonal headed bolt. (b) Foundry operations like mould preparation for gear and step cone pulley. (c) Fitting – Exercises – Preparation of square fitting and vee – fitting models.</p>					
2.	<u>GROUP B (ELECTRICAL & ELECTRONICS)</u>					
	<p>III ELECTRICAL ENGINEERING PRACTICE 1. Residential house wiring using switches, fuse, indicator, lamp and energy meter. 2. Fluorescent lamp wiring. 3. Stair case wiring 4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit. 5. Measurement of energy using single phase energy meter. 6. Measurement of resistance to earth of electrical equipment.</p>					

IV ELECTRONICS ENGINEERING PRACTICE	
1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR. 2. Study of logic gates AND, OR, EOR and NOT. 3. Generation of Clock Signal. 4. Soldering practice – Components Devices and Circuits – Using general purpose PCB. 5. Measurement of ripple factor of HWR and FWR.	
30 PERIODS	
COURSE OUTCOMES	
At the end of this course, the students will be able to:	
CO1:	Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
CO2:	Wire various electrical joints in common household electrical wire work.
CO3:	Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipment.
CO4:	Make simple products like tray shaped structures out of sheet metal.
CO5:	Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.
REFERENCES	
1.	Jeyachandran K., Natarajan S. & Balasubramanian S., “A Primer on Engineering Practices Laboratory”, Anuradha Publications, (2007).
2.	Jeyapooan T., Saravanapandian M. & Pranitha S., “Engineering Practices Lab Manual”, Vikas Publishing House Pvt. Ltd, (2006)
3.	Bawa H.S., “Workshop Practice”, Tata McGraw – Hill Publishing Company Limited, (2007).
4.	Rajendra Prasad A. & Sharma P.M.M.S., “Workshop Practice”, Sree Sai Publication, (2002).

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	2	1	1	1	3	2	2	2	3	1	1	2	2	2
CO2:	2	1	1	1	3	2	2	2	3	1	1	2	2	2
CO3:	2	1	1	1	3	2	2	2	3	1	1	2	2	2
CO4:	2	1	1	1	3	2	2	2	3	1	1	2	2	2
CO5:	2	1	1	1	3	2	2	2	3	1	1	2	2	2
AVG	2.0	1.0	1.0	1.0	3.0	2.0	2.0	2.0	3.0	1.0	1.0	2.0	2.0	2.0

1 - low, 2 - medium, 3 – high

BEO131	INDIAN CONSTITUTION AND HUMAN VALUES	L	T	P	C	TOTAL MARKS
		1	0	0	0	-
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Create the basic philosophical tenets of Indian Constitution and Human Rights.					
2	Underline the significance of our Constitution as Fundamental Law of the land and its features					
3	Respect human rights, rule of law and democracy					
4	Gain In-depth insight into the constitutional, statutory and institutional aspects of human rights protection in India.					
5	Identify the constitutional provisions dealing with human rights and special legislations dealing with protection of vulnerable and marginalized groups					
UNIT 1:	THE CONSTITUTION					3
Definition and Principles of the Constitution – Socio, Economic and Political Conditions in India at the time of Independence – Contents and Amendments to the Constitution						
UNIT 2:	FUNDAMENTAL RIGHTS					3
Historical Perspectives on Rights in India – Fundamental Rights in India – Provisions in Articles 14 to 32 and its implications on Human Rights – Right against unlawful detention.						
UNIT 3:	DUTIES, DIRECTIVE PRINCIPLES AND AFFIRMATIVE ACTIONS					3
Fundamental Duties of a citizen in India - Directive Principles - Policy and Practices in Reservation – Affirmative Actions: Special Provisions for SCs and STs.						
UNIT 4:	PROTECTION OF WEAKER SECTIONS OF SOCIETY					3
Constitutional Provisions for the Protection of women and children - Safeguard for the Labours - Minorities – Tribals.						
UNIT 5:	ENFORCEMENT MECHANISM AND EVALUATION					3
Protection of Human Rights Act 1993 – National and State Human Rights Commissions – Role of Judiciary in Human Rights Protection – Critical Appraisal of the Current Status of Human Rights in India AFSPA.						
15 PERIODS						
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	Demonstrate the provisions under the Constitution of India dealing with human rights.					
CO2:	Display the nature and scope of special legislations dealing with protection of human rights of marginalized and vulnerable sections.					
CO3:	Apply practically human rights law to specific human rights problems in India.					
CO4:	Analyze complex human rights problems and apply relevant provisions of human rights law in India to a hypothetical situation/case study.					
CO5:	Acquainted with the theoretical knowledge of the underpinnings of the human rights framework in India, its operation and issues associated with its implementation					
TEXT BOOKS & REFERENCES						
1.	Desai, A.R. (ed.) (1986), Violations of Democratic Rights in India, Bombay: Popular Prakashan.					
2.	Meghraj Kapurderiya (2013) Indian Philosophical Foundation of Human Rights, New Delhi: R.P. Publications.					
3.	Mishra, P.K. (2012) Human Rights: Human Rights: Acts, Statues and Constitutional Provisions, Jaipur: Ritu Publications.					
4.	Satish Chandra (1995) Minorities in National And International Laws, New Delhi: Deep and Deep Publications.					
5.	Desai, A.R. (ed.) (1986), Violations of Democratic Rights in India, Bombay: Popular Prakashan.					

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	2	1	1	1	3	2	2	2	3	1	1	2	2	2
CO2:	2	1	1	1	3	2	2	2	3	1	1	2	2	2
CO3:	2	1	1	1	3	2	2	2	3	1	1	2	2	2
CO4:	2	1	1	1	3	2	2	2	3	1	1	2	2	2
CO5:	2	1	1	1	3	2	2	2	3	1	1	2	2	2
AVG	2.0	1.0	1.0	1.0	3.0	2.0	2.0	2.0	3.0	1.0	1.0	2.0	2.0	2.0

1 - low, 2 - medium, 3 - high

SEMESTER III

BMG246	HUMANITIES ELECTIVE I (HUMAN VALUES AND ETHICS)	L	T	P	C	TOTAL MARKS
		2	0	2	3	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Create an awareness on Engineering Ethics and Human Values.					
2	Instill Moral and Social Values and Loyalty.					
3	Appreciate the rights of others.					
4	Create awareness on assessment of safety and risk					
5	Provide knowledge on Intellectual Property Rights.					
UNIT 1:	INTRODUCTION TO HUMAN VALUES					9
Meaning and Nature of Human Values – Significance of Human Values in life – Relation between values and Ethics – relevance of Human values. Theory of Naya(Jainism) – Deontology, virtue ethics – Utilitarianism.						
UNIT 2:	INTEGRATED PERSONALITY AND WELL-BEING					9
Relationship among self, Identity and Personality – Understanding integrated personality with 3 Gunas theory of Sankhya, the four Antah – Karanas (inner instruments) in Yoga and Panchkosha (5 sheaths) in Upanishad						
UNIT 3:	ETHICS AND GLOBAL CITIZENSHIP					9
Nature, characteristics and scope of Professional Ethics – Types of Professional Ethics Trusteeship, Inclusiveness, Commitment, Sustainability, Accountability, Transparency, Impartiality. Values for Global citizenship – Equality, Justice and Human Dignity.						
UNIT 4:	SAFETY, RESPONSIBILITIES AND RIGHTS					9
Safety and Risk – Assessment of safety and risk – Risk Benefit Analysis and reducing risk – Collective Bargaining – Confidentiality – Conflicts of interest – Occupational crime – Professional Rights – Employee rights - -Intellectual Property rights (IPR) discrimination.						
UNIT 5:	ETHICS IN PUBLIC AFFAIRS AND PROFESSION					9
Ethical standards for elected representatives of the people – Ethics for the bureaucracy, police and other institutions of coercive authority – basic values in the civil services – dedication to public service and empathy for weaker sections and groups in society and non-corruptibility. Ethics at the workplace: Cybercrime, Plagiarism, fraudulent use of institutional resources.						
45 PERIODS						
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	Identify and analyze an ethical issue in the subject matter under investigation or in a relevant field.					
CO2:	Identify the multiple ethical interests at stake in a real-world situation or practice.					
CO3:	Articulate what makes a particular course of action ethically defensible					
CO4:	Assess their own ethical values and the social context of problems					
CO5:	Demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work integrate, synthesize, and apply knowledge of ethical dilemmas and resolutions in academic settings.					
TEXT BOOKS&REFERENCES						
1.	Mike W. Martin and Roland Schinzinger “Ethics in Engineering” Tata McGraw-Hill–2003.					
2.	Prof. A.R. Aryasri, Dharanikota Suyodhana “Professional Ethics and Morals” Maruthi Publications.					
3.	A. Alavudeen, R. KalilRahman and M. Jayakumaran “Professional Ethics and Human					

	Values” -LaxmiPublications.
4.	Prof. D.R. Kiran “Professional Ethics and Human Values” .
5.	PSR Murthy “Indian Culture, Values and Professional Ethics”, BS Publication.
6.	https://www.aicte-india.org/
7.	http://www.egyankosh.ac.in/

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	2	3	1	1	1	2	1	1	1	2	1	2	2
CO2:	3	1	3	1	1	1	2	1	1	1	2	1	2	3
CO3:	3	2	3	1	1	1	2	1	1	1	2	1	3	2
CO4:	3	2	3	1	1	1	2	1	1	1	2	1	2	3
CO5:	3	2	3	1	1	1	2	1	1	1	2	1	3	2
AVG	2.0	1.0	1.0	1.0	3.0	2.0	2.0	2.0	3.0	1.0	1.0	2.0	2.0	2.0

1 - low, 2 - medium, 3 - high

BMA245	MATHEMATICS ELECTIVE (DISCRETE MATHS WITH PROBABILITY AND STATISTICS)	L	T	P	C	TOTAL MARKS
		3	2	0	4	100
PREREQUISITES: BMA131& BMA121						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Acquire knowledge in discrete mathematical structures as applied to Computer science and Information Technology students.					
2	Apply the concepts of mathematical logics, mathematical Induction, permutations and combinations, Recurrence relations and its applications.					
3	Apply graph theory to solve real world problems.					
4	Understand the concepts of algebraic structure, lattices and Boolean algebra					
UNIT 1:	SETS AND LOGIC					9+3
Basic Notations – Sets - Set and Properties - Set laws - The Boolean algebra of sets - The Boolean identities for sets - Propositional Logic - Propositional equivalences - Predicates and Quantifiers.						
UNIT 2:	ALGEBRAIC STRUCTURES					9+3
Algebraic systems – Semi groups and monoids - Groups – Subgroups – Homomorphism's – Normal subgroup and Cossets – Lagrange's theorem – Definitions and examples of Rings and Fields.						
UNIT 3:	PROBABILITY					9+3
Probability - The axioms of probability - Conditional probability - Baye's theorem - Discrete and continuous random variables - Moments - Moment generating functions - Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions						
UNIT 4:	TESTING OF HYPOTHESIS					9+3
Sampling distributions – Estimation of parameters – Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means – Tests based on t, Chi-square and F distributions for variance.						
UNIT 5:	DESIGN OF EXPERIMENTS					9+3
Double integrals–Change of order of integration–Double integrals in polar co-ordinates -Area enclosed by plane curves – Triple integrals – Volume of solids –Change of variables in double and triple integrals – Applications: Moments and centres of mass, moment of inertia.						
						60 PERIODS
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	Get thorough knowledge of sets and Logic and do simple problems					
CO2:	Get thorough knowledge Algebraic Structure					
CO3:	Apply the concept of Probability in real life problems and derive at the solution					
CO4:	Identify large sample and small sample the apply various test for single mean, double mean and variance.					
CO5:	Classify One-way or Two-way ANNOVA and construct the table, finally solve the problem.					
TEXT BOOKS&REFERENCES						
1.	J.P.Tremblay. R. Manohar “Discrete Mathematical Structures with applications to Computer Science” Tata Mc-Graw-Hill Publishing company pvt. Ltd.New Delhi, 35th edition, 2008.					
2.	Veerajan.T, Discrete Mathematics with Graph Theory and Combinatorics”, 10 th edition, Tata Mc-Graw-Hill Companies, 2010.					
3.	An Introduction to Probability Theory and Its Applications: By William Feller					
4.	Probability and statistics for engineers and scientists: By Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying E. Ye					
5.	Fundamentals of Statistics by P.R. Vital-2000					

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	2	2	2	-	2	-	3	2	1	2	3	2	1	2
CO2:	2	2	2	2	2	3	3	2	3	2	2	2	2	2
CO3:	2	2	3	2	2	2	2	1	3	3	2	3	1	2
CO4:	3	2	2	2	2	3	3	2	2	3	2	2	3	3
CO5:	3	2	2	3	3	1	1	2	2	1	3	1	3	3
AVG	2.4	2.0	2.2	1.8	2.2	1.8	2.4	1.8	2.2	2.2	2.2	2.0	2.0	2.4

1 - low, 2 - medium, 3 - high

BCS201	OPERATING SYSTEMS	L	T	P	C	TOTAL MARKS
		3	0	2	4	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Understand the basics and functions of operating systems, processes and threads					
2	Analyze scheduling algorithms, process synchronization and the concept of deadlocks.					
3	Analyze various memory management schemes.					
4	Familiar with I/O management and file systems.					
5	Familiar with the basics of virtual machines and Mobile OS like iOS and Android.					
UNIT 1:	INTRODUCTION					9
Computer System - Elements and organization; Operating System Overview - Objectives and Functions - Evolution of Operating System; Operating System Structures – Operating System Services - User Operating System Interface - System Calls – System Programs - Design and Implementation - Structuring methods.						
UNIT 2:	PROCESS MANAGEMENT					9
Processes - Process Concept - Process Scheduling - Operations on Processes - Inter-process Communication; CPU Scheduling - Scheduling criteria - Scheduling algorithms: Threads - Multithread Models – Threading issues; Process Synchronization - The Critical-Section problem - Synchronization hardware – Semaphores – Mutex - Classical problems of synchronization - Monitors; Deadlock - Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.						
UNIT 3:	MEMORY MANAGEMENT					9
Main Memory - Swapping - Contiguous Memory Allocation – Paging - Structure of the Page Table - Segmentation, Segmentation with paging; Virtual Memory - Demand Paging – Copy on Write - Page Replacement - Allocation of Frames –Thrashing.						
UNIT 4:	STORAGE MANAGEMENT					9
Mass Storage system – Disk Structure - Disk Scheduling and Management; File-System Interface - File concept - Access methods - Directory Structure - Directory organization - File system mounting - File Sharing and Protection; File System Implementation - File System Structure - Directory implementation - Allocation Methods - Free Space Management; I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem.						
UNIT 5:	VIRTUAL MACHINES AND MOBILE OS					9
Virtual Machines – History, Benefits and Features, Building Blocks, Types of Virtual Machines and their Implementations, Virtualization and Operating-System Components; Mobile OS - iOS and Android.						
						45 PERIODS
PRACTICAL EXERCISES						15 PERIODS
1.	Installation of Windows operating system					
2.	Illustrate UNIX commands and Shell Programming					
3.	Write C programs to implement the various CPU Scheduling Algorithms					
4.	Illustrate the inter-process communication strategy					
5.	Implement mutual exclusion by Semaphore					
6.	Write C programs to avoid Deadlock using Banker's Algorithm					
7.	Write a C program to Implement a Deadlock Detection Algorithm					
8.	Write a C program to implement Threading					
9.	Implement the paging Technique using C program					

10.	Write C programs to implement the following Memory Allocation Methods a. First Fit b. Worst Fit c. Best Fit
11.	Write C programs to implement the various Page Replacement Algorithms
12.	Write C programs to Implement the various File Organization Techniques
13.	Implement the following File Allocation Strategies using C programs a. Sequential b. Indexed c. Linked
14.	Write C programs for the implementation of various disk scheduling algorithms
15.	Install any guest operating system like Linux using VMware
60 PERIODS	
COURSE OUTCOMES:	
Upon successful completion of the course, students will be able to:	
CO1:	Define and implement UNIX Commands.
CO2:	Compare the performance of various CPU Scheduling Algorithms.
CO3:	Compare and contrast various Memory Allocation Methods.
CO4:	Define File Organization and File Allocation Strategies.
CO5:	Implement Virtualization concepts.
TEXT BOOKS	
1.	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”l, 10th Edition, John Wiley and Sons Inc., 2018.
2.	Andrew S Tanenbaum, "Modern Operating Systems", Pearson, 5th Edition, 2022 New Delhi.
REFERENCES	
1.	Ramaz Elmasri, A. Gil Carrick, David Levine, “ Operating Systems – A Spiral Approach”, Tata McGraw Hill Edition, 2010.
2.	William Stallings, "Operating Systems: Internals and Design Principles", 7th Edition, Prentice Hall, 2018.
3.	Achyut S. Godbole, Atul Kahate, “Operating Systems”, McGraw Hill Education, 2016.

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	2	2	2	-	2	-	3	2	1	2	3	2	1	2
CO2:	2	2	2	2	2	3	3	2	3	2	2	2	2	2
CO3:	2	2	3	2	2	2	2	1	3	3	2	3	1	2
CO4:	3	2	2	2	2	3	3	2	2	3	2	2	3	3
CO5:	3	2	2	3	3	1	1	2	2	1	3	1	3	3
AVG	2.4	2.0	2.2	1.8	2.2	1.8	2.4	1.8	2.2	2.2	2.2	2.0	2.0	2.4

1 - low, 2 - medium, 3 - high

BCS202	COMPUTER ARCHITECTURE	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: None						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Gain knowledge on the basic structure of a computer system					
2	Acquaint the arithmetic operations familiarity					
3	Comprehend Processor and control unit					
4	Understand parallelism, hardware multithreading and parallel architectures					
5	Familiarize the concept of memory and I/O Subsystems					
UNIT 1:	BASIC STRUCTURE OF A COMPUTER SYSTEM					9
Functional Units – Basic Operational Concepts, Performance, Instructions, Language of the Computer Operations, Operands, Instruction representation, Logical operations, decision making, MIPS Addressing.						
UNIT 2:	ARITHMETIC FOR COMPUTERS					9
Addition and Subtraction, Multiplication, Division, Floating Point Representation, Floating Point Addition and Multiplication, Subword Parallelism						
UNIT 3:	PROCESSOR AND CONTROL UNIT					9
A Basic MIPS implementation, Building a Datapath, Control Implementation Scheme, Pipelining Pipelined data path and control, Handling Data Hazards & Control Hazards, Exceptions.						
UNIT 4:	PARALLELISM					9
Parallel processing challenges, Flynn’s classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures, Hardware multithreading Multi-core processors and other Shared Memory Multiprocessors, Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers, Data flow computer architectures, VLSI Computing Structures, Systolic array architecture.						
UNIT 5:	MEMORY AND I/O SUBSYSTEMS					9
Memory Hierarchy memory technologies, cache memory, measuring and improving cache performance, virtual memory, TLB’s, Accessing I/O Devices, Interrupts, Direct Memory Access, Bus structure, Bus operation, Arbitration, Interface circuits, USB.						
						45 PERIODS
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Understand the basic structure of a computer system.					
CO2:	Gain knowledge on the arithmetic operations for computers.					
CO3:	Familiarize the basic MIPS implementation..					
CO4:	Handle parallel processing challenges and understand about graphics processing units					
CO5:	Perceive memory hierarchy and I/O subsystems					
TEXT BOOKS						
1.	David A. Patterson, John L.Hennessy, “Computer Organization and Design”, Fifth Edition, Morgan Kaufmann Publishers, 2014.					
REFERENCES						
1.	Carl Hamacher, Zvonko Vranesic, safwat Zaky, “Computer Organization and Embedded Systems”, Sixth Edition, Tata McGraw Hill, 2011.					
2.	William Stallings, “Computer Organization and Architecture”, Tenth Edition, Pearson Education, 2015.					

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	3	3	2	2	2	2	2	2	3	3	3
CO2:	2	2	2	2	2	0	0	0	1	0	1	1	2	3
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	2
CO4:	2	1	2	2	2	0	0	0	0	0	2	2	2	2
CO5:	2	2	3	2	2	2	1	2	2	2	1	3	2	2
AVG	2.4	2.2	2.4	2.4	2.2	1.2	1.0	1.0	1.4	1.2	1.6	2.2	2.4	2.4

1 - low, 2 - medium, 3 - high

BCS203	DATABASE MANAGEMENT SYSTEMS	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Learn the fundamentals of data models, relational algebra and SQL					
2	Represent a database system using ER diagrams and to learn normalization techniques					
3	Understand the fundamental concepts of transaction, concurrency and recovery processing					
4	Understand the internal storage structures using different file and indexing techniques which will help in physical DB design					
5	Have an introductory knowledge about Distributed databases, NOSQL and database security					
UNIT 1:	RELATIONAL DATABASES					9
Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL						
UNIT 2:	DATABASE DESIGN					9
Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form						
UNIT 3:	TRANSACTIONS					9
Transaction Concepts – ACID Properties – Schedules – Serializability – Transaction support in SQL – Need for Concurrency – Concurrency control –Two-Phase Locking- Timestamp – Multiversion – Validation and Snapshot isolation– Multiple Granularity locking – Deadlock Handling – Recovery Concepts – Recovery based on deferred and immediate update – Shadow paging – ARIES Algorithm						
UNIT 4:	STORAGE IMPLEMENTATION TECHNIQUES					9
RAID – File Organization – Organization of Records in Files – Data dictionary Storage – Column Oriented Storage– Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for Selection, Sorting and join operations – Query optimization using Heuristics - Cost Estimation						
UNIT 5:	ADVANCED TOPICS					9
Distributed Databases: Architecture, Data Storage, Transaction Processing, Query processing and optimization – NOSQL Databases: Introduction – CAP Theorem – Document-Based systems – Key value Stores – Column-Based Systems – Graph Databases. Database Security: Security issues – Access control based on privileges – Role Based access control – SQL Injection – Statistical Database security – Flow control – Encryption and Public Key infrastructures – Challenges						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Construct SQL Queries using relational algebra					
CO2:	Design a database using the ER model and normalize the database					
CO3:	Construct queries to handle transaction processing and maintain consistency of the database					
CO4:	Compare and contrast various indexing strategies and apply the knowledge to tune the performance of the database					
CO5:	Appraise how advanced databases differ from Relational Databases and find a suitable database for the given requirement					
TEXT BOOKS						

1.	Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, McGraw Hill, 2020.
2.	Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2017
REFERENCES	
1.	C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	3	3	2	2	2	2	2	2	3	3	3
CO2:	2	2	2	2	2	0	0	0	1	0	1	1	2	3
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	2
CO4:	2	1	2	2	2	0	0	0	0	0	2	2	2	2
CO5:	2	2	3	2	2	2	1	2	2	2	1	3	2	2
AVG	2.4	2.2	2.4	2.4	2.2	1.2	1.0	1.0	1.4	1.2	1.6	2.2	2.4	2.4

1 - low, 2 - medium, 3 - high

BEC221	EMBEDDED SYSTEMS AND IOT	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Learn the internal architecture and programming of an embedded processor.					
2	Introduce interfacing I/O devices to the processor.					
3	Introduce the evolution of the Internet of Things (IoT).					
4	Build a small low-cost embedded and IoT system using Arduino/Raspberry Pi/ open platform.					
5	Apply the concept of Internet of Things in real world scenario.					
UNIT 1:	EMBEDDED PROCESSORS					9
8-Bit Microcontroller, Architecture, Instruction Set and Programming, Programming Parallel Ports Timers and Serial Port, Interrupt Handling						
UNIT 2:	EMBEDDED C PROGRAMMING					9
Memory And I/O Devices Interfacing, Programming Embedded Systems in C, Need For RTOS Multiple Tasks and Processes, Context Switching, Priority Based Scheduling Policies.						
UNIT 3:	IOT AND ARDUINO PROGRAMMING					9
Introduction to the Concept of IoT Devices, IoT Devices Versus Computers, IoT Configurations Basic Components, Introduction to Arduino, Types of Arduino, Arduino Toolchain, Arduino Programming Structure, Sketches Pins Input/Output From Pins Using Sketches, Introduction to Arduino Shields, Integration of Sensors and Actuators with Arduino.						
UNIT 4:	IOT COMMUNICATION AND OPEN PLATFORMS					9
IoT Communication Models and APIs, IoT Communication Protocols, Bluetooth, WiFi , ZigBee, GPS, GSM modules, Open Platform (like Raspberry Pi), Architecture, Programming, Interfacing Accessing GPIO Pins, Sending and Receiving Signals Using GPIO Pins, Connecting to the Cloud.						
UNIT 5:	APPLICATIONS DEVELOPMENT					9
Complete Design of Embedded Systems – Development of IoT Applications – Home Automation – Smart Agriculture – Smart Cities – Smart Healthcare.						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Explain the architecture of embedded processors.					
CO2:	Write embedded C programs.					
CO3:	Design simple embedded applications.					
CO4:	Compare the communication models in IOT					
CO5:	Design IoT applications using Arduino/Raspberry Pi /open platform.					
TEXT BOOKS						
1.	Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, “The 8051 Microcontroller and Embedded Systems”, Pearson Education, Second Edition, 2014					
2.	Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, CISCO Press, 2017					
REFERENCES						
1.	Michael J. Pont, “Embedded C”, Pearson Education, 2007.					
2.	Wayne Wolf, “Computers as Components: Principles of Embedded Computer System Design”, Elsevier, 2006.					
3.	Andrew N Sloss, D. Symes, C. Wright, “Arm System Developer’s Guide”, Morgan Kauffman/ Elsevier, 2006.					
4.	Arshdeep Bahga, Vijay Madiseti, “Internet of Things – A hands-on approach”, Universities Press, 2015					

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	3	3	2	2	2	2	2	2	3	3	3
CO2:	2	2	2	2	2	0	0	0	1	0	1	1	2	3
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	2
CO4:	2	1	2	2	2	0	0	0	0	0	2	2	2	2
CO5:	2	2	3	2	2	2	1	2	2	2	1	3	2	2
AVG	2.4	2.2	2.4	2.4	2.2	1.2	1.0	1.0	1.4	1.2	1.6	2.2	2.4	2.4

1 - low, 2 - medium, 3 - high

BEN221	ESSENTIAL SKILLS AND APTITUDE FOR ENGINEERS	L	T	P	C	TOTAL MARKS
		0	0	2	1	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Acquire the basic knowledge of concepts of logical reasoning Skills					
2	Acquire satisfactory competency in use of reasoning					
3	Solve campus placements aptitude papers covering Quantitative Ability, Logical Reasoning Ability					
4	Compete in various competitive exams like CAT, CMAT, GATE, GRE, GATE, UPSC, GPSC etc.					
UNIT 1:	QUANTITATIVE ABILITY (BASIC MATHEMATICS)					3
Number Systems-LCM and HCF-Decimal Fractions-Simplification-Square Roots and Cube Roots-Average-Problems on Ages-Surds & Indices-Percentages-Problems on Numbers						
UNIT 2:	QUANTITATIVE ABILITY (APPLIED & ENGINEERING MATHEMATICS)					4
Logarithm-Permutation and Combinations-Probability-Profit and Loss Simple and Compound Interest-Time, Speed and Distance-Time & Work-Ratio and Proportion-Area						
UNIT 3:	DATA INTERPRETATION					4
Data Interpretation-Tables-Column Graphs-Bar Graphs-Line Charts-Pie Chart-Venn Diagrams						
UNIT 4:	LOGICAL REASONING (DEDUCTIVE REASONING)					4
Analogy-Blood Relation-Directional Sense-Number and Letter Series-Coding- Decoding-Calendar-Clocks-Venn Diagrams-Mathematical Operations						
15 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Apply the basic concepts of quantitative ability					
CO2:	Acquire the basic knowledge of concepts of logical reasoning Skills					
CO3:	Acquire satisfactory competency in use of reasoning					
CO4:	Solve campus placements aptitude papers covering Quantitative Ability, Logical Reasoning Ability					
CO5:	Compete in various competitive exams like CAT, CMAT, GATE, GRE, GATE, UPSC, GPSC etc.					
REFERENCES						
1.	A Modern Approach To Verbal & Non Verbal Reasoning By R S Agarwal					
2.	Analytical and Logical reasoning By Sijwali B S					
3.	Quantitative aptitude for Competitive examination By R S Agarwal					
4.	Analytical and Logical reasoning for CAT and other management entrance test By Sijwali B					
5.	Quantitative Aptitude by Competitive Examinations by Abhijit Guha 4 th edition					
6.	https://prepinsta.com/					
7.	https://www.indiabix.com/					
8.	https://www.javatpoint.com/					

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	3	3	2	2	2	2	2	2	3	3	3
CO2:	2	2	2	2	2	0	0	0	1	0	1	1	2	3
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	2
CO4:	2	1	2	2	2	0	0	0	0	0	2	2	2	2
CO5:	2	2	3	2	2	2	1	2	2	2	1	3	2	2
AVG	2.4	2.2	2.4	2.4	2.2	1.2	1.0	1.0	1.4	1.2	1.6	2.2	2.4	2.4

1 - low, 2 - medium, 3 - high

BCS207	DATABASE MANAGEMENT SYSTEMS LABORATORY	L	T	P	C	TOTAL MARKS
		0	0	4	2	100
PREREQUISITES: NIL						
COURSE OBJECTIVES						
The main objectives of this course are to:						
1	Learn and implement important commands in SQL.					
2	Learn the usage of nested and joint queries.					
3	Understand functions, procedures and procedural extensions of databases.					
4	Understand the design and implementation of typical database applications.					
5	Be familiar with the use of a front-end tool for GUI-based application development.					
PRACTICAL EXERCISES:						
1.	Create a database table, add constraints (primary key, unique, check, Not null), insert rows, and update and delete rows using SQL DDL and DML commands.					
2.	Create a set of tables, add foreign key constraints and incorporate referential integrity.					
3.	Query the database tables using different 'where' clause conditions and also implement aggregate functions.					
4.	Query the database tables and explore sub-queries and simple join operations.					
5.	Query the database tables and explore natural, equi and outer joins.					
6.	Write user-defined functions and stored procedures in SQL.					
7.	Execute complex transactions and realize DCL and TCL commands.					
8.	Write SQL Triggers for insert, delete, and update operations in a database table.					
9.	Create a View and index for database tables with a large number of records.					
10.	Create an XML database and validate it using XML schema.					
11.	Create Document, column and graph-based data using NOSQL database tools.					
12.	Develop a simple GUI-based database application and incorporate all the above-mentioned features					
13.	<p>Case Study using any of the real-life database applications from the following list</p> <ol style="list-style-type: none"> Inventory Management for an EMart Grocery Shop Society Financial Management Cop Friendly App – Eseva Property Management – eMall Star Small and Medium Banking and Finance <ul style="list-style-type: none"> Build Entity Model diagram. The diagram should align with the business and functional goals stated in the application. Apply Normalization rules in designing the tables in scope. Prepared applicable views, triggers (for auditing purposes), and functions for enabling enterprise-grade features. Build PL SQL / Stored Procedures for Complex Functionalities, ex EOD Batch Processing for calculating the EMI for Gold Loan for each Eligible Customer. Ability to showcase ACID Properties with sample queries with appropriate settings 					
						30 PERIODS
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	Create databases with different types of key constraints.					
CO2:	Construct simple and complex SQL queries using DML and DCL commands.					

CO3:	Use advanced features such as stored procedures and triggers and incorporate in GUI-based application development.
CO4:	Create an XML database and validate with meta-data (XML schema).
CO5:	Create and manipulate data using the NOSQL database.

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	3	3	2	2	2	2	2	2	3	3	3
CO2:	2	2	2	2	2	0	0	0	1	0	1	1	2	3
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	2
CO4:	2	1	2	2	2	0	0	0	0	0	2	2	2	2
CO5:	2	2	3	2	2	2	1	2	2	2	1	3	2	2
AVG	2.4	2.2	2.4	2.4	2.2	1.2	1.0	1.0	1.4	1.2	1.6	2.2	2.4	2.4

1 - low, 2 - medium, 3 - high

SEMESTER IV

BCS211	ARTIFICIAL INTELLIGENCE	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Gain knowledge on the basic concepts of Artificial Intelligence					
2	Acquaint knowledge for problem-solving and game-playing					
3	Apply knowledge gained on knowledge representation and uncertainty for a given scenario					
4	Understand planning and machine learning					
5	Understand about expert systems and its applications					
UNIT 1:	INTRODUCTION TO ARTIFICIAL INTELLIGENCE					9
Introduction to AI - Problem formulation, Problem Definition - Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics - Specialized production system – Problem-solving methods - Problem graphs, Matching, Indexing and Heuristic functions - Hill Climbing - Depth first and Breadth-first, Constraint satisfaction - Related algorithms, Measure of performance and analysis of search algorithms						
UNIT 2:	KNOWLEDGE OF PROBLEM-SOLVING AND GAME-PLAYING					9
Game playing - Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic - Structured representation of knowledge.						
UNIT 3:	KNOWLEDGE REPRESENTATION & UNCERTAINTY					9
Knowledge representation - Production-based system, Frame-based system. Inference – Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning - Certainty factors, Bayesian Theory – Bayesian Network - Dempster - Shafer theory.						
UNIT 4:	PLANNING AND MACHINE LEARNING					9
Basic plan generation systems - Strips - Advanced plan generation systems – K strips – Strategic explanations -Why, Why not and how explanations. Learning - Machine learning, adaptive Learning.						
UNIT 5:	EXPERT SYSTEMS AND THEIR APPLICATIONS					9
Expert systems - Architecture of expert systems, Roles of expert systems - Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems - MYCIN, DART, XCON, Expert systems shells..						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Apply the Artificial Intelligence concepts for solving problems.					
CO2:	Represent knowledge for problem-solving and game playing using various logics.					
CO3:	Investigate the modes to represent and handle uncertainty and vagueness.					
CO4:	Assess the concepts of planning and machine learning.					
CO5:	Gain knowledge on Expert Systems and its applications					
TEXT BOOKS						
1.	Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE) “, McGraw Hill 2010. (Units-I, II, VI & V)					
2.	Dan W. Patterson, “Introduction to AI and ES”, Pearson Education, 2007. (Unit-III)					
REFERENCES						
1.	Peter Jackson, “Introduction to Expert Systems”, 3rd Edition, Pearson Education, 2007.					
2.	Stuart Russell and Peter Norvig, “AI – A Modern Approach”, 3rd Edition, Pearson Education, 2010.					
3.	Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013.					

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	3	2	2	2	1	2	1	1	1	2	3	2
CO2:	3	3	2	3	2	1	1	2	2	2	1	2	3	3
CO3:	3	2	3	2	2	2	1	1	1	2	2	2	2	3
CO4:	2	2	2	3	3	1	2	2	2	1	1	1	2	2
CO5:	3	2	2	3	2	1	2	1	2	2	2	2	3	3
AVG	2.8	2.4	2.4	2.6	2.2	1.4	1.4	1.6	1.6	1.6	1.4	1.8	2.6	2.6

1 - low, 2 - medium, 3 - high

BCS212	COMPUTER NETWORKS	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	To understand the concept of layering in networks.					
2	To know the functions of routing protocols.					
3	Gain knowledge of network layer protocols.					
4	To learn the functions of transport layer protocols					
5	To familiarize the functions and protocols of the Application layer					
UNIT 1:	INTRODUCTION AND PHYSICAL LAYERS					9
Data Communication – Networks, Network Types, Protocol Layering, TCP/IP Protocol suite, OSI Model, Introduction to Sockets, Transmission media						
UNIT 2:	DATA LINK LAYER					9
Data Link Layer, Framing, Flow control, Error control, Data-Link Layer Protocols, HDLC, PPP, Media Access Control, Ethernet Basics, CSMA/CD, Virtual LAN, Wireless LAN (802.11), Physical Layer: Data and Signals, Performance, Transmission media- Switching, Circuit Switching.						
UNIT 3:	NETWORK LAYER					9
Switching: Packet Switching, Internet protocol, IPV4, IP Addressing, Subnetting IPV6, ARP, RARP, ICMP, DHCP Routing and protocols: Unicast routing, Distance Vector Routing, RIP, Link State Routing, OSPF, Path-vector routing BGP, Multicast Routing: DVMRP, PIM.						
UNIT 4:	TRANSPORT LAYER					9
Introduction, Transport-Layer Protocols: UDP, TCP: Connection Management, Flow control, Congestion Control, Congestion avoidance (DECbit, RED), SCTP, Quality of Service						
UNIT 5:	APPLICATION LAYER					9
Application Layer protocols: HTTP, FTP, Email protocols (SMTP - POP3 - IMAP - MIME), DNS, SNMP						
TOTAL PERIODS: 45						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Explain the basic layers and its functions in computer networks.					
CO2:	Understand the basics of how data flows from one node to another.					
CO3:	Analyze routing algorithms.					
CO4:	Describe protocols for various functions in the network.					
CO5:	Analyze the working of various application layer protocols					
TEXT BOOKS						
1.	James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Eighth Edition, Pearson Education, 2021.					
2.	Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, Sixth Edition TMH, 2022					
REFERENCES						
1.	Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.					
2.	William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.					
3.	Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.					
4.	Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open-Source Approach”, McGraw Hill, 2012.					

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	2	2	2	0	2	0	0	0	3	3	3	3	3
CO2:	0	0	0	0	0	0	0	0	0	2	1	2	3	0
CO3:	0	3	3	2	0	2	0	0	0	2	2	3	3	0
CO4:	0	0	1	0	0	0	0	0	0	3	2	3	3	0
CO5:	0	3	3	3	0	0	0	0	0	2	2	2	3	0
AVG	3	2.6	2.6	2.3	0	2	0	0	0	2	2	3	3	3

1 - low, 2 - medium, 3 - high

BCS213	FUNDAMENTALS OF DATA SCIENCE	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: None						
CO.URSE OBJECTIVES:						
The main objectives of this course are to:						
1	Understand the data science fundamentals and process.					
2	Learn to describe the data for the data science process.					
3	Learn to describe the relationship between data.					
4	Utilize the Python libraries for Data Wrangling.					
5	Present and interpret data using visualization libraries in Python					
UNIT 1:	INTRODUCTION TO DATA SCIENCE					9
Data Science: Benefits and uses, facets of data - Data Science Process: Overview, Defining research goals – Retrieving data, Data preparation, Exploratory Data analysis, build the model, presenting findings and building applications , Data Mining, Data Warehousing, Basic Statistical descriptions of Data						
UNIT 2:	DESCRIBING DATA					9
Types of Data, Types of Variables, Describing Data with Tables and Graphs, Describing Data with Averages Describing Variability, Normal Distributions and Standard (z) Scores						
UNIT 3:	DESCRIBING RELATIONSHIPS					9
Correlation , Scatter plots, correlation coefficient for quantitative data, computational formula for correlation coefficient , Regression, regression line, least squares regression line, Standard error of estimate, interpretation of r2 –multiple regression equations –regression towards the mean						
UNIT 4:	PYTHON LIBRARIES FOR DATA WRANGLING					9
Basics of Numpy arrays, aggregations, computations on arrays, comparisons, masks, Boolean logic , fancy indexing, structured arrays , Data manipulation with Pandas, data indexing and selection, operating on data missing data, Hierarchical indexing, combining datasets, aggregation and grouping, pivot tables.						
UNIT 5:	DATA VISUALIZATION					6+3
Importing Matplotlib, Line plots, Scatter plots , visualizing errors , density and contour plots, Histograms – legends, colors, subplots, text and annotation, customization, three-dimensional plotting, Geographic Data with Basemap , Visualization with Seaborn.						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Define the data science process					
CO2:	Understand different types of data descriptions for data science process					
CO3:	Gain knowledge on relationships between data					
CO4:	Use the Python Libraries for Data Wrangling					
CO5:	Apply visualization Libraries in Python to interpret and explore data					
TEXT BOOKS						
1.	David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016. (Unit I)					
2.	Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017. (Units II and III)					
3.	Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016. (Units IV and V)					
REFERENCES						
1.	Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press,2014					

CO’s-PO’s & PSO’s MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	2	2	2	0	2	0	0	0	3	3	3	3	3
CO2:	0	0	0	0	0	0	0	0	0	2	1	2	3	0
CO3:	0	3	3	2	0	2	0	0	0	2	2	3	3	0
CO4:	0	0	1	0	0	0	0	0	0	3	2	3	3	0
CO5:	0	3	3	3	0	0	0	0	0	2	2	2	3	0
AVG	3	2.6	2.6	2.3	0	2	0	0	0	2	2	3	3	3

1 - low, 2 - medium, 3 - high

BCS214	DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	C	TOTAL MARKS
		3	0	2	4	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Understand and apply the algorithm analysis techniques in searching and sorting algorithms					
2	To critically analyze the efficiency of graph algorithms					
3	To understand different algorithm design techniques					
4	To solve programming problems using a state space tree					
5	To understand the concepts behind NP-completeness, Approximation algorithms and randomized algorithms.					
UNIT 1:	INTRODUCTION					9
Algorithm analysis: Time and space complexity - Asymptotic Notations and its properties Best case, Worst case and average case analysis – Recurrence relation: substitution method - Lower bounds – searching: linear search, binary search and Interpolation Search, Pattern search: The naïve string-matching algorithm - Rabin-Karp algorithm Knuth-Morris-Pratt algorithm. Sorting: Insertion sort – heap sort						
UNIT 2:	GRAPH ALGORITHMS					9
Graph algorithms: Representations of graphs - Graph traversal: DFS – BFS - applications - Connectivity, strong connectivity, bi-connectivity - Minimum spanning tree: Kruskal’s and Prim’s algorithm- Shortest path: Bellman-Ford algorithm - Dijkstra’s algorithm - Floyd-Warshall algorithm Network flow: Flow networks - Ford-Fulkerson method – Matching: Maximum bipartite matching						
UNIT 3:	ALGORITHM DESIGN TECHNIQUES					9
Divide and Conquer methodology: Finding maximum and minimum - Merge sort - Quick sort Dynamic programming: Elements of dynamic programming — Matrix-chain multiplication - Multi stage graph — Optimal Binary Search Trees. Greedy Technique: Elements of the greedy strategy- Activity-selection problem — Optimal Merge pattern — Huffman Trees.						
UNIT 4:	STATE SPACE SEARCH ALGORITHMS					9
Backtracking: n-Queens problem - Hamiltonian Circuit Problem - Subset Sum Problem – Graph coloring problem Branch and Bound: Solving a 15-Puzzle problem - Assignment problem - Knapsack Problem - Travelling Salesman Problem						
UNIT 5:	NP-COMPLETE AND APPROXIMATION ALGORITHM					9
Tractable and intractable problems: Polynomial-time algorithms – Venn diagram representation - NP-algorithms - NP-hardness and NP-completeness – Bin Packing problem - Problem reduction: TSP – 3-CNF problem. Approximation Algorithms: TSP - Randomized Algorithms: concept and application - primality testing - randomized quick sort - Finding kth smallest number						
						45 PERIODS
PRACTICAL EXERCISES:						15 PERIODS
1.	Implement Selection sort and find how many steps are required to sort 10 elements.					
2.	Implement and Analyze factorial of a number program using iterative and recursive methods					
3.	Write a program to find the Greatest Common Divisor of two numbers using recursion and find how many steps are required to execute it.					
4.	Write a program to check whether a given graph is connected or not using the DFS method					
5.	Implement minimum spanning tree using Prim’s algorithm and analyse its time complexity					
6.	Apply dynamic programming methodology to implement 0/1 Knapsack problem.					
7.	Apply dynamic programming methodology to find all pairs shortest path of a directed graph using Floyd’s algorithm.					
8.	Implement graph coloring problem using backtracking.					
9.	Find the solution of the 0/1 Knapsack Problem using Least Cost Branch and Bound.					
10.	Find the solution to the Travelling Salesman Problem. Repeat the experiment for a graph having					

	total number of nodes (n) = 4, 8, 12, 16, 20 and note the time required to find the solution. Plot the graph taking n on the x-axis and time on y-axis and analyze the graph to determine whether it is exponential or not.
11.	Find a subset of a given set $S = \{s_1, s_2, \dots, s_n\}$ of n positive integers whose sum is equal to a given positive integer d. For example, if $S = \{1, 2, 5, 6, 8\}$ and $d = 9$ there are two solutions $\{1, 2, 6\}$ and $\{1, 8\}$. A suitable message is to be displayed if the given problem instance doesn't have a solution
12.	Apply Greedy method to compress the given data using Huffman encoding
60 PERIODS	
COURSE OUTCOMES:	
Upon successful completion of the course, students will be able to:	
CO1:	Analyze and implement the efficiency of algorithms using various frameworks.
CO2:	Apply and implement graph algorithms to solve problems and analyze their efficiency.
CO3:	Make use of algorithm design techniques like divide and conquer, dynamic programming and greedy techniques to solve problems
CO4:	Use the state space tree method for solving problems
CO5:	Solve problems using approximation algorithms and randomized algorithms
TEXT BOOKS	
1.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, Prentice Hall of India, 2009.
2.	Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran "Computer Algorithms/C++" Orient Blackswan, 2 nd Edition, 2019.
REFERENCES	
1.	Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson Education, 2012.
2.	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Reprint Edition, Pearson Education, 2006.
3.	S. Sridhar, "Design and Analysis of Algorithms", Oxford University Press, 2014.

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BEE231	ROBOTICS AND INDUSTRY 4.0	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Introduce the functional elements of Robotics					
2	Impart knowledge on the direct and inverse kinematics					
3	Introduce the manipulator differential motion and control					
4	Educate on various path planning techniques, dynamics and control of manipulators					
5	Introduce the concept of CPS					
UNIT 1:	BASIC CONCEPTS					9
Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and control issues-Variou manipulators – Sensors - work cell - Programming languages						
UNIT 2:	DIRECT AND INVERSE KINEMATICS					9
Mathematical representation of Robots - Position and orientation – Homogeneous transformation-Variou joints-Representation using the Denavit Hattenberg parameters -Degrees of freedom-Direct kinematics-Inverse kinematics- SCARA robots- Solvability – Solution methods-Closed form solution						
UNIT 3:	MANIPULATOR DIFFERENTIAL MOTION AND STATICS					9
Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance						
UNIT 4:	PATH PLANNING, DYNAMICS AND CONTROL					9
Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning, Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model –Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator						
UNIT 5:	INDUSTRY 4.0 AND CYBER PHYSICAL SYSTEM					9
Introduction to Cyber Physical Systems (CPS), Architecture of CPS- Components, Data science and technology for CPS, Emerging applications in CPS in different fields. Case study: Application of CPS in health care domain.						
						45 PERIODS
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Understand basic concept of robotics.					
CO2:	Understand Mathematical representation and Kinematics of robotics.					
CO3:	Demonstrate different motion in robotics					
CO4:	Evaluate the various path planning techniques, dynamics and control in robotics industries					
CO5:	Analyze the components of Cyber Physical Systems					
TEXT BOOKS						
1.	M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, ‘Industrial Robotics’, McGraw-HillSingapore, 1996					
2.	JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education,2009..					
3.	R.K.Mittal and I.J.Nagrath, ‘Robotics and Control’, Tata McGraw Hill, New Delhi,4th Reprint, 2005					
4.	Raj Rajkumar, Insup Lee, Lui Sha, John Stankovic, Cyber-Physical Systems: The Next Computing Revolution, Springer, 2016.					
REFERENCES						
1.	Ashitava Ghoshal, ‘Robotics–Fundamental Concepts and Analysis’, Oxford University Press, Sixth impression, 2010.					
2.	K. K.AppuKuttan, ‘Robotics’, I K International, 2007					
3.	Edwin Wise, ‘Applied Robotics’, Cengage Learning, 2003					
4.	R.D.Klafter,T.A.Chimielewski and M.Negin, ‘Robotic Engineering–An Integrated Approach’, Prentice					

	Hall of India, New Delhi, 1994.
5.	B.K.Ghosh, 'Control in Robotics and Automation: Sensor Based Integration', Allied Publishers, Chennai, 1998.
6.	Edward A. Lee, Sanjit A. Seshia, Introduction to Embedded Systems: A Cyber-Physical Systems Approach, MIT Press, 2nd Edition, 2017

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS217	COMPUTER NETWORKS LABORATORY	L	T	P	C	TOTAL MARKS
		0	0	4	2	100
PREREQUISITES: NONE						
COURSE OBJECTIVES						
The main objectives of this course are to:						
1	Learn and use network commands.					
2	Learn socket programming.					
3	Implement and analyze various network protocols.					
4	Learn and use simulation tools.					
5	Use simulation tools to analyze the performance of various network protocols.					
PRACTICAL EXERCISES:						
1.	Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and trace route PDUs using a network protocol analyzer and examine.					
2.	Write an HTTP web client program to download a web page using TCP sockets.					
3.	Applications using TCP sockets like a) Echo client and echo server b) Chat					
4.	Simulation of DNS using UDP sockets.					
5.	Use a tool like Wireshark to capture packets and examine the packets					
6.	Write a code simulating ARP /RARP protocols.					
7.	Study of Network Simulator (NS) and Simulation of Congestion Control Algorithms using NS.					
8.	Study of TCP/UDP performance using the Simulation tool.					
9.	Simulation of Distance Vector/ Link State Routing algorithm.					
10.	Simulation of an error correction code (like CRC)					
						30 PERIODS
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	Implement various protocols using TCP and UDP.					
CO2:	Compare the performance of different transport layer protocols.					
CO3:	Use simulation tools to analyze the performance of various network protocols.					
CO4:	Analyze various routing algorithms.					
CO5:	Implement error correction codes.					
REFERENCES						
1.	W. Richard Stevens, TCP/IP Illustrated, Volume 1: The Protocols, Addison-Wesley, Second Edition, 2011.					
2.	Behrouz A. Forouzan, Data Communications and Networking, McGraw-Hill, Fifth Edition, 2013.					
3.	Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, Pearson, Fifth Edition, 2011.					
4.	Kurose J.F., Ross K.W., Computer Networking: A Top-Down Approach, Pearson, Seventh Edition, 2017.					
5.	Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Morgan Kaufmann, Sixth Edition, 2021.					
6.	William Stallings, Data and Computer Communications, Pearson, Tenth Edition, 2013.					

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	2	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	2	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.8	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS218	ARTIFICIAL INTELLIGENCE AND DATA SCIENCE LABORATORY	L	T	P	C	TOTAL MARKS
		0	0	4	2	100
PREREQUISITES: NIL						
COURSE OBJECTIVES						
The main objectives of this course are to:						
1	Understand uninformed and expert systems					
2	Understand the basic Statistical and Probability measures for data science.					
3	Learn descriptive analytics on the benchmark data sets.					
4	Apply correlation and regression analytics on standard data sets.					
5	Present and interpret data using visualization packages in Python.					
PRACTICAL EXERCISES:						
1.	Implement uninformed search (BFS, DFS) and informed search (A*, Greedy Best-First) algorithms for solving a state-space problem such as the 8-puzzle or pathfinding in a grid.					
2.	Develop a simple expert system (e.g., medical diagnosis, career guidance, or troubleshooting system) using forward chaining and backward chaining techniques.					
3.	Download, install and explore the features of NumPy, SciPy, Jupyter, Statsmodels and Pandas packages.					
4.	Working with Numpy arrays					
5.	Working with Pandas data frames					
6.	Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set.					
7.	Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following: a. Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis. b. Bivariate analysis: Linear and logistic regression modeling c. Multiple Regression analysis d. Also, compare the results of the above analysis for the two data sets.					
8.	Apply and explore various plotting functions on UCI data sets. a. Normal curves b. Density and contour plots c. Correlation and scatter plots d. Histograms e. Three-dimensional plotting					
9.	Visualizing Geographic Data with Basemap					
						30 PERIODS
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	Demonstrate uninformed and expert systems					
CO2:	Make use of the basic Statistical and Probability measures for data science.					
CO3:	Perform descriptive analytics on the benchmark data sets.					
CO4:	Perform correlation and regression analytics on standard data sets					
CO5:	Present and interpret data using visualization packages in Python.					
REFERENCES						
1.	Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.					
2.	G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.					
3.	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021					

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BEN231	COMMUNICATION SKILLS FOR CAREER SUCCESS	L	T	P	C	TOTAL MARKS
		0	0	2	1	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	To improve the communicative competence of learners.					
2	To build on students 'English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.					
3	To develop analytical thinking skills for problem solving in communicative contexts.					
4	To equip them with writing skills needed for academic as well as work place contexts.					
5	To equip them with personal skills.					
UNIT 1:	PREPARING FOR A CAREER					3
Identifying job openings, Applying for a job, Preparing Cover letters, Preparing a CV/Resume and Effective Profiling.						
UNIT 2:	PRESENTATION SKILLS					3
Preparing a PowerPoint Presentation, Greeting and introducing, Presenting a Paper, Group Discussions, Preparing for and Facing a Job Interview.						
UNIT 3:	BUSINESS COMMUNICATION					3
Preparing Agenda and Minutes for Meetings ,Writing Notices and Memos ,Drafting an E-mail, Press Release ,Correspondence with Govt./Authorities, Office Orders, Enquiries and Replies.						
UNIT 4:	TIME & STRESS MANAGEMENT					3
Identifying Time Wasters, Time Management Tips ,Identifying Factors Responsible for Stress , Stress Management Tips ,Test Preparation Tips.						
UNIT 5:	Soft Skills for Leadership and Team Management					3
Qualities of a Good Leader , Leadership Styles ,Decision Making ,Intrapersonal skills , Interpersonal skills , Problem solving , Critical thinking , Negotiation skills.						
						15 PERIODS
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	Listen and comprehend complex academic texts.					
CO2:	Read and infer the denotative and connotative meanings of technical texts.					
CO3:	Write definitions, descriptions narrations and essays on various topics.					
CO4:	Speak fluently and accurately and informal communicative contexts.					
CO5:	Express their opinions effectively in both oral and written medium of communication.					
TEXT BOOKS & REFERENCES						
1.	English for Technical Communication (With CD) by Aysha Viswamohan, Mcgraw Hill Education, ISBN: 0070264244.					
2.	Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.					
3.	Learning to Communicate– Dr.V.Chellammal, Allied Publishing House, New Delhi, 2003.					

IKS101	INDIAN KNOWLEDGE SYSTEM	L	T	P	C	TOTAL MARKS
		2	0	0	2	100
PREREQUISITES: None						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Introduce students to the foundational concepts of the Indian Knowledge System (IKS)					
2	Explore the relevance and applications of IKS in contemporary times.					
3	Promote interdisciplinary learning through the integration of traditional Indian knowledge and modern education					
UNIT 1:	FOUNDATIONS OF INDIAN KNOWLEDGE SYSTEM					6
Meaning and Scope of IKS-Historical evolution and literary sources: Vedas, Upanishads, Puranas-Philosophical foundations: Darshanas (Nyaya, Vaisheshika, Samkhya, Yoga, Mimamsa, Vedanta)-Interdisciplinary nature of IKS.						
UNIT 2:	EDUCATION, LANGUAGE, AND LITERATURE					6
Traditional education systems: Gurukula, Pathashalas-Higher education: Nalanda, Takshashila-Role of Sanskrit and regional languages-Contributions of Panini, Bhartrihari-Epics and classical literature						
UNIT 3:	SCIENCE AND TECHNOLOGY IN IKS					6
Mathematics: Sulbasutras, Aryabhata, Bhaskara-Astronomy: Surya Siddhanta-Ayurveda: Tridosha, healing systems-Metallurgy, Vastu Shastra, water management-						
UNIT 4:	INDIAN ART, CULTURE, AND SOCIETY					6
Music, dance, painting, sculpture-Rasa theory, Natya Shastra-Festivals, rituals, socio-cultural life-Dharma, Purusharthas, social organization.						
UNIT 5:	CONTEMPORARY RELEVANCE AND APPLICATIONS OF IKS					6
IKS in modern education and research-Sustainable practices in agriculture, ecology, lifestyle-Yoga and meditation in wellness-Role of IKS in national identity and global relevance.						
30 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Describe the meaning, scope, and philosophical foundations of IKS					
CO2:	Summarize the features of Indian education, language, and literary contributions					
CO3:	Illustrate traditional Indian scientific and technological advancements					
CO4:	Examine the impact of Indian art, aesthetics, and socio-cultural practices					
CO5:	Evaluate the relevance and application of IKS in contemporary society					
TEXT BOOKS						
1.	Kapil Kapoor (Ed.) – Encyclopedia of Hinduism, Rupa Publications, Comprehensive overview of philosophical and literary foundations of IKS.					
2.	Michel Danino – The Indian Mind: A Cultural and Philosophical Perspective, DK Printworld-Offers insight into Indian civilization's unique philosophical frameworks and relevance today.					
3.	V. Sivaramakrishnan (Ed.) – Cultural Heritage of India, Ramakrishna Mission Institute of Culture-Multi-volume work covering various aspects of Indian science, arts, literature, and education.					
4.	Subhash Kak, David Frawley & N.S. Rajaram – In Search of the Cradle of Civilization, Motilal Banarsidass-Discusses early Indian contributions to science, mathematics, and cosmology.					
5.	Bharatiya Vidya Bhavan Series – History and Culture of Indian People-A classic multi-volume series offering a deep dive into ancient Indian education, society, arts, and sciences.					
6.	Debroy, Bibek – The Bhagavad Gita, Upanishads, and the Vedas (Translations)-For primary source reading and understanding scriptural references in IKS.					
7.	R. Balasubramanian (Ed.) – The Bloomsbury Research Handbook of Indian Epistemology and Metaphysics					
8.	Yoga Sutras of Patanjali (Various commentaries) – for insights into yoga, wellness, and consciousness studies					

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	2	2	2	0	2	0	0	0	3	3	3	3	3
CO2:	0	0	0	0	0	0	0	0	0	2	1	2	3	0
CO3:	0	3	3	2	0	2	0	0	0	2	2	3	3	0
CO4:	0	0	1	0	0	0	0	0	0	3	2	3	3	0
CO5:	0	3	3	3	0	0	0	0	0	2	2	2	3	0
AVG	3	2.6	2.6	2.3	0	2	0	0	0	2	2	3	3	3

1 - low, 2 - medium, 3 - high

SEMESTER V

BCS301	OBJECT ORIENTED SOFTWARE ENGINEERING	L	T	P	C	TOTAL MARKS
		2	0	4	4	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Understand Software Engineering Lifecycle Models					
2	Perform software requirements analysis					
3	Gain knowledge of the System Analysis and Design concepts using UML.					
4	Understand software testing and maintenance approaches					
5	Work on project management scheduling using DevOps					
UNIT 1:	SOFTWARE PROCESS AND AGILE DEVELOPMENT					9+3
Introduction to Software Engineering, Software Process, Perspective and Specialized Process, Models Introduction to Agility-Agile process-Extreme programming-XP Process-Case Study						
UNIT 2:	REQUIREMENT ANALYSIS AND OBJECT MODELLING USING UML					9+3
Requirement analysis and specification, Requirements gathering and analysis, Software Requirement Specification, Formal system specification, Finite State Machines, Petrinets Object modelling using UML Use case Model, Class diagrams, Interaction diagrams, Activity diagrams, State chart diagrams, Functional modelling, Data Flow Diagram, CASE TOOLS.						
UNIT 3:	SOFTWARE DESIGN					9+3
Software design, Design process, Design concepts, Coupling, Cohesion, Functional independence, Design patterns, Model-view-controller, Publish-subscribe, Adapter, Command, Strategy, Observer, Proxy, Façade, Architectural styles, Layered, Client Server, Tiered Pipe and filter, User interface design-Case Study.						
UNIT 4:	SOFTWARE TESTING AND MAINTENANCE					9+3
Testing, Unit testing, Black box testing, White box testing, Integration and System testing, Regression testing , Debugging - Program analysis – Symbolic execution, Model Checking, Case Study						
UNIT 5:	PROJECT MANAGEMENT					9+3
Software Project Management, Software Configuration Management, Project Scheduling, DevOps: Motivation, Cloud as a platform Operations, Deployment Pipeline: Overall Architecture Building and Testing-Deployment, Tools- Case Study						
						45 PERIODS
PRACTICAL EXERCISES						15 PERIODS
To develop a mini-project by following the 9 exercises listed below						
1	To develop a problem statement.					
2	Identify Use Cases and develop the Use Case model.					
3	Identify the conceptual classes and develop a domain model with UML Class diagram.					
4	Using the identified scenarios, find the interaction between objects and represent them Using UML Sequence diagrams					
5	Draw relevant state charts and activity diagrams.					
6	Identify the User Interface, Domain objects, and Technical services. Draw the partial layered, logical architecture diagram with UML package diagram notation					
7	Develop and test the technical services layer.					
8	Develop and test the Domain objects layer.					

9	Develop and test the User interface layer.
SUGGESTED DOMAINS FOR MINI-PROJECT	
1	Passport automation system.
2	Book bank
3	Exam Registration
4	Stock maintenance system.
5	Online course reservation system
6	E-ticketing
7	Software personnel management system
8	Credit card processing
9	e-book management system
10	Recruitment system
11	Foreign trading system
12	Conference Management System
13	BPO Management System
14	Library Management System
15	Student Information System
60 PERIODS	
COURSE OUTCOMES	
At the end of this course, the students will be able to:	
CO1:	Compare various Software Development Lifecycle Models
CO2:	Perform formal analysis on specifications.
CO3:	Use UML diagrams for analysis and design
CO4:	Understand software testing and maintenance
CO5:	Evaluate project management approaches as well as cost and schedule estimation strategies
TEXT BOOKS	
1.	Bernd Bruegge and Allen H. Dutoit, "Object-Oriented Software Engineering: Using UML, Patterns and Java", Third Edition, Pearson Education, 2009
2.	Roger S. Pressman, Object-Oriented Software Engineering: An Agile Unified Methodology, First Edition, Mc Graw-Hill International Edition, 2014
REFERENCES	
1.	Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, 2nd edition, PHI Learning Pvt. Ltd., 2010..
2.	Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education, 2005.
3.	Len Bass, Ingo Weber and Liming Zhu, "DevOps: A Software Architect's Perspective", Pearson Education, 2016
4.	Rajib Mall, Fundamentals of Software Engineering, 3rd edition, PHI Learning Pvt. Ltd., 2009
5.	Stephen Schach, Object-Oriented and Classical Software Engineering, 8th ed, McGraw-Hill, 2010

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS302	AUTOMATA THEORY AND COMPILER DESIGN	L	T	P	C	TOTAL MARKS
		3	0	2	4	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	To understand and list the different stages in the process of compilation.					
2	Identify different methods of lexical analysis and design top-down and bottom-up parsers					
3	Identify synthesized and inherited attributes					
4	Develop syntax directed translation schemes					
5	Develop algorithms to generate code for a target machine					
UNIT 1:	FORMAL LANGUAGES AND REGULAR EXPRESSION					9+3
Introduction: Phases of compilation and overview. Lexical Analysis (scanner): Regular languages, finite automata DFA,NFA. Conversion of regular expression to NFA, NFA to DFA. Applications of finite automata to lexical analysis, scanner generator (lex, flex).						
UNIT 2:	SYNTAX ANALYSIS (PARSER)					9+3
Context-free languages and grammars, push-down automata, LL(1) grammars and top-down parsing, operator grammars, LR(O), SLR(1), LR(1), LALR(1) grammars and bottom-up parsing, ambiguity and LR parsing, LALR(1) parser generator (yacc, bison)Context-sensitive features-Chomsky hierarchy of languages and recognizers, type checking, type conversions, equivalence of type expressions.						
UNIT 3:	SEMANTICS AND RUNTIME ENVIRONMENTS					9+3
Semantic Analysis: Attribute grammars, syntax directed definition, evaluation and flow of attribute in a syntax tree. Symbol Table: its structure, symbol attributes and management. Run-time environment: Procedure activation, parameter passing, value return, memory allocation, and scope						
UNIT 4:	INTERMEDIATE CODE GENERATION & OPTIMIZATION					9+3
Intermediate Code Generation: Translation of different language features, different types of intermediate forms. Code Improvement (optimization): Analysis: control-flow, data-flow dependence etc.; Code improvement local optimization, global optimization, loop optimization, peep-hole optimization etc. Architecture dependent, code improvement: instruction scheduling (for pipeline), loop optimization (for cache memory) etc.						
UNIT 5:	CODE GENERATION & TURNING MACHINE					9+3
Register allocation and target code generation Advanced topics: Type systems, data abstraction, compilation of Object Oriented features and non-imperative programming languages. Turing machine: Basic Turing Machine Model, Representation of TMs. Representation of TMs, Language acceptability of TMs, Techniques for TM construction. TM as computer of integer functions, Universal TM, Linear bounded automata, Church Thesis, Halting problem, post correspondence problem.						
						45 PERIODS
PRACTICAL EXERCISES						15 PERIODS
1	Implementation of Symbol Table					
2	Develop a lexical analyzer to recognize a few patterns in C. (Ex. identifiers, constants, comments, operators etc.)					
3	Implementation of Lexical Analyzer using Lex Tool					
4	Generate YACC specification for a few syntactic categories. a) Program to recognize a valid arithmetic expression that uses operator +, -, * and /. b) Program to recognize a valid variable which starts with a letter followed by any number of letters or digits. c)Implementation of Calculator using LEX and YACC					
5	Convert the BNF rules into Yacc form and write code to generate Abstract Syntax Tree.					
6	Implement type checking					
7	Implement control flow analysis and Data flow Analysis					

8	Implement any one storage allocation strategies (Heap, Stack, Static)
9	Construction of DAG.
10	Implement the back end of the compiler which takes the three address code and produces the 8086 assembly language instructions that can be assembled and run using a 8086 assembler. The target assembly instructions can be simple move, add, sub, jump. Also simple addressing modes are used.
11	Implementation of Simple Code Optimization Techniques (Constant Folding., etc.)
12	To design and simulate a Turing Machine (TM) that accepts binary palindromes — strings that read the same forward and backward (e.g., 0110, 101).

60 PERIODS

COURSE OUTCOMES

At the end of this course, the students will be able to:

CO1:	Construct finite automata and apply them in designing lexical analyzers using tools like Lex/Flex.
CO2:	Operate parser generators to implement top-down and bottom-up parsing techniques for context-free grammars.
CO3:	Design syntax-directed translation schemes and manage symbol tables for semantic analysis during compilation.
CO4:	Refine intermediate code by applying optimization techniques such as loop and peephole optimization.
CO5:	Demonstrate code generation techniques and simulate Turing Machine operations for language recognition.

TEXT BOOKS

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education, 2009

REFERENCES

1. Randy Allen, Ken Kennedy, "Optimizing Compilers for Modern Architectures: A Dependence based Approach", Morgan Kaufmann Publishers, 2002
2. Steven S. Muchnick, "Advanced Compiler Design and Implementation", Morgan Kaufmann Publishers, 2003
3. Keith D Cooper and Linda Torczon, Engineering a Compiler, Morgan Kaufmann Publishers Elsevier Science, 2004
4. V. Raghavan, "Principles of Compiler Design", Tata McGraw Hill Education, 2010
5. Allen I. Holub, "Compiler Design in C", Prentice-Hall Software Series, 1993.

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS303	COMPUTER GRAPHICS AND MULTIMEDIA	L	T	P	C	TOTAL MARKS
		3	0	2	4	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Comprehend the fundamental concepts of graphics and multimedia.					
2	Gain and apply the acquired knowledge pertaining to 2D and 3D concepts in graphics programming					
3	Understand the basic 3D modeling and rendering techniques.					
4	Realize the importance of animation concepts					
5	Be familiar with multimedia communication standards.					
UNIT 1:	INTRODUCTION					9+3
Survey of computer graphics, Overview of graphics systems – Video display devices, Raster scan systems, Random scan systems, Graphics monitors and Workstations, Input devices, Hard copy Devices, Graphics Software; Output primitives – points and lines, line drawing algorithms, loading the frame buffer, line function; circle and ellipse generating algorithms; Pixel addressing and object geometry, filled area primitives						
UNIT 2:	TWO DIMENSIONAL GRAPHICS					9+3
Two dimensional geometric transformations – Matrix representations and homogeneous coordinates, composite transformations; Two dimensional viewing – viewing pipeline, viewing coordinate reference frame; widow-to-viewport coordinate transformation, Two dimensional viewing functions; clipping operations – point, line, and polygon clipping algorithms.						
UNIT 3:	THREE DIMENSIONAL GRAPHICS AND COLOR MODELS					9+3
Three dimensional concepts; Three dimensional object representations – Polygon surfaces- Polygon tables- Plane equations - Polygon meshes; Curved Lines and surfaces, Quadratic surfaces; Blobby objects; Spline representations – Bezier curves and surfaces -B-Spline curves and surfaces. Three dimensional geometric and modeling transformations .Light sources - basic illumination models – halftone patterns and dithering techniques; Properties of light - Standard primaries and chromaticity diagram; Intuitive colour concepts - RGB colour model - YIQ colour model - CMY colour model - HSV colour model - HLS colour model; Colour selection						
UNIT 4:	ANIMATIONS & REALISM					9+3
Animation Graphics: Design of Animation sequences – animation function – raster animation – key frame systems – motion specification –morphing – tweening. Computer Graphics Realism:Tiling the plane – Recursively defined curves – Koch curves – C curves – Dragons –space filling curves – fractals – Grammar based models – fractals – turtle graphics – ray tracing.						
UNIT 5:	MULTIMEDIA COMMUNICATIONS					9+3
JPEG, MPEG-7 standardization process of Multimedia content description, MPEG-21 Multimedia framework, ITU-T standardization process, Audio-visual systems(H.322, H.324), Video coding standards (H.261, H.26L)						
						45 PERIODS
PRACTICAL EXERCISES						15 PERIODS
1	To Study various in build graphics functions in C library.					
2	Write a program to draw a line using DDA algorithm.					
3	Write a program to draw a line using Bresenham’s algorithm.					
4	Write a program to draw a circle using midpoint algorithm.					
5	Write a program to draw a circle using Bresenham’s algorithm.					
6	Write a program to draw a rectangle using line drawing algorithm.					

7	Write a program to perform 2D Transformation on a line.
8	Write a program to perform shear transformation on a rectangle.
9	Write a program to rotate a circle (alternatively inside and outside) around the circumference of another circle
10	Write a program to draw a car using in build graphics function and translate it from bottom left corner to right bottom corner of screen.
11	Write a program to draw balloons using in build graphics function and translate it from bottom left corner to right top corner of screen
12	Write a program to draw a cube using in build library function and perform 3D transformations i). Translations in x, y, z directions, ii) Rotation by angle 450 about z axis, rotation by 600 about y-axis in succession. iii) Scaling in x-direction by a factor of 2, scaling in y- direction by a factor of 3.
13	Write a program to implement line clipping (Cohen Sutherland algorithm).
14	Write a program for making Bezier curve.
15	Write a program to study various in build functions for 2D drawing in MAYA software.
16	Write a program to show animation of a ball moving in a helical path
17	Write a program to show animation of solar system

60 PERIODS

COURSE OUTCOMES

At the end of this course, the students will be able to:

CO1:	Learn about graphics system and algorithm to design and implement primitives like line, circle and ellipse
CO2:	Design two dimensional graphics and apply two dimensional transformation.
CO3:	Demonstrate three-dimensional object representation and basic illumination models.
CO4:	Design and implement animation sequences and fractal-based graphics using keyframe techniques, motion specifications, and recursive modeling methods such as Koch curves and ray tracing.
CO5:	Apply multimedia communication standards such as JPEG, MPEG-7, MPEG-21, and video coding protocols (H.261, H.26L) in the development of audio-visual systems.

TEXT BOOKS

1.	John F. Hughes, Andries Van Dam, Morgan Mc Guire ,David F. Sklar , James D. Foley, Steven K. Feiner and Kurt Akeley, "Computer Graphics: Principles and Practice", 3rdEdition, Addison Wesley Professional, 2013
2.	Donald Hearn, Pauline Baker, "Computer Graphics", Prentice Hall, New Delhi 2007
3.	K.R. Rao, Zoran S. Bojkovic and Dragorad A. Milovanovic, "Multimedia Communication Systems: Techniques, Standards, and Networks", Pearson Prentice Hall, 2014

REFERENCES

1.	F.S.Hill, Computer Graphics using OPENGL, Second edition, Pearson Education, 2009
2.	James D. Foley, Andries Van Dam, Steven K. Feiner, John F. Hughes, "Computer Graphics-Principles and practice", 2nd Edition, Pearson Education, 2007
3.	Kamisetty Rao, Zoran Bojkovic, Dragorad Milovanovic, "Introduction to Multimedia Communications: Applications, Middleware, Networking ", Wiley, 2016.

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BEN321	LEADERSHIP SKILLS AND PERSONALITY DEVELOPMENT	L	T	P	C	TOTALMARKS
		0	0	2	1	100
PREREQUISITES:NIL						
COURSEOBJECTIVES:						
The main objectives of this course are to:						
1	To help students in enhancing their self-awareness, interpersonal skills and overall personal grooming					
2	To foster personal growth and development by focusing on self- awareness, communication skills, emotional intelligence and goal setting					
3	To explore various aspects of personality enhancement and leadership qualities for improving their confidence, firmness and relationships with others					
UNIT 1:	PERSONALITY ENHANCEMENT					3
Introduction- Definitions- Importance of Personality Enhancement Types – (i) Extroverts and (ii) Introverts						
UNIT 2:	HEREDITARY FACTORS INFLUENCING PERSONALITY:					3
Introduction- Physique and Physical Health- Endocrine System- Nervous System						
UNIT 3:	TIPS FOR ENHANCING PERSONALITY:					3
Think Positive- Avoid Backbiting- Be Soft-spoken- Be Confident- Be Optimistic- Be an Attentive Listener- Improve Communication Skills- Be Loving and Congenial- Seek Feedback						
UNIT 4:	LEADERSHIP DEVELOPMENT					3
Introduction- Definitions- Importance of Leadership Development- Evolution of Leadership in Indian Context						
UNIT 5:	COMMUNICATION SKILLS FOR LEADERS: ACTIVE LISTENING- PUBLIC SPEAKING AND PRESENTATION- GIVING AND RECEIVING FEEDBACK- NON-VERBAL COMMUNICATION					3
Qualities of a Good Leader , Leadership Styles ,Decision Making ,Intrapersonal skills , Interpersonal skills , Problem solving , Critical thinking , Negotiation skills.						
15 PERIODS						
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	To comprehend the role of confidence and self-esteem in personal development					
CO2:	To create a comprehensive action plan for personality enhancement and leadership development					
CO3:	To cultivate personality and leadership qualities in Diverse and Inclusive Environments					
TEXT BOOKS & REFERENCES						
1.	D. P. Subharwal – Personality Development Handbook Rajiv Mishra – Personality Development: Transform Yourself					
2.	Dr. Shailesh Tondon& Dr. Asish Kaushal – Personality Development & Grooming, Thakur Publication Pvt. Ltd..					
3.	Dale Carnegie, The Leader in You, year not confirmed.					
4.	Peter G. Northouse – Leadership: Theory and Practice					
5.	Steve Radcliffe, Leadership: Plain and Simple, Pearson (Financial Times Series), 2012.					

SEMESTER VI

BCS311	INTERNET PROGRAMMING	L	T	P	C	TOTAL MARKS
		3	0	2	4	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Facilitate students to understand introduction to Internet					
2	Help students to gain a basic understanding of web designing					
3	Inculcate knowledge on client-side processing and scripting					
4	Gain knowledge on server-side processing and scripting					
5	Gain knowledge on PHP Session Management and Database Connectivity					
UNIT 1:	INTRODUCTION TO INTERNET					9
Internet Overview- Networks - Web Protocols, Web Organization and Addressing, Web Browsers and Web Servers -Security and Vulnerability-Web System Architecture , URL, Domain Name, Client-side and server-side scripting.						
UNIT 2:	WEB DESIGNING					9
HTML5, Form elements, Input types and Media elements, CSS3, Selectors, Box Model, Backgrounds and Borders, Text Effects, Animations, Multiple Column Layout, User Interface						
UNIT 3:	CLIENT-SIDE PROCESSING AND SCRIPTING					9
JavaScript Introduction, Functions, Arrays, DOM, Built-in Objects, Regular Expression, Exceptions, Event handling, Validation- AJAX - JQuery. XML Basics, XSL, XSLT, XML Schema-JSON.						
UNIT 4:	SERVER SIDE PROCESSING AND SCRIPTING PHP					9+3
Introduction to PHP, Operators, Conditionals, Looping, Functions, Arrays, Date and Time Functions, String functions, File Handling, File Uploading, Email Basics, Email with attachments						
UNIT 5:	PHP SESSION MANAGEMENT AND DATABASE CONNECTIVITY AND NODE JS					9
Sessions-Cookies-MySQL Basics, Querying single and multiple MySQL Databases with PHP, PHP Data Objects. Introduction to Node.js, Installing Node.js, using Events, Listeners, Timers, and Callbacks inNode.js, Introduction to Mongo DB, Accessing MongoDB from Node.js.						
						45 PERIODS
PRACTICAL EXERCISES						15 PERIODS
1	Create a basic webpage using HTML5 elements.					
2	Design a registration form with various input types.					
3	Apply CSS3 for page styling using selectors, box model, and text effects.					
4	Develop a responsive multi-column layout with CSS animations and transitions.					
5	Implement JavaScript functions for form validation and event handling.					
6	Perform DOM manipulation using JavaScript to modify page content dynamically.					
7	Validate input fields using JavaScript regular expressions.					
8	Create an AJAX-based application using jQuery.					
9	Develop an XML document with schema and transform it using XSL/XSLT; parse JSON data.					
10	Write PHP programs using operators, conditionals, looping, arrays, and string functions.					
11	Design a feedback form in PHP with file handling and file upload features.					
12	Connect PHP to MySQL for CRUD operations and implement a simple Node.js application					

	with MongoDB connectivity.
60 PERIODS	
COURSE OUTCOMES	
At the end of this course, the students will be able to:	
CO1:	Identify various concepts of mobile programming that make it unique from programming for other platforms
CO2:	Design web pages using HTML and CSS
CO3:	Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces
CO4:	Program mobile applications for the Android operating system that use basic and advanced phone features
CO5:	Deploy applications to the Android marketplace for distribution
TEXT BOOKS	
1.	Paul Deitel, Harvey Deitel, Abbey Deitel, Internet & World Wide Web - Howto Program, 5th edition, Pearson Education, 2012.
2.	Brad Dayley, Brendan Dayley, and Caleb Dayley , Node.js, MongoDB and Angular WebDevelopment: The definitive guide to using the MEAN stack to build web applications, 2nd Edition, Pearson Education, 2018
REFERENCES	
1.	Lindsay Bassett, Introduction to JavaScript Object Notation, 1st Edition, O'Reilly Media, 2015
2.	Fritz Schneider, Thomas Powell , JavaScript – The Complete Reference, 3rd Edition, McGraw Hill, 2017
3.	Barry Burd, "Android Application Development All in one for Dummies", John Wiley & Sons, 2011

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	3	2	3	2	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.6	2.4	2.4	2.0	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS312	MOBILE APPLICATION DEVELOPMENT	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Facilitate students to understand android SDK					
2	Help students to gain a basic understanding of Android application development					
3	Inculcate working knowledge of Android Studio development tool					
4	Gain knowledge on files, database and location-based services					
5	Understand audio, video and SMS messaging services					
UNIT 1:	INTRODUCTION TO ANDROID					9
What is Android, Android versions and its feature set, Android Development Environment - Android SDK, Installing Java, and ADT bundle - Eclipse Integrated Development Environment (IDE), Creating Android Virtual Devices (AVDs), Creating a New Android Project ,Defining the Project Name and SDK Settings, Project Configuration Settings, Configuring the Launcher Icon, Creating an Activity.						
UNIT 2:	ARCHITECTURE OVERVIEW					9
The Android Software Stack, The Linux Kernel, Android Runtime - Dalvik Virtual Machine, Android Runtime – Core Libraries, Dalvik VM Specific Libraries, Java Interoperability Libraries, Android Libraries, Application Framework, Running the Application in the AVD, Stopping a Running Application, Modifying the Example Application, Reviewing the Layout and Resource Files.						
UNIT 3:	ANDROID SOFTWARE DEVELOPMENT PLATFORM AND FRAMEWORK OVERVIEW					9
Understanding Java SE and the Dalvik Virtual Machine , The Directory Structure of an Android Project , Common Default Resources Folders , The Values Folder , Leveraging Android XML, Screen Sizes , Launching Your Application: The AndroidManifest.xml File, Creating Your First Android Application; Android Application Components, Android Activities: Defining the UI, Android Services: Processing in the Background, Broadcast Receivers: Announcements and Notifications Content Providers: Data Management, Android Intent Objects: Messaging for Components Android Manifest XML: Declaring Your Components.						
UNIT 4:	ANDROID AND GUI					9
Designing for Different Android Devices, Views and View Groups, Android Layout Managers, The View Hierarchy, Designing an Android User Interface using the Graphical Layout Tool, Displaying Text with TextView, Retrieving Data from Users, Using Buttons, Check Boxes and Radio Groups, Getting Dates and Times from Users, Using Indicators to Display Data to Users, Adjusting Progress with SeekBar, Working with Menus using views, Displaying Pictures, Gallery, ImageSwitcher, GridView, and ImageView views to display images, Creating Animation, Intent Overview, Implicit Intents, Creating the Implicit Intent Example Project, Explicit Intents, Creating the Explicit Intent Example Application, Intents with Activities, Intents with Broadcast Receivers.						
UNIT 5:	FILES, DATABASES, MESSAGING, LOCATION-BASED SERVICES AND MULTIMEDIA					9
Saving and Loading Files, SQLite Databases, Android Database Design, Exposing Access to a Data Source through a Content Provider, Content Provider Registration, Native Content Providers. Sending SMS Messages Programmatically, Getting Feedback after Sending the Message Sending SMS Messages Using Intent Receiving, sending email, Introduction to location-based service, configuring the Android Emulator for Location-Based Services, Geocoding and Map-Based Activities, Playing Audio and Video, Recording Audio and Video, Using the Camera to Take and Process Pictures.						
						45 PERIODS
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	Identify various concepts of mobile programming that make it unique from					

	programming for other platforms
CO2:	Critique mobile applications on their design pros and cons
CO3:	Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces
CO4:	Program mobile applications for the Android operating system that use basic and advanced phone features
CO5:	Deploy applications to the Android marketplace for distribution
TEXT BOOKS	
1.	Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd ed. (2011)
REFERENCES	
1.	Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd, 2011
2.	Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd, 2010
3.	Barry Burd, "Android Application Development All in one for Dummies", John Wiley & Sons, 2011

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS317	MOBILE APPLICATION DEVELOPMENT LABORATORY	L	T	P	C	TOTAL MARKS
		0	0	4	2	100
PREREQUISITES: NONE						
COURSE OBJECTIVES						
The main objectives of this course are to:						
1	Introduce the fundamentals of mobile application development with emphasis on Android platform.					
2	Provide knowledge and practice in designing user interfaces using GUI components, layouts, fonts, and colors.					
3	Enable students to integrate device features such as GPS, storage, notifications, and alarms in applications.					
4	Develop the ability to connect applications with databases, external data sources, and implement multithreading.					
5	Encourage problem-solving and creativity through the design and development of real-world mobile applications.					
PRACTICAL EXERCISES:						
1.	Develop an application that uses GUI components, Font and Colours					
2.	Develop an application that uses Layout Managers and event listeners.					
3.	Develop a native calculator application.					
4.	Write an application that draws basic graphical primitives on the screen.					
5.	Develop an application that makes use of database.					
6.	Develop an application that makes use of RSS Feed.					
7.	Implement an application that implements Multi threading					
8.	Develop a native application that uses GPS location information.					
9.	Implement an application that writes data to the SD card.					
10.	Implement an application that creates an alert upon receiving a message.					
11.	Write a mobile application that creates alarm clock					
						30 PERIODS
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	Design and implement mobile applications using GUI components, layout managers, and event-driven programming.					
CO2:	Develop native applications that utilize device features such as GPS, SD card storage, and alarms.					
CO3:	Create applications that integrate with databases and external sources such as RSS feeds.					
CO4:	Apply multithreading and background processing to improve application performance.					
CO5:	Demonstrate the ability to design, test, and deploy functional mobile applications for real-world use.					
REFERENCES						
1.	Neil Smyth, Android Studio 4.2 Development Essentials – Kotlin Edition, Payload Media, 2021					
2.	Bill Phillips, Chris Stewart, Kristin Marsicano, Android Programming: The Big Nerd Ranch Guide, 4th Edition, Big Nerd Ranch, 2019					
3.	Joseph Anuzzi Jr., Lauren Darcey, Shane Conder, Introduction to Android Application Development, 5th Edition, Addison-Wesley, 2017					

4.	Ed Burnette, Hello, Android: Introducing Google's Mobile Development Platform, 4th Edition, Pragmatic Bookshelf, 2015
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CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	2	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	2	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	2	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.6	1.8	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS318	COMPETITIVE CODING	L	T	P	C	TOTAL MARKS
		0	0	2	1	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are:						
1	To impart knowledge of designing solutions to print various patterns or shapes.					
2	Be familiar with various number-based problems and their solutions.					
3	To understand problem concepts based on arrays and design solutions.					
4	Be familiar with functions, recursion, and to design the implementation of solutions based on recursion.					
5	To learn and develop solutions for problems on pointers.					
6	To understand and apply solutions based on linked lists, stacks, and queues					
UNIT 1:	BASIC PROBLEMS					3
<p>Pattern-based problems, triangle pattern, diamond shapes, Pascal shape, Floyd triangle, etc. Number-based problems: Prime, Armstrong, Strong, Perfect, Palindrome, Kaprekar numbers etc.</p> <p>Code the following</p> <ol style="list-style-type: none"> Print the multiplication table of a given number up to another specific number Find m power n Find out the generic root of a number by c program Sum of Prime factors of a number Display the factors of a given number Find whether given number is Armstrong or not? Find whether given number is Perfect or not? Find whether given number is Strong or not? Find whether given number is Palindrome or not? Find whether given number is Kaperkar or not? Print following patterns <p>a.</p> <pre> 5 5 4 5 4 3 5 4 3 2 5 4 3 2 1 </pre> <p>b.</p> <pre> 1 2 3 4 5 6 7 8 9 10 </pre> <p>c.</p> <pre> 1 2 3 4 5 1 2 3 4 1 2 3 1 2 1 </pre> <p>d.</p> <pre> * </pre>						

```

*****
*****
***
*

```

e.
3
44
555
6666
555
44
3

f.
1
3*2
6*5*4
10*9*8*7

12. Find nth Prime
13. Find first n primes
14. Find 1 to n primes
15. Find whether the given number is a perfect square or not.

UNIT 2:	ARRAY BASED PROBLEMS	3
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Array-based problems (one-dimensional and two-dimensional) – segregation-making two lists from one list making three lists from one list, list searching techniques, various sorting, special series problems, matrix printing in spiral order, matrix diagonal printing, maze problems, etc.
Character and string-based problems – removal of spaces, word reversal in sentence, reverse sentence without reversing words, making string shortest possible palindrome, etc.

Code the following:

1. Conversion from uppercase to lowercase using a C program
2. Counting different characters in a string using C program
3. Code which prints the initial of any name
4. Segregate 0's & 1's in a list. Segregate 0's, 1's & 2's in an array. Segregate positive and negative numbers in an array.
5. Find the second last index occurrence of a number in list of elements and if the given number does not occur twice, display -1.
6. Longest sub sequence in an array
7. Find the only number which occurs odd number of times in an array (where all other numbers are even) without counting.
8. Remove duplicates from sorted array
9. Print a given matrix in spiral form Given a 2d array, print it in spiral form. See the following examples.

Please comment down the code in other languages as well below –

Input:

```

1 2 3 4
5 6 7 8
9 10 11 12
13 14 15 16

```

Output:

1 2 3 4 8 12 16 15 14 13 9 5 6 7 11 10

Input:

1 2 3 4 5 6

7 8 9 10 11 12

13 14 15 16 17 18

Output:

1 2 3 4 5 6 12 18 17 16 15 14 13 7 8 9 10 11

10. Print the following pattern

Testcase 1:

1 1 1 1 1 2

3 2 2 2 2 2

3 3 3 3 3 4

5 4 4 4 4 4

5 5 5 5 5 6

7 6 6 6 6 6

Testcase 2:

1 1 1 2

3 2 2 2

3 3 3 4

11. Zigzag (or diagonal) traversal of Matrix

Given a 2D matrix, print all elements of the given matrix in diagonal order. For example, consider the following 5 X 4 input matrix.

```
1   2   3   4
5   6   7   8
9   10  11  12
13  14  15  16
17  18  19  20
```

Diagonal printing of the above matrix is

```
1   5   2   9   6   3   13  10   7   4   17  14   11
      8   18  15  12  19  16  20
```

12. Check for Matrix Symmetry

13. Removal of spaces in a string

14. Reverse words in sentence. Reverse sentence without reversing words

15. Make a string the shortest possible palindrome

UNIT 3: FUNCTIONS AND RECURSION

3

Functions and recursion, pointer-based problems, function pointers and array pointers

1. Write a C program to print Fibonacci series of given range.

2. Consider the below series: 0,0,2,1,4,2,6,3,8,4,10,5,12,6,14,7,16,8

This series is a mixture of 2 series. All the odd terms in this series form even numbers in ascending order, and every even term is derived from the previous term using the formula $(x/2)$

Write a program to find the nth term in this series.

The value n in a positive integer that should be read from stdin. The nth term that is calculated by the program should be written to stdout. You can assume that the n will not exceed 20,000.

3. Consider the following series: 1,1,2,3,4,9,8,27,16,81,32,243,64,729,128,2187...

This series is a mixture of 2 series – all the odd terms in this series form a geometric series, and all

the even terms form yet another geometric series. Write a program to find the nth term in the series. The value n is a positive integer that should be read from stdin. The nth term that is calculated by the program should be written to stdout. May consider that n not greater than 30.

4. There is a colony of 8 houses represented as cells arranged in a straight line. Each day, every cell competes with its adjacent cells (neighbours). Each day, for each cell, if its neighbours are both active or both inactive, the cell becomes inactive the next day; Otherwise, it becomes active the next day.

Assumptions: the two cells on the ends have a single adjacent cell, so the other adjacent cell can be assumed to be always inactive. Even after updating the cell state, consider its previous state for updating the state of other cells. Update the cell information of all cells simultaneously.

Write a function cellcompete which takes one 8 element array of integers cells representing the current state of 8 cells and one integer days representing the number of days to simulate. An integer value of 1 represents an active cell and value of 0 represents an inactive cell.

5. The least recently used (lru) cache algorithm evicts the element from the cache that was least recently used when the cache is full. After an element is requested from the cache, it should be added to the cache (if not there) and considered the most recently used element in the cache whether it is newly added or was already existing. Initially, the cache is empty. Implement the function lrucountmiss shall consist of an integer max_cache_size, an array pages and its length len and the function returns an integer indicating the number of cache misses m using the lru cache algorithm execution for the given input. Assume that the array pages always have pages numbered from 0 to 50. (a hit means the requested page is already existing in the cache and a miss means the requested page is not found in the cache). Input format: cache size s, the n pages being requested from the cache and the number of page requests n separated by a space.

6. Print palindrome from num to given number of digits when num is less than the max of given number of digits in the following pattern; otherwise, print "invalid."

Input:

3 2

[4,5,6,7,8,9,11,22,33,44,55,66,77,88,99]

7. Sandwich pattern Input:

5

Output:

1 *2 *3 *4 *5

11 *12 *13 *14 *15

21 *22 *23 *24 *25

16 *17 *18 *19 *20

6 *7 *8 *9 *10

Input: 6 Output:

1 *2 *3 *4 *5 *6

13 *14 *15 *16 *17 *18

25 *26 *27 *28 *29 *30

31 *32 *33 *34 *35 *36

19 *20 *21 *22 *23 *24

7 *8 *9 *10 *11 *12

8. TRAPEZIUM PATTERN INPUT:

4

OUTPUT:

1*2*3*4*17*18*19*20

5*6*7*14*15*16

8*9*12*13

10*11

9. Longest Increasing Subsequence using Longest Common Subsequence Algorithm

10. Number of sub arrays with negative product Array is {-1,2,-2} No. of negative products are

4.

UNIT 4:	LINKED LISTS	3
Linked lists, Queues, Stack, Graph and tree based problems 1.Merge two sorted lists into third list 2.Reverse linked list without using extra space 3. Sort the linked list without using extra space 4.Intersection of two linked lists 5.Swap pair wise nodes in Linked Lists 6.Count of triples (A, B, C) where A*C is greater than B*B, where A, B and C are integers..		
UNIT 5:	QUEUES STACKS GRAPH AND TREE BASED PROBLEMS	3
1.Implement Queue using Stack 2.Implement Stack using Queue 3.Design an Algorithm to find articulation point of a tree. 4.Convert a graph to a tree.		
15 PERIODS		
COURSE OUTCOMES		
At the end of this course, the students will be able to:		
CO1:	Design solutions for problems based on various printing patterns/shapes.	
CO2:	Demonstrate the basic principles of various number-based problems and design solutions	
CO3:	Apply appropriate algorithm design technique to solve array-based application problems	
CO4:	Identify suitable method to solve problems based on functions and recursion	
CO5:	Solve problems based on pointers	
TEXT BOOKS		
1.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, And Clifford Stein, Introduction To Algorithms, First Or Second Edition, Mcgraw Hill, 2001	
2.	Narasimha Karumanch Data , Structures and Algorithmic Thinking With Python, Careermonk Publications, 2015	
3.	Meenakshi& Kamal Rawat ,Dynamic Programming For Coding Interviews. A Bottom-Up Approach To Problem Solving,Notion Press 2017	
REFERENCES		
1.	Guide To Competitive Programming: Learning And Improving Algorithms Through Contests (Undergraduate Topics In Computer Science) Springer, 2020	
2.	https://cses.fi/book/book.pdf . https://www.comp.nus.edu.sg/~stevenha/myteaching/	
3.	https://www.javatpoint.com/programs-list https://practice.geeksforgeeks.org/	

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	3	2	1	2	-	-	2	2	-	3	2	3
CO2:	3	3	3	2	2	2	-	-	1	1	-	3	3	3
CO3:	2	3	2	1	2	1	-	-	1	1	-	2	2	2
CO4:	2	3	3	2	2	2	-	-	2	2	-	3	2	2
CO5:	3	3	3	2	3	3	2	2	3	2	2	3	3	3
AVG	2.4	3.9	2.8	1.8	2.0	1.0	0.4	0.4	1.8	1.6	0.4	2.8	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS310	DESIGN THINKING AND INNOVATIONS	L	T	P	C	TOTAL MARKS
		0	0	4	2	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Demonstrate the significance of design thinking and contrast it with traditional problem-solving techniques.					
2	Manipulate each phase of the design thinking process to solve human-centered problems.					
3	Equip students with essential tools and techniques for user-centered design, creative idea generation, and rapid prototyping					
4	Understand innovation types, overcome barriers, analyze success stories, and effectively pitch ideas.					
5	Build innovative models through ideation and prototyping tools and strategies.					
UNIT 1:	INTRODUCTION TO DESIGN THINKING					9
Definition and importance of design thinking - Comparison with traditional problem-solving approaches - Key principles: Empathy, experimentation, and iteration. Problem Reframing Techniques.						
UNIT 2:	PHASES OF DESIGN THINKING					9
Empathize: Understanding users and their needs - Define: Framing the right problem to solve. Ideate: Generating a wide range of ideas - Prototype: Building representations of ideas - Test: Gathering feedback to refine solutions.						
UNIT 3:	TOOLS AND TECHNIQUES					9
Empathy maps, user personas, journey mapping - Brainstorming, SCAMPER, mind mapping - Rapid prototyping techniques: sketches, models, digital tools. Rapid idea generation tools for expanding creative thinking.						
UNIT 4:	INNOVATION STRATEGIES					9
Types of innovation: product, process, business model - Barriers to innovation and how to overcome them - Case studies of successful innovations- Presenting and pitching ideas to stakeholders						
UNIT 5:	SUSTAINABLE DESIGN AND PROTOTYPING					9
Design thinking for sustainability and social Impact. Tangible outcomes in terms of design and prototype development						
45 PERIODS						
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	Distinguish between traditional and design thinking approaches through hands-on comparisons.					
CO2:	Apply the five phases of design thinking to solve a user-focused problem.					
CO3:	Create and use empathy-based design tools to develop human-centric solutions.					
CO4:	Analyze innovation types, strategies, case studies, and confidently pitch ideas to stakeholders.					
CO5:	Develop sustainable, impactful solutions through design thinking and prototyping.					
REFERENCES						
1.	Jeanne Liedtka, Randy Salzman, Daisy Azer, Experiencing Design: The Innovator's Journey, Columbia Business School Publishing, 2021					
2.	Arne van Oosterom, Marcel Zwiers, This is Design Thinking. This is Service Design Doing, BIS Publishers, 202					
3.	Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Bloomsbury Academic, 2nd Edition, 2022					

4.	Michael Lewrick, Patrick Link, Larry Leifer, The Design Thinking Toolbox: A Guide to Mastering the Most Popular and Valuable Innovation Methods, Wiley, 2020
5.	Robert Curedale, Design Thinking Process and Methods 5th Edition, Design Community College Inc., 2021.

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	2	1	1	2	2	3	3	3	2	2	3	2	3
CO2:	3	3	2	2	3	2	3	2	3	2	3	3	3	3
CO3:	3	3	3	2	3	2	2	2	2	1	3	3	3	3
CO4:	2	2	2	2	2	2	2	2	3	2	2	2	2	2
CO5:	3	2	2	2	2	3	3	3	3	2	3	3	3	3
AVG	2.8	2.4	2.0	1.8	2.4	1.2	2.6	2.4	2.8	1.8	2.6	2.8	2.6	2.8

1 - low, 2 - medium, 3 - high

SEMESTER VIII

BCS401	CRYPTOGRAPHY AND CYBER SECURITY	L	T	P	C	TOTAL MARKS
		3	0	2	4	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Learn to analyze the security of in-built cryptosystems.					
2	Know the fundamental mathematical concepts related to security.					
3	Develop cryptographic algorithms for information security.					
4	Comprehend the various types of data integrity and authentication schemes					
5	Understand cyber crimes and cyber security.					
UNIT 1:	INTRODUCTION TO COMPUTER SECURITY					9
Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services and Mechanisms, A Model for Network Security, Classical encryption techniques: Substitution techniques, Transposition techniques, Steganography, Foundations of modern cryptography: Perfect security , Information Theory, Product Cryptosystem, Cryptanalysis						
UNIT 2:	SYMMETRIC CIPHERS					9
Number theory , Algebraic Structures, Modular Arithmetic , Euclid’s algorithm, Congruence and matrices – Group, Rings, Fields, Finite Fields SYMMETRIC KEY CIPHERS: SDES, Block Ciphers DES, Strength of DES , Differential and linear cryptanalysis, Block cipher design principles , Block cipher mode of operation, Evaluation criteria for AES, Pseudorandom Number Generators, RC4 Key distribution..						
UNIT 3:	ASYMMETRIC CRYPTOGRAPHY					9
MATHEMATICS OF ASYMMETRIC KEY CRYPTOGRAPHY: Primes, Primality Testing, Factorization, Euler’s totient function, Fermat’s and Euler’s Theorem, Chinese Remainder Theorem, Exponentiation and logarithm ASYMMETRIC KEY CIPHERS: RSA cryptosystem, Key distribution, Key management, Diffie Hellman key exchange, Elliptic curve arithmetic, Elliptic curve cryptography						
UNIT 4:	INTEGRITY AND AUTHENTICATION ALGORITHMS					9
Authentication requirement – Authentication function – MAC – Hash function – Security of hash function: HMAC, CMAC – SHA – Digital signature and authentication protocols – DSS – Schnorr Digital Signature Scheme – ElGamal cryptosystem – Entity Authentication: Biometrics, Passwords, Challenge Response protocols – Authentication applications – Kerberos MUTUAL TRUST: Key management and distribution – Symmetric key distribution using symmetric and asymmetric encryption – Distribution of public keys – X.509 Certificates.						
UNIT 5:	CYBER CRIMES AND CYBER SECURITY					9
Cyber Crime and Information Security – classifications of Cyber Crimes – Tools and Methods – Password Cracking, Keyloggers, Spywares, SQL Injection – Network Access Control – Cloud Security – Web Security – Wireless Security						
						45 PERIODS
PRACTICAL EXERCISES						15 PERIODS
1.	Implementation of Caesar Cipher, Monoalphabetic Cipher, and Playfair Cipher.					
2.	Implementation of Rail Fence Cipher and Columnar Transposition Cipher.					
3.	Steganography – Hide and retrieve messages from media files.					
4.	Simulation of Simplified DES (SDES) algorithm.					
5.	Implementation of DES algorithm with different block cipher modes.					

6.	Implementation of AES algorithm and performance analysis.
7.	RSA algorithm – key generation, encryption, and decryption.
8.	Simulation of Diffie-Hellman key exchange.
9.	Implementation of SHA-256 and HMAC for message authentication.
10.	Digital signature generation and verification using RSA/DSS.
11.	Simulation of Kerberos authentication protocol.
12.	Demonstration of cybersecurity tools – password cracking, SQL injection, and packet analysis using Wireshark.
60 PERIODS	
COURSE OUTCOMES	
At the end of this course, the students will be able to:	
CO1:	Understand the fundamentals of networks security, security architecture, threats and vulnerabilities .
CO2:	Apply the different cryptographic operations of symmetric cryptographic algorithms
CO3:	Apply the different cryptographic operations of public key cryptography
CO4:	Apply the various Authentication schemes to simulate different applications.
CO5:	Understand various cyber crimes and cyber security.
TEXT BOOKS	
1.	William Stallings, "Cryptography and Network Security - Principles and Practice", Seventh Edition, Pearson Education, 2017.
2.	Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber crimes, Computer Forensics and Legal Perspectives", First Edition, Wiley India, 2011.
REFERENCES	
1.	Behrouz A. Ferouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", 3rd Edition, Tata Mc Graw Hill, 2015.
2.	Charles Pfleeger, Shari Pfleeger, Jonathan Margulies, "Security in Computing", Fifth Edition, Prentice Hall, New Delhi, 2015.

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

ELECTIVE I

BCS341	SOFT COMPUTING	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience					
2	Provide the mathematical background for carrying out the optimization associated with neural network learning					
3	Learn various evolutionary Algorithms					
4	Become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems.					
5	Introduce case studies utilizing the above and illustrate the Intelligent behavior of programs based on soft computing					
UNIT 1: INTRODUCTION TO SOFT COMPUTING AND FUZZY LOGIC						9
Introduction, Fuzzy Logic, Fuzzy Sets, Fuzzy Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Operations on Fuzzy Relations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems						
UNIT 2: NEURAL NETWORKS						9
Supervised Learning Neural Networks, Perceptrons, Backpropagation, Multilayer, Perceptrons – Unsupervised Learning Neural Networks, Kohonen Self-Organizing Networks						
UNIT 3: GENETIC ALGORITHMS						9
Chromosome Encoding Schemes, Population initialization and selection methods, Evaluation function Genetic operators- Cross over, Mutation, Fitness Function, Maximizing function						
UNIT 4: NEURO FUZZY MODELLING						9
ANFIS architecture, hybrid learning, ANFIS as universal approximator, Coactive Neuro fuzzy modeling Framework, Neuron functions for adaptive networks, Neuro fuzzy spectrum, Analysis of Adaptive Learning Capability						
UNIT 5: APPLICATIONS						9
Modeling a two input sine function, Printed Character Recognition, Fuzzy filtered neural networks – Plasma Spectrum Analysis, Hand written neural recognition, Soft Computing for Color Recipe Prediction.						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Understand the fundamentals of fuzzy logic operators and inference mechanisms					
CO2:	Understand neural network architecture for AI applications such as classification and clustering					
CO3:	Learn the functionality of Genetic Algorithms in Optimization problems					
CO4:	Use hybrid techniques involving Neural networks and Fuzzy logic					
CO5:	Apply soft computing techniques in real world applications					
TEXT BOOKS						
1.	Sajang, J.-S. R., Sun, C.-T., & Mizutani, E. (1997). Neuro-fuzzy and soft computing: A computational approach to learning and machine intelligence. Upper Saddle River, NJ, Prentice Hall, 1997					
2.	Himanshu Singh, Yunis Ahmad Lone, Deep Neuro-Fuzzy Systems with Python With Case Studies and Applications from the Industry, Apress, 2020					
REFERENCE BOOKS						

1.	Roj Kaushik and Sunita Tiwari, Soft Computing-Fundamentals Techniques and Applications, 1st Edition, McGraw Hill, 2018.
2.	S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003
3.	Samir Roy, Udit Chakraborty, Introduction to Soft Computing, Neuro Fuzzy and Genetic Algorithms, Pearson Education, 2013
4.	S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, Third Edition, Wiley India Pvt Ltd, 2019.

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS342	SOCIAL NETWORK SECURITY	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Develop semantic web related simple applications					
2	Explain Privacy and Security issues in Social Networking					
3	Explain the data extraction and mining of social networks					
4	Discuss the prediction of human behavior in social communities					
5	Describe the Access Control, Privacy and Security management of social networks					
UNIT 1:	FUNDAMENTALS OF SOCIAL NETWORKING					9
Introduction to Semantic Web, Limitations of current Web, Development of Semantic Web, Emergence of the Social Web, Social Network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis, Historical overview of privacy and security, Major paradigms, for understanding privacy and security						
UNIT 2:	SECURITY ISSUES IN SOCIAL NETWORKS					9
The evolution of privacy and security concerns with networked technologies, Contextual influences on privacy attitudes and behaviors, Anonymity in a networked world						
UNIT 3:	EXTRACTION AND MINING IN SOCIAL NETWORKING DATA					9
Extracting evolution of Web Community from a Series of Web Archive, Detecting communities in social networks, Definition of community, Evaluating communities, Methods for community detection and mining, Applications of community mining algorithms, Tools for detecting communities social network infrastructures and communities, Big data and Privacy						
UNIT 4:	PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES					9
Understanding and predicting human behavior for social communities, User data Management, Inference and Distribution, Enabling new human experiences, Reality mining, Context, Awareness, Privacy in online social networks, Trust in online environment, What is Neo4j, Nodes, Relationships, Properties						
UNIT 5:	ACCESS CONTROL, PRIVACY AND IDENTITY MANAGEMENT					9
Understand the access control requirements for Social Network, Enforcing Access Control Strategies, Authentication and Authorization, Roles-based Access Control, Host, storage and network access control options, Firewalls, Authentication, and Authorization in Social Network, Identity & Access Management, Single Sign-on, Identity Federation, Identity providers and service consumers, The role of Identity provisioning						
45 PERIODS						
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	Develop semantic web related simple applications					
CO2:	Address Privacy and Security issues in Social Networking					
CO3:	Explain the data extraction and mining of social networks					
CO4:	Discuss the prediction of human behavior in social communities					
CO5:	Describe the applications of social networks					
TOTAL:45 PERIODS						
TEXT BOOKS						
1.	Peter Mika, Social Networks and the Semantic Web, First Edition, Springer 2007.					
2.	BorkoFurht, Handbook of Social Network Technologies and Application, First Edition, Springer, 2010.					
3.	Learning Neo4j 3.x Second Edition By Jérôme Baton, Rik Van Bruggen, Packt publishing					

REFERENCES	
1.	Easley D. Kleinberg J., Networks, Crowds, and Markets – Reasoning about a Highly Connected World, Cambridge University Press, 2010.
2.	Jackson, Matthew O., Social and Economic Networks, Princeton University Press, 2008.
3.	Guandong Xu, Yanchun Zhang and Lin Li, —Web Mining and Social Networking – Techniques and applications, First Edition, Springer, 2011.
4.	Dion Goh and Schubert Foo, Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively, IGI Global Snippet, 2008.
5.	Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modeling, IGI Global Snippet, 2009

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS343	GRID AND CLOUD COMPUTING	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: Distributed Computing						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Understand about the Grid computing					
2	Gain knowledge in the grid services and architecture					
3	To gain knowledge about virtualization Infrastructure.					
4	To explore and experiment with various Cloud deployment environments.					
5	To learn about the security issues in the cloud environment.					
UNIT 1:	INTRODUCTION					9
Evolution of Distributed computing: Scalable computing over the Internet , Technologies for network based systems – clusters of cooperative computers - Grid computing Infrastructures, cloud computing - service oriented architecture – Introduction to Grid Architecture and standards Elements of Grid – Overview of Grid Architecture						
UNIT 2:	GRID SERVICES					9
Introduction to Open Grid Services Architecture (OGSA), Motivation, Functionality Requirements – Practical & Detailed view of OGSA/OGSI – Data intensive grid service models – OGSA services						
UNIT 3:	CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE					9
Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture, Cloud deployment models – Cloud service models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges- Virtual Machine Basics Taxonomy of Virtual Machines – Hypervisor – Key Concepts –Virtualization structure – Implementation levels of virtualization						
UNIT 4:	VIRTUALIZATION INFRASTRUCTURE AND DOCKER					9
Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating, Virtualization – Application Virtualization – Virtual clusters and Resource Management – Containers vs. Virtual Machines – Introduction to Docker – Docker Components – Docker Container – Docker Images and Repositories.						
UNIT 5:	CLOUD DEPLOYMENT ENVIRONMENT and CLOUD SECURITY					9
Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack.- Specific Attacks: Guest hopping – VM migration attack – hyperjacking. Data Security and Storage						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Understand the design challenges in the grid					
CO2:	Understand the grid architecture and its types					
CO3:	Understand the design challenges in the cloud environment					
CO4:	Apply the concept of virtualization and its type					
CO5:	Explain security challenges in the cloud environment.					
TEXT BOOKS						
1.	Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012					
2.	James Turnbull, “The Docker Book”, O’Reilly Publishers, 2014.					

REFERENCE BOOKS

1.	James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
2.	Tim Mather, Subra Kumaraswamy, and Shahed Latif, “Cloud Security and Privacy: an enterprise perspective on risks and compliance”, O’Reilly Media, Inc., 2009.

CO’s-PO’s & PSO’s MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS344	MULTIMEDIA AND ANIMATION	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: Computer Graphics and Multimedia						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	To grasp the fundamental knowledge of Multimedia elements and systems					
2	To get familiar with Multimedia file formats and standards					
3	To learn the process of Authoring multimedia presentations					
4	To learn the techniques of animation in 2D and 3D and for the mobile UI					
5	To explore different popular applications of multimedia					
UNIT 1:	INTRODUCTION TO MULTIMEDIA					9
Definitions, Elements, Multimedia Hardware and Software, Distributed multimedia systems, challenges: security, sharing / distribution, storage, retrieval, processing, computing. Multimedia metadata, Multimedia databases, Hypermedia, Multimedia Learning						
UNIT 2:	MULTIMEDIA FILE FORMATS AND STANDARDS					9
File formats – Text, Image file formats, Graphic and animation file formats, Digital audio and Videofile formats, Color in image and video, Color Models. Multimedia data and file formats for the web						
UNIT 3:	MULTIMEDIA AUTHORIZING					9
Authoring metaphors, Tools Features and Types: Card and Page Based Tools, Icon and Object Based Tools, Time Based Tools, Cross Platform Authoring Tools, Editing Tools, Painting and Drawing Tools, 3D Modeling and Animation Tools, Image Editing Tools, audio Editing Tools, Digital Movie Tools, Creating interactive presentations, virtual learning, simulations						
UNIT 4:	ANIMATION					9
Principles of animation: staging, squash and stretch, timing, onion skinning, secondary action, 2D, 2 ½ D, and 3D animation, Animation techniques: Keyframe, Morphing, Inverse Kinematics, Hand Drawn, Character rigging, vector animation, stop motion, motion graphics, , Fluid Simulation, skeletal animation, skinning Virtual Reality, Augmented Reality						
UNIT 5:	MULTIMEDIA APPLICATIONS					9
Multimedia Big data computing, social networks, smart phones, surveillance, Analytics, Multimedia Cloud Computing, Multimedia streaming cloud, media on demand, security and forensics, Online social networking, multimedia ontology, Content based retrieval from digital libraries.						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Get the bigger picture of the context of Multimedia and its applications					
CO2:	Use the different types of media elements of different formats on content pages					
CO3:	Author 2D and 3D creative and interactive presentations for different target multimedia applications.					
CO4:	Use different standard animation techniques for 2D, 2 1/2 D, 3D applications					
CO5:	Understand the complexity of multimedia applications in the context of cloud, security, bigdata streaming, social networking, CBIR etc.,					
TEXT BOOKS						
1.	Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, Fundamentals of Multimedia”, Third Edition, Springer Texts in Computer Science, 2021..					
2.	John M Blain, The Complete Guide to Blender Graphics: Computer Modeling & Animation, CRC press, 3 rd Edition, 2016					
REFERENCES						
1.	Gerald Friedland, Ramesh Jain, “Multimedia Computing”, Cambridge University Press, 2018.					
2.	Mohsen Amini Salehi, Xiangbo Li, “Multimedia Cloud Computing Systems”, Springer Nature, 1 st Edition, 2021.					

3.	Mark Gaimbruno, “3D Graphics and Animation”, Second Edition, New Riders, 2002.
4.	Rogers David, “Animation: Master – A Complete Guide (Graphics Series)”, Charles River Media, 2006.
5.	Rick parent, “Computer Animation: Algorithms and Techniques”, Morgan Kauffman, 3 rd Edition, 2012.

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS345	DATA VISUALIZATION TECHNIQUES	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	To develop skills to both design and critique visualizations.					
2	To introduce visual perception and core skills for visual analysis.					
3	To understand technological advancements of data visualization					
4	To understand various data visualization techniques					
5	To understand the methodologies used to visualize large data sets					
UNIT 1:	INTRODUCTION AND DATA FOUNDATION					9
Basics - Relationship between Visualization and Other Fields, The Visualization Process , Pseudo code Conventions - The Scatter plot. Data Foundation, Types of Data - Structure within and between Records - Data Preprocessing - Data Sets						
UNIT 2:	FOUNDATIONS FOR VISUALIZATION					9
Visualization stages - Semiology of Graphical Symbols - The Eight Visual Variables – Historical Perspective - Taxonomies - Experimental Semiotics based on Perception Gibson’s Affordance theory – A Model of Perceptual Processing						
UNIT 3:	VISUALIZATION TECHNIQUES					9
Spatial Data: One-Dimensional Data - Two-Dimensional Data – Three Dimensional Data - Dynamic Data - Combining Techniques. Geospatial Data : Visualizing Spatial Data - Visualization of Point Data - Visualization of Line Data - Visualization of Area Data – Other Issues in Geospatial Data Visualization Multivariate Data : Point-Based Techniques - LineBased Techniques - Region-Based Techniques - Combinations of Techniques – Trees Displaying Hierarchical Structures – Graphics and Networks- Displaying Arbitrary Graphs/Networks.						
UNIT 4:	INTERACTION CONCEPTS AND TECHNIQUES					9
Text and Document Visualization: Introduction - Levels of Text Representations - The Vector Space Model - Single Document Visualizations -Document Collection Visualizations – Extended Text Visualizations Interaction Concepts: Interaction Operators - Interaction Operands and Spaces A Unified Framework. Interaction Techniques: Screen Space - Object-Space –Data Space - Attribute Space- Data Structure Space - Visualization Structure – Animating Transformations - Interaction Control						
UNIT 5:	RESEARCH DIRECTIONS IN VISUALIZATIONS					9
Steps in designing Visualizations – Problems in designing effective Visualizations- Issues of Data. Issues of Cognition, Perception, and Reasoning. Issues of System Design Evaluation , Hardware and Applications						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Visualize the objects in different dimensions.					
CO2:	Design and process the data for Visualization.					
CO3:	Apply the visualization techniques in physical sciences, computer science, applied mathematics and medical sciences					
CO4:	Apply the virtualization techniques for research projects.					
CO5:	Identify appropriate data visualization techniques given particular requirements imposed by the data.					
TEXT BOOKS						
1.	Matthew Ward, Georges Grinstein and Daniel Keim, “Interactive Data Visualization Foundations, Techniques, Applications”, 2010.					
2.	Colin Ware, “Information Visualization Perception for Design”, 4th edition, Morgan Kaufmann Publishers, 2021.					
REFERENCES						
1.	Robert Spence “Information visualization – Design for interaction”, Pearson Education, 2nd Edition, 2007.					

2.	Alexandru C. Telea, "Data Visualization: Principles and Practice," A. K. Peters Ltd, 2008.
3.	Matthew Ward, Georges Grinstein and Daniel Keim, "Interactive Data Visualization Foundations, Techniques, Applications", 2010.

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS346	APPLICATION DEVELOPMENT	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES:NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Introduce the basic concepts of application development, types of applications, and tools for development					
2	Teach the fundamentals of creating user interfaces using HTML, CSS, and JavaScript.					
3	Provide an introduction to server-side programming and interaction with RESTful APIs.					
4	Introduce the tools and techniques for designing and developing mobile applications.					
5	Enable students to apply their acquired knowledge to solve real-world problems by designing and deploying a comprehensive application.					
UNIT 1:	FUNDAMENTALS OF APPLICATION DEVELOPMENT					9
Introduction to Application Development: Types of Applications: Web, Mobile, Desktop-Key Development Stages: Design, Development, Deployment. Tools and Platforms Overview: IDEs: VS Code, Android Studio Version Control: Git and GitHub Basics, Basic Programming Concepts Refresher						
UNIT 2:	FRONTEND DEVELOPMENT ESSENTIALS					9
HTML: Structuring Web Pages, CSS: Styling the Interface, JavaScript Basics: DOM Manipulation, Event Handling, Simple Animations.						
UNIT 3:	BACKEND DEVELOPMENT AND APIs					9
Introduction to Backend Development: Basics of Python Flask or Node.js - Server-Side Scripting Fundamentals, Introduction to RESTful APIs: Understanding APIs and Endpoints - Using Public APIs, Basic Security in Applications						
UNIT 4:	MOBILE APPLICATION DEVELOPMENT					9
Introduction to Mobile App Development: Overview of Android Studio or Flutter/Dart -Designing Basic Mobile App Interfaces - Responsive and Adaptive Layouts, Working with Local Storage (SQLite/Firebase).						
UNIT 5:	PROJECT DEVELOPMENT AND DEPLOYMENT					9
Basics of Application Deployment: Web Applications: GitHub Pages, Netlify - Mobile Applications: Generating and Testing APK Files, Final Project Guidance: Designing the Application Flow - Integrating Frontend, Backend, and Database.						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Students will be able to set up a development environment and understand the key stages of application development.					
CO2:	Students will be able to design and implement responsive and interactive web pages.					
CO3:	Students will be able to develop basic server-side logic and integrate public APIs into applications.					
CO4:	Students will be able to create a simple mobile app with responsive layouts and local storage integration.					
CO5:	Students will be able to successfully design, implement, and deploy a real-world application that integrates all components of application development					
TEXT BOOKS						
1.	Mike Scobey and Jeffrey Rosenblatt, Web Programming and Internet Technologies, Jones & Bartlett Learning, 2020					

2.	Eric Matthes, Python Crash Course: A Hands-On, Project-Based Introduction to Programming (2nd Edition), No Starch Press, 2019
3.	Elisabeth Robson and Eric Freeman, Head First HTML and CSS, O'Reilly Media, 2012
REFERENCE BOOKS	
1.	Douglas Crockford , "JavaScript: The Good Parts" by, O'Reilly Media, 2008
2.	Alessandro Biessek , Flutter for Beginners" by, Packt Publishing, 2020
3.	Shalabh Aggarwal, Full-Stack Web Development with Flask, 2021
4.	Jennifer Niederst Robbins, Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics" by O'Reilly Media, 2018 (5th Edition).
5.	Mark Masse , "REST API Design Rulebook" O'Reilly Media, 2011

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

ELECTIVE II

BCS348	MACHINE LEARNING FOR REAL WORLD APPLICATIONS	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES:NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Understand the fundamentals in machine learning					
2	Understand pattern classification algorithms to classify multivariate data					
3	Understand the Implementation of genetic algorithms					
4	Gain knowledge about Q-Learning					
5	Create new machine learning techniques.					
UNIT 1:	BASICS					9
Learning Problems Perspectives and Issues Concept Learning Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search						
UNIT 2:	NEURAL NETWORKS AND GENETIC ALGORITHMS					9
Neural Network Representation Problems Perceptions Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms Hypothesis Space Search– Genetic Programming – Models of Evolutions and Learning						
UNIT 3:	BAYESIAN AND COMPUTATIONAL LEARNING					9
Bayes Theorem Concept Learning Maximum Likelihood Minimum Description Length Principle Bayes Optimal Classifier Gibbs Algorithm Naïve Bayes Classifier Bayesian Belief Network EM Algorithm Probability Learning Sample Complexity Finite and Infinite Hypothesis Spaces – Mistake Bound Model.						
UNIT 4:	NEURO FUZZY MODELLING					9
K- Nearest Neighbor Learning Locally weighted Regression Radial Bases Functions – Case Based Learning.						
UNIT 5:	ADVANCED LEARNING					9
Learning Sets of Rules Sequential Covering Algorithm Learning Rule Set First Order Rules Sets of First Order Rules Induction on Inverted Deduction Inverting Resolution Analytical Learning Perfect Domain Theories Explanation Base Learning – FOCL Algorithm - Reinforcement Learning Task Learning Temporal Difference Learning						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Analyse the problem to be solved using the appropriate machine learning algorithm					
CO2:	Develop and apply pattern classification algorithms to classify multivariate data					
CO3:	Develop and apply regression algorithms for finding relationships between data variables					
CO4:	Develop and apply reinforcement learning algorithms for learning to control complex systems					
CO5:	Write scientific reports on computational machine learning methods, results and conclusions.s					
TEXT BOOKS						
1.	Tom M. Mitchell, “Machine Learning”, McGraw-Hill, 2010					
2.	Bishop, Christopher. Neural Networks for Pattern Recognition. New York, NY: Oxford University Press, 1995					
REFERENCE BOOKS						
1.	Ethem Alpaydin, (2004) “Introduction to Machine Learning (Adaptive Computation and Machine Learning)”, The MIT Press					
2.	T. astie, R. Tibshirani, J. H. Friedman, “The Elements of Statistical Learning”, Springer(2nd ed.),					

	2009
3.	Aurélien Géron Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, Inc. 2nd Edition

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS349	DIGITAL FORENSICS	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	To understand basic digital forensics and techniques.					
2	To understand digital crime and investigation.					
3	To understand how to be prepared for digital forensic readiness.					
4	To understand and use forensics tools for iOS devices.					
5	To understand and use forensics tools for Android devices					
UNIT 1:	INTRODUCTION TO DIGITAL FORENSICS					9
Forensic Science – Digital Forensics – Digital Evidence – The Digital Forensics Process – Introduction – The Identification Phase – The Collection Phase – The Examination Phase – The Analysis Phase – The Presentation Phase						
UNIT 2:	DIGITAL CRIME AND INVESTIGATION					9
Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – International Cooperation to Collect Digital Evidence						
UNIT 3:	DIGITAL FORENSIC READINESS					9
Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness – Challenges in Digital Forensics						
UNIT 4:	iOS FORENSICS					9
Mobile Hardware and Operating Systems - iOS Fundamentals – Jailbreaking – File System – Hardware – iPhone Security – iOS Forensics – Procedures and Processes – Tools – Oxygen Forensics – MobilEdit – iCloud						
UNIT 5:	ANDROID FORENSICS					9
Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security – Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools – Oxygen Forensics – MobilEdit – Android App Decompiling						
						60 PERIODS
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	Have knowledge on digital forensics.					
CO2:	Know about digital crime and investigations.					
CO3:	Be forensic ready.					
CO4:	Investigate, identify and extract digital evidence from iOS devices.					
CO5:	Investigate, identify and extract digital evidence from Android devices.					
						TOTAL:60 PERIODS
TEXT BOOKS						
1.	Andre Arnes, “Digital Forensics”, Wiley, 2018.					
2.	Chuck Eastom, “An In-depth Guide to Mobile Device Forensics”, First Edition, CRC Press, 2022..					
REFERENCES						
1.	Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, CharlesRiver Media, 2005, ISBN: 1-58450-389.					

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS350	SOFTWARE DEFINED NETWORKS	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES:NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Understand the need for SDN and its data plane operations					
2	Understand the functions of control plane					
3	Comprehend the migration of networking functions to SDN environment					
4	Explore various techniques of network function virtualization					
5	Comprehend the concepts behind network virtualization					
UNIT 1: SDN: INTRODUCTION						9
Evolving Network Requirements – The SDN Approach – SDN architecture - SDN Data Plane , Control plane and Application Plane						
UNIT 2: SDN DATA PLANE AND CONTROL PLANE						9
Data Plane functions and protocols - OpenFlow Protocol - Flow Table - Control Plane Functions - Southbound Interface, Northbound Interface – SDN Controllers - Ryu, OpenDaylight, ONOS - Distributed Controllers						
UNIT 3: SDN APPLICATIONS						9
SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking						
UNIT 4: NETWORK FUNCTION VIRTUALIZATION						9
Network Virtualization - Virtual LANs – OpenFlow VLAN Support - NFV Concepts – Benefits and Requirements – Reference Architecture						
UNIT 5: NFV FUNCTIONALITY						9
NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Describe the motivation behind SDN					
CO2:	Identify the functions of the data plane and control plane					
CO3:	Design and develop network applications using SDN					
CO4:	Orchestrate network services using NFV Explain various use cases of SDN and NFV					
CO5:	Explain various use cases of SDN and NFV					
TEXT BOOKS						
1.	William Stallings, “Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud”, Pearson Education, 1st Edition, 2015.					
2.	Ken Gray, Thomas D. Nadeau, “Network Function Virtualization”, Morgan Kauffman, 2016					
REFERENCE BOOKS						
1.	Thomas D Nadeau, Ken Gray, “SDN: Software Defined Networks”, O’Reilly Media, 2013.					
2.	Fei Hu, “Network Innovation through OpenFlow and SDN: Principles and Design”, 1st Edition, CRC Press, 2014					
3.	Paul Goransson, Chuck Black Timothy Culver, “Software Defined Networks: A Comprehensive Approach”, 2nd Edition, Morgan Kaufmann Press, 2016.					
4.	Oswald Coker, Siamak Azodolmolky, “Software-Defined Networking with OpenFlow”, 2nd Edition, O’Reilly Media, 2017.					

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS351	AUGMENTED REALITY AND VIRTUAL REALITY	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: BCS303						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Provide foundational knowledge of Augmented Reality (AR), Virtual Reality (VR), and related immersive technologies.					
2	Familiarize students with AR/VR hardware, software, display systems, and interaction techniques.					
3	Develop skills in 3D modeling, animation, and content creation for immersive applications.					
4	Introduce tracking, registration, and calibration methods for AR/VR environments.					
5	Explore advanced AR/VR applications, future trends, and ethical considerations in immersive technology.					
UNIT 1: INTRODUCTION TO AR AND VR						9
Definitions and scope of AR and VR – History and evolution of immersive technologies – Differences between AR, VR, and MR – AR/VR system components (hardware, software, sensors, tracking devices) – Display technologies (HMDs, CAVE systems, handheld devices, holographic displays) – Input devices and controllers – Applications in gaming, education, healthcare, manufacturing, military training, architecture, and tourism.						
UNIT 2: FUNDAMENTALS OF VIRTUAL REALITY						9
Concepts of immersion, presence, and interactivity – Types of VR systems (non-immersive, semi-immersive, fully immersive) – 3D graphics fundamentals: coordinate systems, geometric transformations, viewing pipeline, shading, and rendering – VR hardware: motion trackers, controllers, haptic devices, treadmills – VR locomotion techniques – Audio in VR: spatial audio, binaural sound, ambisonics – Challenges in VR such as motion sickness, latency, and performance optimization						
UNIT 3: FUNDAMENTALS OF AUGMENTED REALITY						9
AR architecture and components – Tracking techniques: marker-based, markerless, model-based, inertial tracking, and SLAM – Registration and calibration methods – AR SDKs and frameworks: ARCore, ARKit, Vuforia, Wikitude, Unity, Unreal Engine – Computer vision basics for AR – Interaction techniques in AR: touch, gesture, gaze, voice – Lighting and occlusion handling in AR – AR usability and design considerations.						
UNIT 4: CONTENT CREATION AND INTERACTION TECHNIQUES						9
3D modeling, mesh generation, and optimization – Texturing, shading, and animation for immersive environments – Interaction design principles for AR/VR – Gesture recognition algorithms and frameworks – Gaze-based and voice-based control – Storytelling techniques for immersive experiences – UX design for AR/VR applications – Real-time rendering optimization – Asset management and pipeline for AR/VR content – Multi-user and collaborative AR/VR experiences.						
UNIT 5: ADVANCED TOPICS AND FUTURE TRENDS						9
Mixed Reality concepts and integration – AR Cloud and persistent AR – AR/VR in IoT and Industry 4.0 – AI-driven AR/VR applications – Edge computing for AR/VR – Holographic and volumetric displays – Brain-computer interfaces – Tactile internet for haptic feedback – Ethical, legal, and privacy concerns – Standards and interoperability – Future research directions – Case studies of successful AR/VR implementations.						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Explain the principles, components, and applications of Augmented Reality, Virtual Reality, and Mixed Reality technologies.					
CO2:	Apply 3D graphics concepts, tracking techniques, and interaction methods to create immersive experiences.					
CO3:	Develop AR and VR applications using appropriate SDKs, frameworks, and development tools.					

CO4:	Analyze performance, usability, and interaction issues in AR/VR systems.
CO5:	Evaluate ethical, privacy, and security concerns associated with immersive technologies.
TEXT BOOKS	
1.	Alan B. Craig, Understanding Augmented Reality: Concepts and Applications, 1st ed., Morgan Kaufmann (2013).
2.	John Vince, Virtual Reality Systems, 1st ed., Addison-Wesley (1995).
REFERENCES	
1.	Dieter Schmalstieg and Tobias Hollerer, Augmented Reality: Principles and Practice, 1st ed., Addison-Wesley (2016).
2.	Grigore C. Burdea and Philippe Coiffet, Virtual Reality Technology, 2nd ed., Wiley-IEEE Press (2011).
	Steve Aukstakalnis, Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR, 1st ed., Addison-Wesley (2016).

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS352	RECOMMENDER SYSTEMS	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES:NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	To understand the foundations of the recommender system.					
2	To learn the significance of machine learning and data mining algorithms for Recommender systems					
3	To learn about collaborative filtering					
4	To make students design and implement a recommender system					
5	To understand the foundations of the recommender system.					
UNIT 1: INTRODUCTION						9
Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Overview of data mining methods for recommender systems- similarity measures- Dimensionality reduction – Singular Value Decomposition (SVD)						
UNIT 2: CONTENT-BASED RECOMMENDATION SYSTEMS						9
High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms						
UNIT 3: COLLABORATIVE FILTERING						9
A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection)						
UNIT 4: ATTACK-RESISTANT RECOMMENDER SYSTEMS						9
Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack –Group attack – Strategies for robust recommender design - Robust recommendation algorithms						
UNIT 5: EVALUATING RECOMMENDER SYSTEMS						9
Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design –Design Issues – Accuracy metrics – Limitations of Evaluation measures						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Understand the basic concepts of recommender systems.					
CO2:	Implement machine-learning and data-mining algorithms in recommender systems data sets.					
CO3:	Implementation of Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics					
CO4:	Design and implement a simple recommender system.					
CO5:	Learn about advanced topics of recommender systems.					
TEXT BOOKS						
1.	Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.					
2.	Dietmar Jannach , Markus Zanker , Alexander Felfernig					
REFERENCES						
1.	Francesco Ricci , Lior Rokach , Bracha Shapira , Recommender Sytems Handbook, 1st ed, Springer (2011),					
2.	Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3 rd edition, Cambridge University Press, 2020					

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS353	AGILE DEVELOPMENT AND SCRUM	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES:NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Introduce students to the fundamental principles, practices, and values of Agile software development					
2	Provide in-depth knowledge of Agile frameworks like Scrum, Extreme Programming (XP), and Lean, highlighting their practical applications					
3	Emphasize the importance of teamwork, communication, and collaboration within Agile environments					
4	Train students on iterative and incremental software development methodologies.					
5	Equip students with the skills to apply Agile techniques to larger projects and enterprise-level systems					
UNIT 1:	AGILE FUNDAMENTALS					9
Agile principles, Agile Manifesto, Agile team roles, Agile documentation, Agile drivers, and values.						
UNIT 2:	AGILE PROCESSES					9
Lean Production, SCRUM, Extreme Programming (XP), Adaptive Software Development, and roles/practices within these frameworks.						
UNIT 3:	AGILITY AND KNOWLEDGE MANAGEMENT					9
Agile decision-making, knowledge acquisition, story cards, and knowledge management challenges in agile environments.						
UNIT 4:	AGILITY AND REQUIREMENTS ENGINEERING (RE)					9
Managing unstable requirements, RE using Agile methods, abstraction models, and requirements modeling.						
UNIT 5:	AGILITY AND QUALITY ASSURANCE					9
Agile product development, Agile metrics, Test-Driven Development (TDD), and scaling Scrum for large projects						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Understand and apply Agile methodologies to manage software projects effectively.					
CO2:	Plan and execute iterative software development processes, including sprint planning and retrospectives					
CO3:	Analyze the impact of social and team dynamics on software project success and enhance team collaboration					
CO4:	Use Agile tools like Jira or Trello and adopt practices like Test-Driven Development (TDD) and Continuous Integration (CI).					
CO5:	Demonstrate the ability to scale Agile frameworks for use in complex, large-scale software projects					
TEXT BOOKS						
1.	Kenneth S , Rubin, “Essential Scrum: A Practical Guide to the Most Popular Agile Process”,. Addison-Wesley, 2012					
2.	Orit Hazzan and Yael Dubinsky, “Agile Software Engineering”, Springer, 2009					
REFERENCE BOOKS						
1.	David J. Anderson and Eli Schragenheim, ”Agile Management for Software Engineering” by Prentice Hall, 2004.					
2.	Orit Hazzan and Yael Dubinsky, “Agile Software Engineering”, Springer, 2009.					

3.	Craig Larman , "Agile and Iterative Development: A Manager's Guide", Pearson, 2004.
4.	Kevin C. Desouza, Butterworth-Heinemann, "Agile Information Systems", 2007

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS354	NANOSCIENCE AND NANOTECHNOLOGY	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES:NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Understand the fundamental concepts of nanoscience					
2	Apply the basic concepts of physics, chemistry and biology concepts to understand the advanced concepts of nanoscience					
3	Influence of size and morphology and other factors on various properties of materials.					
4	Analyze the acquired knowledge and understanding on real time applications of various applications					
5	Remote scientific research, activity, and a balanced viewpoint					
UNIT 1:	INTRODUCTION					9
Background to nanoscience – Historical perspectives and Scientific revolutions – Definitions and Classifications based on dimension : Zero, One, Two and Three - Clusters, Quantum dots, Nanowires, Rods and tubes, and thin films; Hard sphere model: Grain and Grain boundary concepts						
UNIT 2:	CRYSTALLITES AND NANOCOMPOSITES					9
Top-Down and Bottom-Up Approaches: Physical - Chemical and Mechanical Routes; Influence of various parameters on morphology of crystallites - Nanocomposites: Metal and Metal Oxides; Metal Oxide - Metal Oxide; Nano in Nature: Gecko Effect, Lotus leaf effect, Superhydrophobicity, Self-Cleaning and Antifogging – Colored Glasses and Dichroism.						
UNIT 3:	UNIQUE PROPERTIES					9
Quantum Confinement Effects: Influence of grain size and morphology – Physical properties with Uniqueness compared to bulk and microscopic solids: Optical – Surface Plasmon Resonance, Band Gap Widening, Magnetic – Superparamagnetism, Thermal – Melting point depression.						
UNIT 4:	ADVANCED NANOSTRUCTURED MATERIALS					9
Allotropes of carbon: Graphene, CNT, C-dots, Fullerenes – Inorganic: Organic hybrids – Ferrofluids, Zeolites- Core-shells – Nanostructures of Zinc Oxide: tetrapods, rings, springs, belt, rods, wires - Additive Manufacturing of 3D Nanoarchitected Metals – Nanorobots						
UNIT 5:	ROAD MAP					9
Miniaturization of electronic materials and devices – Lithography techniques - Scaling issues – batch fabrication and circuit integration – MEMS and NEMS – Current and future challenges						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Identify and classify nanomaterials based on their dimensional characteristics and structural models such as the hard sphere model and grain boundaries.					
CO2:	Demonstrate the synthesis of nanomaterials using top-down and bottom-up approaches and relate them to natural nanoscale phenomena like the lotus leaf effect.					
CO3:	Infer the influence of grain size and quantum confinement on the optical, magnetic, and thermal properties of nanomaterials					
CO4:	Construct advanced nanostructures such as carbon allotropes, core-shells, and hybrid materials with potential technological applications.					
CO5:	Operate basic lithographic and fabrication techniques used in the development of MEMS/NEMS and nanoelectronic devices, and assess current challenges.					
TEXT BOOKS						
1.	S.O. Pillai, “Solid State Physics”, 4th Ed, New Age International Publishers (2001).					
2.	C. Kittel, ”Introduction To Solid-State Physics”, Wiley (1986).					
3.	D. Craik ,”Magnetism: Principles and Applications”, Wiley (1995).					
4.	Bharat Bhushan, ”Springer Handbook of Nanotechnology”, Springer (2006)					
REFERENCES						
1.	T. Pradeep ,”NANO: The Essentials: Understanding Nanoscience and Nanotechnology”,					

	McGraw Hill (2017)
2.	A. Spaldin ,”Magnetic Materials : Fundamentals And Applications” , Cambridge University Press, 2nd Edition, (2018)

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

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ELECTIVE III

BCS355	DEEP LEARNING	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES:NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Present the mathematical, statistical and computational challenges of building neural Networks					
2	Study the concepts of deep learning					
3	Introduce dimensionality reduction techniques					
4	Analyze the key computations underlying deep learning, then use them to build and train deep neural networks for various tasks.					
5	Apply deep learning models for suitable applications.					
UNIT 1:	INTRODUCTION					9
Introduction to machine learning- Linear models (SVMs and Perceptron, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates						
UNIT 2:	DEEP NETWORKS					9
History of Deep Learning- A Probabilistic Theory of Deep Learning- Backpropagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning						
UNIT 3:	DIMENTIONALITY REDUCTION					9
Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks -Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyper parameter optimization						
UNIT 4:	OPTIMIZATION AND GENERALIZATION					9
Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience						
UNIT 5:	APPLICATIONS AND CASE STUDY OF DEEP LEARNING					9
Images segmentation – Object Detection – Automatic Image Captioning – Image generation with Generative adversarial networks – Video to Text with LSTM models – Attention models for Computer Vision – Case Study: Named Entity Recognition – Opinion Mining using Recurrent Neural Networks – Parsing and Sentiment Analysis using Recursive Neural Networks – Sentence Classification using Convolutional Neural Networks – Dialogue Generation with LSTMs.						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Understand basics of deep learning					
CO2:	Implement various deep learning models					
CO3:	Realign high dimensional data using reduction techniques					
CO4:	Analyze optimization and generalization in deep learning					
CO5:	Explore the deep learning applications					
TEXT BOOKS						
1.	Ian J. Good fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.					
2.	Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018					
REFERENCE BOOKS						

1.	Cosma Rohilla Shalizi, Advanced Data Analysis from an Elementary Point of View, 2015.
2.	Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013
3.	Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS356	ETHICAL HACKING	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	To understand the basics of computer based vulnerabilities.					
2	To explore different foot printing, reconnaissance and scanning methods.					
3	To expose the enumeration and vulnerability analysis methods.					
4	To understand hacking options available in Web and wireless applications.					
5	To explore the options for network protection.					
UNIT 1:	INTRODUCTION TO ETHICAL HACKING					9
Overview of cybersecurity and hacking, Types of hackers, Roles of ethical hackers, Penetration testing phases, Information security laws and regulations, Overview of TCP/IP model, IP addressing, OSI layers, Network devices and protocols						
UNIT 2:	RECONNAISSANCE AND FOOTPRINTING					9
Footprinting techniques, Passive and active reconnaissance, Whois, NSlookup, Social engineering, Google hacking, DNS enumeration, Email and social media foot printing, Tools: Maltego, Recon-ng, the Harvester						
UNIT 3:	SCANNING AND VULNERABILITY ANALYSIS					9
Network scanning: Nmap, Hping, Netcat, Banner grabbing, Port scanning, Service enumeration, Vulnerability assessment tools: Nessus, OpenVAS, Nikto, Identifying vulnerabilities in web servers and systems, Exploit databases						
UNIT 4:	SYSTEM HACKING AND EXPLOITATION					9
Password cracking techniques: Dictionary, brute force, rainbow tables, Keyloggers, Buffer overflow attacks, Privilege escalation, Rootkits and backdoors, Sniffing and spoofing attacks, Session hijacking, Exploitation frameworks: Metasploit						
UNIT 5:	WEB APPLICATION AND WIRELESS SECURITY					9
Web application vulnerabilities: SQL injection, XSS, CSRF, File inclusion, Command injection, OWASP Top 10, Wireless attacks: WEP/WPA cracking, Rogue access points, Wireless sniffing tools: Aircrack-ng, Kismet, Best practices for securing applications and networks						
						45 PERIODS
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	Explain the role of security professionals and penetration testers, along with TCP/IP layers and malware protection strategies.					
CO2:	Demonstrate footprinting and scanning techniques using tools to uncover digital traces from various online sources.					
CO3:	Analyze system vulnerabilities and perform enumeration across OS and network services using appropriate forensic tools.					
CO4:	Apply forensic procedures to extract and interpret evidence from iOS devices using tools like Oxygen Forensics and MobilEdit.					
CO5:	Perform forensic analysis of Android devices, including rooting, ADB, app decompiling, and data extraction using specialized tools					
						TOTAL:45 PERIODS
TEXT BOOKS						
1.	Andre Arnes, "Digital Forensics", Wiley, 2018.					
2.	Chuck Easttom, "An In-depth Guide to Mobile Device Forensics", First Edition, CRC Press, 2022..					
REFERENCES						
1.	Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, CharlesRiver Media, 2005, ISBN: 1-58450-389.					

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS357	STORAGE TECHNOLOGIES	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES:NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Characterize the functionalities of logical and physical components of storage					
2	Describe various storage networking technologies					
3	Identify different storage virtualization technologies					
4	Discuss the different backup and recovery strategies					
5	Understand common storage management activities and solutions					
UNIT 1:	STORAGE SYSTEMS					9
Introduction to Information Storage: Digital data and its types, Information storage, Key characteristics of data center and Evolution of computing platforms. Information Lifecycle Management. Third Platform Technologies: Cloud computing and its essential characteristics, Cloud services and cloud deployment models, Big data analytics, Social networking and mobile computing, Characteristics of third platform infrastructure and Imperatives for third platform transformation. Data Center Environment: Building blocks of a data center, Compute systems and compute virtualization and software defined center						
UNIT 2:	INTELLIGENT STORAGE SYSTEMS AND RAID					5
Components of an intelligent storage system, Components, addressing, and performance of hard disk drives and solid-state drives, RAID, Types of intelligent storage systems, Scale-up and scaleout storage Architecture						
UNIT 3:	SDN APPLICATIONS STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION IONS					13
Block-Based Storage System, File-Based Storage System, Object-Based and Unified Storage. Fibre Channel SAN: Software-defined networking, FC SAN components and architecture, FC SAN topologies, link aggregation, and zoning, Virtualization in FC SAN environment. Internet Protocol SAN: iSCSI protocol, network components, and connectivity, Link aggregation, switch aggregation, and VLAN, FCIP protocol, connectivity, and configuration. Fibre Channel over Ethernet SAN: Components of FCoE SAN, FCoE SAN connectivity, Converged Enhanced Ethernet, FCoE architecture.						
UNIT 4:	BACKUP, ARCHIVE AND REPLICATION					12
Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication, Cloud-based and mobile device backup, Data archive, Uses of replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, Disaster Recovery as a Service (DRaaS).						
UNIT 5:	SECURING STORAGE INFRASTRUCTURE					6
Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes.						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Demonstrate the fundamentals of information storage management and various models of Cloud infrastructure services and deployment					
CO2:	Illustrate the usage of advanced intelligent storage systems and RAID					
CO3:	Interpret various storage networking architectures - SAN, including storage subsystems and virtualization					
CO4:	Examine the different role in providing disaster recovery and remote replication technologies					
CO5:	Infer the security needs and security measures to be employed in information storage management					
TEXT BOOKS						

1.	EMC Corporation, Information Storage and Management, Wiley, India
2.	Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas Introduction to Storage Area Networks, Ninth Edition, IBM - Redbooks, December 2017

REFERENCE BOOKS

1.	Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Hausteine, Storage Networks Explained, Second Edition, Wiley, 2009
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CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS358	VIDEO AND AUDIO EDITING	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: NONE						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Understand the fundamental concepts and workflow of audio and video editing					
2	Learn to record and edit audio effectively.					
3	Learn various editing techniques for video, including cutting, transitions, and effects.					
4	Master advanced techniques for syncing audio and video..					
5	To know the technologies involved in the development of AR/VR based applications					
UNIT 1: INTRODUCTION TO AUDIO AND VIDEO EDITING						9
Overview of Audio and Video Production-Key Concepts: Audio formats, video resolutions, frame rates, codecs Understanding Editing Software: Introduction to industry-standard software (Adobe Premiere Pro, Final Cut Pro, Audacity, etc.)- Basic Workflow of Audio and Video Editing-Setting up Projects and File Management-Overview of Input/Output Devices (Microphones, Cameras, etc.)						
UNIT 2: AUDIO EDITING TECHNIQUES						9
Audio Recording Basics: Microphone selection, room acoustics, soundproofing-Introduction to Sound Editing: Waveforms, editing tools, and timeline-Noise Reduction and Audio Cleaning Techniques-Equalization, Compression, and Reverb-Adding and Editing Sound Effects, Music, and Voiceovers-Syncing Audio with Video (Lip Sync)-Advanced Techniques: Multi-track editing, automation, and panning						
UNIT 3: VIDEO EDITING TECHNIQUES						9
Understanding Video Formats and Codecs-Video Editing Software Features: Cutting, trimming, and splicing clips Transitions and Effects: Using crossfade, dissolves, wipes, and other transitions-Color Correction and Grading: Basic principles of color theory and tools-Using Layers and Keyframes for Motion Graphics-Titles, Captions, and Lower Third-Speed and Time Manipulation: Slow motion, time-lapse, and reverse						
UNIT 4: ADVANCED AUDIO-VIDEO SYNCHRONIZATION TECHNIQUES						9
Audio Mixing and Sound Design for Video-Using Audio-Visual Synchronization for Storytelling -Working with Multicam Edits-The Role of Music in Video Production: Timing, mood setting, and transitions Dynamic Range and Peak Levels in Audio Mixing-Use of Foley and ADR (Automated Dialog Replacement) for Enhanced Sound						
UNIT 5: FINAL PROJECT AND INDUSTRY TRENDS						9
Final Project: End-to-End Audio and Video Editing Project (Video production, editing, and sound design) Industry Trends and Emerging Tools: AI in video editing, automated sound design, cloud-based editing tools Exporting and Rendering Projects: File formats, resolution settings, and distribution platforms-Delivery Formats: YouTube, Instagram, Film, Television-Legal Aspects: Copyright, Fair Use, and Licensing in Audio and Video Editing-Career Opportunities in Audio-Video Production						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Gain proficiency in both audio and video editing, from basic to advanced techniques.					
CO2:	Understand the technical aspects of editing, including file formats, sound design, and visual effects.					
CO3:	Develop practical skills in using industry-standard editing software and equipment.					
CO4:	Be equipped to produce high-quality media projects for various platforms.					
CO5:	Be aware of the latest trends and ethical considerations in media production.					
TEXT BOOKS						
1.	Keith Underdahl ,”Adobe Premiere Pro CC For Dummies”, John Wiley & Sons, 2014..					

2.	Ashley Kennedy “Avid Media Composer 8: Professional Video Editing”, Cengage Learning, 2014
REFERENCES	
1.	Maxim Jago , “Adobe Premiere Pro Classroom in a Book”, Adobe Press, 2019
2.	Ric Viers ,”The Sound Effects Bible: How to Create and Record Hollywood-Style Sound Effects”, Wiese Productions, 2008
3.	Juniper C. K., “Video Editing with Adobe Premiere Pro CC”, Apres, 2017

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS359	SOCIAL NETWORK ANALYSIS	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES:NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Understand the components of the social network					
2	Model and visualize the social network					
3	Mine the users in the social network					
4	Understand the evolution of the social network					
5	Mine the interest of the user					
UNIT 1:	INTRODUCTION					9
Introduction to Web - Limitations of current Web, Development of Semantic Web, Emergence of the Social Web, Statistical Properties of Social Networks, Network analysis, Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks						
UNIT 2:	MODELING AND VISUALIZATION					9
Visualizing Online Social Networks, A Taxonomy of Visualizations, Graph Representation – Centrality Clustering, Node-Edge Diagrams, Visualizing Social Networks with Matrix Based Representations- Node, Link Diagrams, Hybrid Representations, Modelling and aggregating social network data, Random Walks and their Applications, Use of Hadoop and Map Reduce, Ontological representation of social individuals and relationships						
UNIT 3:	MINING COMMUNITIES					9
Aggregating and reasoning with social network data, Advanced Representations - Extracting evolution of Web Community from a Series of Web Archive, Detecting Communities in Social Networks, Evaluating Communities, Core Methods for Community Detection & Mining, Applications of Community Mining Algorithms, Node Classification in Social Networks.						
UNIT 4:	EVOLUTION					9
Evolution in Social Networks, Framework, Tracing Smoothly Evolving Communities, Models and Algorithms for Social Influence Analysis, Influence Related Statistics, Social Similarity and Influence - Influence Maximization in Viral Marketing, Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints with Score Propagation, Expert Team Formation Link Prediction in Social Networks, Feature based Link Prediction, Bayesian Probabilistic Models, Probabilistic Relational Models						
UNIT 5:	TEXT AND OPINION MINING					9
Text Mining in Social Networks -Opinion extraction, Sentiment classification and clustering - Temporal sentiment analysis, Irony detection in opinion mining, Wish analysis, Product review mining Review Classification, Tracking sentiments towards topics over time						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Work on the internal components of the social network					
CO2:	Model and visualize the social network					
CO3:	Mine the behaviour of the users in the social network					
CO4:	Predict the possible next outcome of the social network					
CO5:	Mine the opinion of the user					
TEXT BOOKS						
1.	Charu C. Aggarwal, “Social Network Data Analytics”, Springer; 2011					
2.	Peter Mika, “Social Networks and the Semantic Web”, Springer, 1st edition, 2007					
REFERENCES						
1	BorkoFurht, “Handbook of Social Network Technologies and Applications”, Springer, 1st edition, 2010.					

2	GuandongXu ,Yanchun Zhang and Lin Li, “Web Mining and Social Networking – Techniques and applications”, Springer, 1st edition, 2011.
3	Giles, Mark Smith, John Yen, “Advances in Social Network Mining and Analysis”, Springer, 2010
4	Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, “Computational Social Network Analysis: Trends, Tools and Research Advances”, Springer, 2009.
5	Toby Segaran, “Programming Collective Intelligence”, O’Reilly, 2012

CO’s-PO’s & PSO’s MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS360	AUTOMATION AND TESTING	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES:NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Introduce students to the foundational concepts of software testing, including manual and automated testing methodologies.					
2	Enable students to develop effective test plans and design test cases that ensure software quality and reliability.					
3	Provide in-depth knowledge of advanced testing concepts such as performance testing, security testing, and testing in agile environments.					
4	Familiarize students with popular automation tools like Selenium and frameworks for automating testing processes.					
5	To equip students with practical skills for applying testing techniques and automation tools to real-world software applications.					
UNIT 1: FOUNDATIONS OF SOFTWARE TESTING						
Basics of software testing, Black-box and White-box testing, Testing lifecycle, and methodologies like V-model - Concepts of reliability, safety, failures, and defects						
UNIT 2: TEST PLANNING						
Test planning strategies, intergroup responsibilities, resource allocation, test schedules, and bug reporting						
UNIT 3: TEST DESIGN AND EXECUTION						
Design factors, boundary value and equivalence class testing, path and data flow testing - Metrics for design effectiveness and bug life cycle.						
UNIT 4: ADVANCED TESTING CONCEPTS						
Performance testing (load, stress, and volume), security testing, testing in agile environments, and testing of web/mobile applications.						
UNIT 5: TEST AUTOMATION AND TOOLS						
Automation concepts, tools like Selenium, and XML-based testing strategies. Focus on web application testing with Selenium WebDriver.						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Apply foundational software testing concepts.					
CO2:	Demonstrate test planning and execution strategies.					
CO3:	Designing and managing effective test cases.					
CO4:	Applying advanced testing techniques.					
CO5:	Using automation tools like Selenium for real-world testing scenarios..					
TEXT BOOKS						
1.	Yogesh Singh , "Software Testing", Cambridge University Press, 2012					
2.	Paul Ammann and Jeff Offutt, "Introduction to Software Testing", Cambridge University Press, 2016 (2nd Edition).					
REFERENCES						
1	Dorothy Graham, Erik van Veenendaal, Isabel Evans, and Rex Black ."Foundations of Software Testing", , Cengage Learning”, 2014 (4th Edition)					
2	Unmesh Gundecha, Packt , "Selenium WebDriver Practical Guide", Publishing, 2018 (2nd Edition)					
2	Gopaldaswamy Ramesh and Srinivasan Desikan "Software Testing: Principles and Practices", , Pearson Education, 2006					
3	Toby Segaran, “Programming Collective Intelligence”, O’Reilly, 2012					

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS361	ROBOTICS	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES:NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Understand the basic concepts and components of robotic systems.					
2	Study the kinematics, dynamics, and control of robotic manipulators.					
3	Introduce sensors, actuators, and microcontrollers used in robotics.					
4	Develop algorithms for robotic motion planning and navigation.					
5	Explore applications of robotics in various engineering domains					
UNIT 1: INTRODUCTION TO ROBOTICS						9
Definition and scope of robotics, Types of robots: industrial, mobile, service, medical, military, Components of robotic systems: sensors, actuators, controllers, Overview of robot anatomy, Degrees of freedom (DOF), Workspace, Robot configurations and classifications						
UNIT 2: KINEMATICS OF ROBOTS						9
Coordinate frames and transformations, Homogeneous transformation matrices, Forward kinematics of serial manipulators, Denavit-Hartenberg (D-H) parameters, Inverse kinematics: analytical and numerical methods, Kinematic redundancy and constraints						
UNIT 3: DYNAMICS AND CONTROL						9
Euler-Lagrange formulation, Newton-Euler dynamics, Joint space and operational space control, PD and PID controllers, Trajectory planning, Force control, Introduction to adaptive and nonlinear control in robotics						
UNIT 4: SENSORS, ACTUATORS, AND EMBEDDED SYSTEMS						9
Types of sensors: position, velocity, proximity, vision, tactile, Actuators: DC/AC motors, servo motors, stepper motors, Pneumatic and hydraulic actuators, Interfacing sensors and actuators with microcontrollers (Arduino/Raspberry Pi), Basics of real-time control						
UNIT 5: APPLICATIONS AND FUTURE TRENDS						9
Robotics in manufacturing, healthcare, agriculture, exploration, Robot navigation and mapping, Simultaneous localization and mapping (SLAM), AI in robotics, Human-robot interaction, Ethical issues and safety in robotics, Trends: swarm robotics, soft robotics, humanoids						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1: Explain the fundamentals of robotic systems and their classifications.						
CO2: Apply kinematic equations for position and orientation analysis of manipulators.						
CO3: Analyze robotic dynamics and implement control strategies.						
CO4: Design and simulate robotic movements and sensor-based interactions.						
CO5: Evaluate the applications and ethical considerations in robotics.						
TEXT BOOKS						
1.	Mikell P. Groover, Industrial Robotics: Technology, Programming, and Applications, McGraw-Hill, 2008.					
2.	Saeed B. Niku, Introduction to Robotics: Analysis, Control, Applications, Wiley, 3rd Edition, 2020.					
3.	John J. Craig, Introduction to Robotics: Mechanics and Control, Pearson, 4th Edition, 2017. Bruno Siciliano and Lorenzo Sciavicco, Robotics: Modelling, Planning and Control, Springer, 2009.					
4.	Roland Siegwart, Illah R. Nourbakhsh, and Davide Scaramuzza, Introduction to Autonomous Mobile Robots, MIT Press, 2nd Edition, 2011.					
5.	Richard D. Klafter, Thomas A. Chmielewski, and Michael Negin, Robotic Engineering: An Integrated Approach, Prentice Hall, 2003.					
6.	Peter Corke, Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Springer, 2011.					

7.	Arduino Project Hub, Arduino Robotics Projects, https://create.arduino.cc/projecthub
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CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

ELECTIVE IV

BCS362	NATURAL LANGUAGE PROCESSING	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Gain knowledge in automated Natural Language Generation and Machine Translation					
2	Provide the student with knowledge of various levels of analysis involved in NLP.					
3	Understand the applications of NLP					
4	Analyze the semantic analysis of natural language					
5	Understand language generation and discourse analysis					
UNIT 1: OVERVIEW AND MORPHOLOGY						9
Introduction – Models -and Algorithms - -Regular Expressions-Basic Regular Expression Patterns Finite State Automata Understand the wireless sensor network-principles. Morphology, Inflectional Morphology - Derivational Morphology. Finite-State Morphological-Parsing, Porter Stemmer						
UNIT 2: WORD LEVEL AND SYNTACTIC ANALYSIS						9
N-grams Models of Syntax - Counting Words-Unsmoothed N-grams .Smoothing, Back-off Deleted Interpolation, Entropy, English Word Classes, Tag sets for English Part of Speech Tagging-Rule Based Part of Speech Tagging, Stochastic Part of Speech Tagging, Transformation-Based Tagging						
UNIT 3: CONTEXT FREE GRAMMARS						9
Context Free Grammars for English Syntax- Context-Free Rules and Trees, Understand the network simulation tools. Sentence- Level Constructions, Agreement , Sub Categorization .Parsing, Top-down – Early Parsing -feature Structures – Probabilistic Context-Free Grammars						
UNIT 4: SEMANTIC ANALYSIS						9
Representing Meaning-Meaning Structure of Language-First Order Predicate-Calculus Representing Linguistically Relevant Concepts -Syntax-Driven Semantic Analysis – Semantic Attachments -Syntax-Driven Analyzer. Robust Analysis - Lexemes and Their Senses – Internal Structure - Word Sense Disambiguation -Information Retrieval						
UNIT 5: LANGUAGE GENERATION AND DISCOURSE ANALYSIS						9
Discourse -Reference Resolution - Text Coherence -Discourse Structure – Coherence. Dialog and Conversational Agents - Dialog Acts – Interpretation -Conversational Agents. Language Generation– Architecture-Surface Realizations - Discourse Planning .Machine Translation -Transfer Metaphor– Interlingua – Statistical Approaches						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Analyze the internal structure of a word of the natural language					
CO2:	Demonstrate probability of word count in language processing(
CO3:	Evaluate the parsing algorithms					
CO4:	Discuss Syntax driven semantic analysis					
CO5:	Categorise the relation between tokens					
TEXT BOOKS						
1.	Daniel Jurafsky and James H Martin, ”Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, Prentice Hall, 2nd Edition, 2008					

2.	C. Manning and H. Schutze, “Foundations of Statistical Natural Language Processing”, MIT Press. Cambridge, MA:,1999
REFERENCE BOOKS	
1.	C. Manning and H. Schutze, “Foundations of Statistical Natural Language Processing”, MIT Press. Cambridge, MA:,1999
2.	Bharati A., Sangal R., ChaitanyaV.. Natural language processing: a Paninian perspective, PHI, 2000
3.	Siddiqui T., Tiwary U. S. Natural language processing and Information retrieval, OUP 2008
4.	https://onlinecourses.nptel.ac.in/noc23_cs45/preview

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS363	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Understand the basics of IPR.					
2	Explore patent rights and copyrights.					
3	Get exposes to trade marks					
4	Explore the various design techniques					
5	Gain knowledge on Information Technology Act					
UNIT 1:	INTRODUCTION					9
Introduction to IPR: Meaning of property, Origin, Nature, Meaning of Intellectual Property Rights Introduction to TRIPS and WTO.Kinds of Intellectual property rights—Copy Right, Patent, Trade Mark, Trade Secret and trade dress, Design, Layout Design, Geographical Indication, Plant Varieties and Traditional Knowledge.						
UNIT 2:	PATENT RIGHTS AND COPY RIGHTS					9
Origin, Meaning of Patent, Types, Inventions which are not patentable, Registration Procedure, Rights and Duties of Patentee, Assignment and licence Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties. COPY RIGHT—Origin, Definition &Types of Copy Right, Registration procedure, Assignment & licence, Terms of Copy Right, Piracy, Infringement, Remedies, Copy rights with special reference to software.						
UNIT 3:	TRADE MARKS					9
Origin, Meaning & Nature of Trade Marks, Types, Registration of Trade Marks, Infringement & Remedies, Offences relating to Trade Marks, Passing Off, Penalties. Domain Names on cyber space.						
UNIT 4:	DESIGN					9
Meaning, Definition, Object, Registration of Design, Cancellation of Registration, International convention on design, functions of Design. Semiconductor Integrated circuits and layout design Act-2000.						
UNIT 5:	BASIC TENENTS OF INFORMATION TECHNOLOGY ACT 2000					9
IT Act - Introduction E-Commerce and legal provisions E- Governance and legal provisions Digital signature and Electronic Signature. Cybercrimes,						
						45 PERIODS
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	Explain the basics concepts of IPT.					
CO2:	Demonstrate about patent rights and copy rights.					
CO3:	Interpret knowledge on trademarks					
CO4:	Investigate, design strategies					
CO5:	Discuss Information Technology Act 2000					
						TOTAL:45 PERIODS
TEXT BOOKS						
1.	Dr. G.B. Reddy , “Intellectual Property Rights and the Law”, Gogia Law Agency					
2.	Dr. B.L.Wadehra “Law relating to Intellectual Property”, Universal Law Publishing Co					
REFERENCES						
1.	P. Narayanan, ”IPR”, Eastern Law House, Jan 2001					

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS364	SECURITY AND PRIVACY IN CLOUD	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES:NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	To know the basic components of cloud & Security in the cloud					
2	To understand the Infrastructure Security, Data Security, storage and security management in the cloud					
3	To gain familiarity with the concepts of Identity and Access Management					
4	To gain knowledge on Identity and Access Management					
5	To illustrate the privacy issues in could environment					
UNIT 1: INTRODUCTION TO CLOUD COMPUTING						9
What Is Cloud Computing: Cloud Computing Defined, The SPI Framework for Cloud Computing, Relevant Technologies in Cloud Computing, The Traditional Software Model,The Cloud Services Delivery Model, Cloud Deployment Models, Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise.						
UNIT 2: INFRASTRUCTURE -DATA SECURITY AND STORAGE						9
Infrastructure Security: The Network Level, Infrastructure Security: The Host Level, Infrastructure Security: The Application Level Data Security and Storage: Aspects of Data Security, Data Security Mitigation, Provider Data and Its Security						
UNIT 3: IDENTITY AND ACCESS MANAGEMENT						9
Identity and Access Management: Trust Boundaries and IAM, Why IAM?,IAM Challenges, IAM Definitions, IAM Architecture and Practice, Getting Ready for the Cloud, Relevant IAM Standards and Protocols for Cloud Services-IAM Practices in the Cloud, Cloud Authorization Management, Cloud Service Provider IAM Practice						
UNIT 4: SECURITY MANAGEMENT IN THE CLOUD						9
Security Management in the Cloud: Security Management Standards, Security Management in the Cloud Availability Management, SaaS Availability Management PaaS Availability Management, IaaS Availability Management, Access Control, Security Vulnerability, Patch, and Configuration Management						
UNIT 5: PRIVACY						9
Privacy : What Is Privacy, What Is the Data Life Cycle, What Are the Key Privacy Concerns in the Cloud, Who Is Responsible for Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations						
						45 PERIODS
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Explain the basic components of cloud & Security in the cloud					
CO2:	Illustrate the Infrastructure Security, Data Security, storage and security management in the cloud.					
CO3:	Summarize the concepts of Identity and Access Management					
CO4	Demonstrate security management in Cloud					
CO5	Discuss the privacy issues in could environment					
TEXT BOOKS						
1.	Tim Mather, Subra Kumara swamy,Shahed Latif,“Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance” O'ReillyMedia, 2009					
REFERENCES						
1.	RonaldL.Krutz,RussellDeanVines,“CloudSecurity”,2010					
2.	John Rittinghouse, James Ransome, “Cloud Computing” CRC Press, 2009.					

3.	J.R.("Vic")Winkler,“SecuringtheCloud”Syngress ,KindleEdition Ltd.,2016.
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CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS365	UI AND UX DESIGN	L	T	P	C	TOTAL MARKS
			0	0	3	100
PREREQUISITES: NONE						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Provide a sound knowledge in UI & UX					
2	Understand the need for UI and UX					
3	Understand the various Research Methods used in Design					
4	Explore the various Tools used in UI & UX					
5	Creating a wireframe and prototype					
UNIT 1: FOUNDATIONS OF DESIGN						9
UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy						
UNIT 2: FOUNDATIONS OF UI DESIGN						9
Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides						
UNIT 3: FOUNDATIONS OF UX DESIGN						9
Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals						
UNIT 4: WIREFRAMING, PROTOTYPING AND TESTING						9
Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration						
UNIT 5: RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE						9
Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Build UI for user Applications					
CO2:	Evaluate UX design of any product or application					
CO3:	Demonstrate UX Skills in product development					
CO4:	Implement Sketching principles					
CO5:	Create Wireframe and Prototype					
TEXT BOOKS						
1.	Joel Marsh, “UX for Beginners”, O’Reilly , 2022					
2.	Jon Yablonski, “Laws of UX using Psychology to Design Better Product & Services” O’Reilly 2021					
REFERENCES						
1.	Jenifer Tidwell, Charles Brewer, Aynne Valencia, “Designing Interface” 3 rd Edition , O’Reilly 2020					
2.	Steve Schoger, Adam Wathan “Refactoring UI”, 2018					
3.	Steve Krug, “Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile”, Third Edition, 2015					
4.	https://www.nngroup.com/articles/					
5.	https://www.interaction-design.org/literature .					

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS366	BUSINESS ANALYTICS	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES:NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Understand the Analytics Life Cycle.					
2	Comprehend the process of acquiring Business Intelligence					
3	Understand various types of analytics for Business Forecasting					
4	Model the supply chain management for Analytics.					
5	Apply analytics for different functions of a business					
UNIT 1:	INTRODUCTION TO BUSINESS ANALYTICS					9
Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration						
UNIT 2:	BUSINESS INTELLIGENCE					9
Data Warehouses and Data Mart - Knowledge Management –Types of Decisions - Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions						
UNIT 3:	BUSINESS FORECASTING					9
Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models –Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics						
UNIT 4:	HR & SUPPLY CHAIN ANALYTICS					9
Human Resources – Planning and Recruitment – Training and Development - Supply chain network Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain Applying HR Analytics to make a prediction of the demand for hourly employees for a year.						
UNIT 5:	MARKETING & SALES ANALYTICS					9
Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales - predictive analytics for customers' behaviour in marketing and sales						
						45 PERIODS
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Explain the real world business problems and model with analytical solutions.					
CO2:	Identify the business processes for extracting Business Intelligence					
CO3:	Apply predictive analytics for business fore-casting					
CO4:	Apply analytics for supply chain and logistics management					
CO5:	Use analytics for marketing and sales					
TEXT BOOKS						
1.	R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017.					
2.	R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016					
REFERENCES						
1.	Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016					
2.	VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.					
3.	Mahadevan B, “Operations Management -Theory and Practice”,3rd Edition,Pearson Education,2018					

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS367	QUANTUM COMPUTING	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Introduce fundamental concepts of quantum computation and quantum information.					
2	Develop understanding of qubits, quantum logic gates, and quantum circuits.					
3	Analyze quantum algorithms such as Grover's and Shor's.					
4	Explore quantum error correction and decoherence.					
5	Provide exposure to quantum programming platforms and applications...					
UNIT 1:	FOUNDATIONS OF QUANTUM COMPUTING					9
Classical vs. quantum computing, postulates of quantum mechanics, Dirac notation, quantum bits (qubits), quantum superposition and entanglement, quantum measurements, Bloch sphere representation.						
UNIT 2:	QUANTUM GATES AND CIRCUITS					9
Quantum logic gates: X, Z, H, T, CNOT, Toffoli, SWAP; universal quantum gates, quantum circuit diagrams, quantum parallelism, tensor product and matrix representation of multi-qubit systems, simulation of basic quantum circuits.						
UNIT 3:	QUANTUM ALGORITHMS					9
Deutsch-Jozsa algorithm, Grover's search algorithm, Simon's algorithm, Shor's factoring algorithm, quantum Fourier transform (QFT), amplitude amplification and estimation, complexity classes: BPP, BQP.						
UNIT 4:	QUANTUM ERROR CORRECTION AND DECOHERENCE					9
Sources of noise and decoherence, quantum error correction basics (bit-flip, phase-flip, Shor code), fault tolerance, no-cloning theorem, quantum repeaters, physical implementation challenges (superconducting qubits, trapped ions).						
UNIT 5:	QUANTUM PROGRAMMING AND APPLICATIONS					9
Quantum programming environments: IBM Qiskit, Microsoft Q#, Google Cirq, writing and executing quantum programs, simulation vs. real quantum hardware, quantum cryptography, quantum key distribution (QKD), current applications and future directions.						
						45 PERIODS
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Explain the principles of quantum mechanics relevant to quantum computing.					
CO2:	Illustrate quantum computation using qubits, gates, and circuits..					
CO3:	Analyze the operation and complexity of basic quantum algorithms..					
CO4:	Evaluate the challenges in quantum error correction and physical implementation.					
CO5:	Develop and simulate quantum programs using modern quantum programming tools.					
TEXT BOOKS						
1.	Michael A. Nielsen, Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 10th Anniversary Edition, 2010 (original edition published in 2000).					
2.	Nikita Gourianov, Quantum Computing for the Very Curious, Quantum Country, 2020					
REFERENCES						
1.	Qiskit Textbook – https://qiskit.org/learn – IBM Quantum, ongoing (since ~2019)					
2.	Microsoft Q# Documentation – https://learn.microsoft.com/en-us/azure/quantum – Microsoft, ongoing (since ~2018)					
3.	Google Cirq – https://quantumai.google/cirq – Google Quantum AI, ongoing (since ~2018)					

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

ELECTIVE V

BCS441	COGNITIVE SCIENCE	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Know the theoretical background of cognition.					
2	Understand the link between cognition and computational intelligence					
3	Explore probabilistic programming language.					
4	Study the computational inference models of cognition.					
5	Study the computational learning models of cognition					
UNIT 1:	PHILOSOPHY, PSYCHOLOGY AND NEUROSCIENCE					9
Philosophy: Mental-physical Relation, From Materialism to Mental Science, Logic and the Sciences of the Mind, Psychology: Place of Psychology within Cognitive Science, Science of Information Processing, Cognitive Neuroscience, Perception, Decision, Learning and Memory, Language Understanding and Processing.						
UNIT 2:	COMPUTATIONAL INTELLIGENCE					9
Machines and Cognition, Artificial Intelligence, Architectures of Cognition, Knowledge Based Systems, Logical Representation and Reasoning, Logical Decision Making, Learning, Language Vision.						
UNIT 3:	PROBABILISTIC PROGRAMMING LANGUAGE					9
WebPPL Language, Syntax Using Javascript Libraries, Manipulating probability types and distributions Finding Inference, Exploring random computation, Coroutines: Functions that receive continuations Enumeration						
UNIT 4:	INFERENCE MODELS OF COGNITION					9
Generative Models, Conditioning, Causal and statistical dependence, Conditional dependence, Data Analysis, Algorithms for Inference.						
UNIT 5:	LEARNING MODELS OF COGNITION					9
Learning as Conditional Inference, Learning with a Language of Thought, Hierarchical Models Learning (Deep) Continuous Functions, Mixture Models.						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Understand the underlying theory behind cognition					
CO2:	Connect to the cognition elements computationally.					
CO3:	Implement mathematical functions through WebPPL..					
CO4:	Develop applications using cognitive inference model.					
CO5:	Develop applications using cognitive learning model					
TEXT BOOKS						
1.	Vijay V Raghavan,Venkat N.Gudivada, Venu Govindaraju, C.R. Rao, Cognitive Computing: Theory and Applications: (Handbook of Statistics 35), Elsevier publications, 2016					
2.	Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley Publications, 2015					
REFERENCE BOOKS						
1.	Robert A. Wilson, Frank C. Keil, “The MIT Encyclopedia of the Cognitive Sciences”,The MIT Press, 1999					

2.	Jose Luis Bermúdez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020
3.	Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, “Probabilistic Models of Cognition”, Second Edition, 2016, https://probmods.org/ .
4.	Noah D. Goodman, Andreas Stuhlmuller, “The Design and Implementation of Probabilistic Programming Languages”, Electronic version of book, https://dippl.org/ .

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS442	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: CRYPTOGRAPHY AND CYBER SECURITY						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Understand block chain models					
2	Familiarize the functional/operational aspects of cryptocurrency					
3	Understand emerging abstract models for Blockchain Technology.					
4	Understand Ethereum block chain technology					
5	Identify technical gaps existing between theory and practice in cryptocurrency					
UNIT 1:	INTRODUCTION OF BLOCK CHAIN MODELS					9
The consensus problem - Asynchronous Byzantine Agreement - AAP protocol and its analysis Nakamoto Consensus on permission-less, nameless, peer-to-peer network - Abstract Models for BLOCKCHAIN - GARAY model - RLA Model - Proof of Work (PoW) as random oracle - formal treatment of consistency, liveness and fairness - Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS).						
UNIT 2:	BASICS FOR CRYPTOCURRENCY					9
Cryptographic basics for cryptocurrency - a short overview of Hashing, signature schemes, encryption schemes and elliptic curve cryptography .						
UNIT 3:	BITCOIN					9
Bitcoin - Wallet - Blocks - Merkle Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bitcoin.						
UNIT 4:	ETHEREUM					9
Ethereum - Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity - Smart Contracts - some attacks on smart contracts .						
UNIT 5:	TRENDS AND TOPICS					9
Zero Knowledge proofs and protocols in Blockchain - Succinct non interactive argument for Knowledge (SNARK) - pairing on Elliptic curves – Zcash						
						60 PERIODS
COURSE OUTCOMES						
At the end of this course, the students will be able to:						
CO1:	Explain the Abstract Models for BLOCKCHAIN					
CO2:	Demonstrate the Cryptographic basics for cryptocurrency					
CO3:	Summarize knowledge on Bitcoin, Wallet, Blocks					
CO4:	Discuss familiarity on Ethereum					
CO5:	Illustrate trends and topics in Blockchain technology					
						TOTAL:60 PERIODS
TEXT BOOKS						
1.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder,” Bitcoin and cryptocurrency technologies: a comprehensive Introduction”, Princeton University Press, 2016. (Free download available)					
REFERENCES						
1.	Joseph Bonneau et al,”SoK: Research perspectives and challenges for Bitcoin and cryptocurrency’, IEEE Symposium on security and Privacy, 2015 (article available for free download).					
2.	J.A.Garay et al, “The bitcoin backbone protocol - analysis and applications”, EUROCRYPT 2015 LNCS VOI 9057, (VOLII), pp 281-310. (Also available at eprint.iacr.org/2016/1048)					
3.	R.Pass et al, “Analysis of Blockchain protocol in Asynchronous networks”, EUROCRYPT 2017, (eprint.iacr.org/2016/454)					
4.	R.Pass et al, “Fruitchain, a fair blockchain”, PODC 2017 (eprint.iacr.org/2016/916).					

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS443	DATA MINING AND WAREHOUSING	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES:						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Gather and analyze large sets of data to gain useful business understanding					
2	Understand the data mining functionalities, technologies and steps in pre-processing the data					
3	Learn data mining algorithms, methods and tools					
4	Understand classification and prediction					
5	Gain knowledge on types of data in cluster analysis					
UNIT 1:	RAW DATA TO VALUABLE INFORMATION					9
Raw data to valuable information-Lifecycle of Data - What is data warehousing - The building Blocks: Defining Features - Data warehouses and data marts - Overview of the components - Metadata in the data warehouse - Basic elements of data warehousing - Principles of dimensional modelling: Star schema, Snowflake schema and Galaxy schema.						
UNIT 2:	INTRODUCTION TO DATA MINING					9
Introduction to Data Mining Systems, Knowledge Discovery Process -Data Objects and attribute types, Statistical description of data, Data Preprocessing- Data Cleaning, Data Integration and Transformation, Data Reduction.						
UNIT 3:	MARKET BASKET ANALYSIS					9
Market Basket Analysis, Frequent Item sets, Closed Itemsets, Association Rules, Frequent Itemset Mining Methods- Apriori algorithm, Generating Association rules from Frequent Itemsets, A Pattern-Growth Approach for mining frequent Itemsets, Mining Frequent Itemsets using the Vertical Data Format.						
UNIT 4:	CLASSIFICATION AND PREDICTION					9
Classification and Prediction ,Basic Concepts, Decision Tree Induction, Bayesian Classification ,RuleBased Classification, Classification by Back propagation , Support Vector Machines, Lazy learners.						
UNIT 5:	TYPES OF DATA IN CLUSTER ANALYSIS					9
Types of Data in Cluster Analysis , Data similarity and dissimilarity measures ,A Categorization of Major Clustering Methods -Partitioning Methods-K-means, K-medoids , Hierarchical Methods-Agglomerative vs Divisive, Distance measures, BIRCH, Clustering High-Dimensional Data- Outlier Analysis and Detection.						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Apply data lifecycle concepts and dimensional modeling techniques to design data warehouses and data marts.					
CO2:	Perform data preprocessing tasks to prepare datasets for effective data mining					
CO3:	Use association rule mining methods to identify frequent itemsets and generate insights					
CO4:	Implement classification and prediction models using various supervised learning techniques.					
CO5:	Apply clustering algorithms and outlier detection methods to analyze multidimensional data..					
TEXT BOOKS						
1.	Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, 3rd Edition, Morgan Kaufmann Publishers, 2012.					
2.	Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson Education, 2018.					
3.	Paulraj Ponniah, Data Warehousing: Fundamentals for IT Professionals, 2nd Edition, Wiley India, 2010.					
REFERENCES						

1.	Alex Berson, Stephen J Smith, Data warehousing, Data mining, and OLAP, Tata McGraw Hill, 2007
2.	G. K. Gupta ,Introduction to Data Mining with Case Studies, Easter Economy Edition, Prentice Hall of India, 2006

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	2	2	3	2	1	2	1	2	3	3	3	3
CO2:	3	2	2	2	2	1	2	1	2	2	2	2	2	2
CO3:	3	3	3	3	2	2	2	1	2	2	2	2	3	3
CO4:	2	2	2	2	3	1	1	1	1	3	2	2	2	2
CO5:	3	3	3	3	2	3	1	2	2	2	2	3	2	3
AVG	2.8	2.6	2.4	2.4	2.4	1.8	1.4	1.4	1.6	2.2	2.2	2.4	2.4	2.6

1 - low, 2 - medium, 3 - high

BCS444	GAME DEVELOPMENT	L	T	P	C	TOTAL MARKS
			0	0	3	100
PREREQUISITES: Audio And Video Editing						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	To gain Knowledge on developing animations using HTML and CSS					
2	To familiarize with OOP Concepts in JavaScript					
3	To design basic 2D game using HTML, CSS and JavaScript					
4	To develop 3D interactive games with HTML, CSS and JavaScript.					
5	To use standard Game Testing techniques and develop reports.					
UNIT 1: INTRODUCTION TO HTML CSS						9
The Evolution of HTML, Need for DOM, HTML 5 Tags - Semantic Tags, useful tags - Template pages – Images- Hyperlink s- Multimedia-Tables – Accessibility - Validating the webpage - Hosting a page, Working on Cpanel. Cascading Style Sheet (CSS): The need for CSS, Introduction to CSS – Basic syntax and structure - Inline Styles – Embedding Style Sheets - Linking External Style Sheets – Backgrounds – CSS Animations - Working with Sound, Video, and Animation - Understanding Codecs and Containers, Understanding Plug-Ins						
UNIT 2: INTRODUCTION TO JAVA SCRIPT						9
Introduction - Core features - Data types and Variables - Operators, Expressions, and Statements - Functions - Objects - Array, Date and Math related Objects, Event Handling - Controlling Windows & Frames and Documents - Form handling and validations - Introduction-Classes – Constructors – Object-Oriented Techniques in JavaScript – Object constructor and Prototyping - Sub classes and Super classes – JSON - jQuery and AJAX						
UNIT 3: INTRODUCTION TO GAME PROGRAMMING						9
Game Introduction – Canvas – Components – Controllers – Obstacles – Game Scores – Multimedia – Images, Sound – Game Gravity, Bouncing – Rotation & Movement.-Create a simple 2D Car game with a controller - UP, Down, Left and Right.						
UNIT 4: GAME WORLD AND INTERACTION						9
Introduction to HTML Game Frameworks – Understanding 2D & 3D platforms, Creating a Basic Game World - Physics Engine Basics - Integrating the Physics Engine - Creating a Mobile Game - Creating the RTS Game World - Intelligent Unit Movement- Adding Game Elements. Create a simple 3D game with Interactive environment						
UNIT 5: GAME DEVELOPMENT AND TESTING						
Game mechanics, rules and challenges - Playtesting, balancing and level design - Prototyping and Pitching – UI Designing - Materials and Shaders - Optimizing Runtime Performance - Collision Detection. Game Testing - Combinatorial Testing - Clean Room Testing - Functionality Testing - Compatibility Testing - Regression Testing - Ad hoc Testing – Playtesting.						
						45 PERIODS
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Implement scripts using HTML & CSS for game animations.					
CO2:	Demonstrate game environment using OOP in JavaScript.					
CO3:	Develop basic 2D games with HTML, CSS and JavaScript.					
CO4:	Create 3D game world and interactions.					
CO5:	Hands on experiment with game testing and reporting					
TEXT BOOKS						
1.	Jon Duckett, HTML and CSS: Design and Build Websites, John Wiley & Sons, 2011					
2.	David Geary, Core HTML5 Canvas: Graphics, Animation, and Game Development, Prentice Hall, 2012.					
3.	Joseph Hocking, Unity in Action: Multiplatform Game Development in C# with Unity, 2nd					

	Edition, Manning Publications, 2018.
REFERENCES	
1.	Jon Duckett, JavaScript and JQuery: Interactive Front-End Web Development, John Wiley & Sons, 2014.
2.	Steve Rabin (Ed.), Introduction to Game Development, 3rd Edition, CRC Press, 2022

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	2	3	2	3	-	-	-	3	2	1	2	3	2
CO2:	3	3	3	3	3	-	-	-	3	3	2	2	3	2
CO3:	3	3	3	3	3	-	-	-	3	3	2	3	3	2
CO4:	3	3	3	3	3	2	-	-	3	3	3	3	3	3
CO5:	3	3	3	3	3	2	-	-	3	3	3	3	3	3
AVG	3.0	2.8	3.0	2.8	3.0	2.0	-	-	3.0	2.8	2.2	2.6	3.0	2.4

1 - low, 2 - medium, 3 – high

BCS445	BIG DATA ANALYTICS	L	T	P	C	TOTAL MARKS
			0	0	3	100
PREREQUISITES: Database Management Systems						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Understand big data for business intelligence.					
2	Learn business case studies for bigdata analytics.					
3	Understand nosql bigdata management.					
4	Perform map-reduce analytics using Hadoop and related tools					
5	Gain knowledge on Hadoop Tools					
UNIT 1:	INTRODUCTION TO BIG DATA					9
What is big data, why big data, convergence of key trends, unstructured data, industry examples of big Data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.						
UNIT 2:	DATA MODELS					9
Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schema less databases, materialized views, distribution models, sharding, master-slave replication, peer- peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations						
UNIT 3:	HADOOP					9
Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures						
UNIT 4:	MAP REDUCE					9
MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort,task execution, MapReduce types, input formats, output formats						
UNIT 5:	HADOOP TOOLS					9
Hbase, data model and implementations, Hbase clients, Hbase examples, praxis. Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration. Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Describe big data and use cases from selected business domains.					
CO2:	Explain NoSQL big data management.					
CO3:	Install, configure, and run Hadoop and HDFS.					
CO4:	Perform map-reduce analytics using Hadoop.					
CO5:	Use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.					
TEXT BOOKS						
1.	Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.					
2.	Eric Sammer, "Hadoop Operations", O'Reilley, 2012.					
3.	Sadalage, Pramod J. "NoSQL distilled", 2013					

REFERENCES	
1.	E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
2.	Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
3.	Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
4.	Alan Gates, "Programming Pig", O'Reilley, 2011

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	3	3	3	-	-	-	2	2	3	1	1	3
CO2:	3	3	2	3	2	-	-	-	2	2	3	3	2	3
CO3:	3	3	3	2	3	-	-	-	2	2	1	2	2	3
CO4:	2	3	3	3	3	-	-	-	2	2	3	2	3	3
CO5:	3	3	3	3	3	-	-	-	3	1	3	2	3	2
AVG	2.8	3	2.8	2.8	2.8	-	-	-	2.2	1.8	2.6	2	2.2	2.8

1 - low, 2 - medium, 3 – high

BCS446	FULL STACK WEB DEVELOPMENT USING GenAI	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES:NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Provide a sound knowledge on full stack development					
2	Understand front end development using React JS					
3	Understand backend development using Node JS and Express JS					
4	Explore database management and AI integration					
5	Deploying Full Stack Web Applications With GenAI Enhanced Testing					
UNIT 1:	INTRODUCTION TO FULL STACK DEVELOPMENT AND GENAI IN WEB DEVELOPMENT					9
Overview of Full Stack Web Development: Frontend, Backend, and Database., Understanding the software development life cycle. Introduction to GenAI and its applications in web development. Tools and frameworks: Node.js, Express.js, React.js, MongoDB, MySQL. Role of GenAI in automating development tasks (e.g., code generation, refactoring, UI/UX design).						
UNIT 2	FRONT-END DEVELOPMENT USING REACT.JS AND GENAI ASSISTANCE					9
HTML5, CSS3, JavaScript fundamentals, Introduction to React.js: Components, JSX, Props, and State, Styling with CSS-in-JS and responsive design, Integrating GenAI tools to automate front-end code generation (e.g., AI-based UI/UX design tools). Best practices in creating interactive user interfaces						
UNIT 3	BACK-END DEVELOPMENT WITH NODE.JS AND EXPRESS.JS					9
Introduction to Node.js and Express.js framework, Setting up server-side architecture., Working with RESTful APIs, Authentication and authorization using JWT (JSON Web Tokens)., Connecting front-end with back-end: Fetch API or Axios for AJAX requests, Using GenAI for backend code generation and API design.						
UNIT 4:	DATABASE MANAGEMENT AND AI INTEGRATION					9
Introduction to databases: SQL vs NoSQL (MySQL, MongoDB), Database design: Tables, schemas, relationships, and queries., CRUD operations and connecting databases to back-end., Integrating GenAI for database query optimization and auto-generation of schema., Using AI for predictive analytics, recommendation systems, and personalized experiences.						
UNIT 5:	DEPLOYING FULL STACK WEB APPLICATIONS WITH GENAI-ENHANCED TESTING					9
Deployment strategies: Heroku, AWS, Azure., Continuous Integration/Continuous Deployment (CI/CD), Integrating GenAI for automated testing: Unit tests, integration tests, and bug detection., Performance monitoring and optimization., Final project: Building a GenAI-powered full-stack application.						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Explain about full-stack development process.					
CO2:	Develop interactive and responsive front-end applications using React.js.					
CO3:	Build a robust back-end for a web application using Node.js and Express.js.					
CO4:	Design and implement databases to support full stack applications					
CO5:	Deploy and maintain full-stack applications.					
TEXT BOOKS						
1.	Himanshu Yadav, Practical AI for Web Development: Building Smart Applications with Full Stack Technologies",					

2.	Matthew C. Leach , "Learning Full Stack Web Development with Python and JavaScript: Integrating AI for Web and App Development
REFERENCES	
1.	Colin J. Ihrig , "Full Stack JavaScript Development with MEAN"
2.	Martin Kleppmann , "Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems"

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	3	3	3	1	1	1	1	1	1	2	3	3
CO2:	3	3	3	3	3	1	1	1	1	1	1	2	3	3
CO3:	3	3	3	3	3	1	1	1	1	1	1	2	3	3
CO4:	3	3	3	3	3	1	1	1	1	1	1	2	3	3
CO5:	3	3	3	3	3	1	1	1	1	1	1	2	3	3
AVG	3.0	3.0	3.0	3.0	3.0	1.0	1.0	1.0	1.0	1.0	1.0	2	3.0	3.0

1 - low, 2 - medium, 3 - high

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BCS447	DIGITAL MARKETING	L	T	P	C	TOTAL MARKS
		3	0	0	3	100
PREREQUISITES: NIL						
COURSE OBJECTIVES:						
The main objectives of this course are to:						
1	Provide understanding of the fundamentals, evolution, and scope of digital marketing.					
2	Equip students with knowledge of SEO, SEM, and online advertising strategies.					
3	Develop skills in social media marketing, content creation, and campaign management.					
4	Familiarize students with web analytics tools for evaluating digital marketing performance.					
5	Expose students to advanced digital marketing strategies, ethical practices, and emerging technologies.					
UNIT 1:	INTRODUCTION TO DIGITAL MARKETING					9
Fundamentals of Digital Marketing, Evolution of Digital Marketing, Traditional vs Digital Marketing, Digital Marketing Framework, Customer Journey in Digital Marketing, Digital Channels Overview, Current Trends and Future Scope						
UNIT 2	SEARCH ENGINE OPTIMIZATION (SEO) AND SEARCH ENGINE MARKETING (SEM)					9
Introduction to SEO, On-page and Off-page Optimization, Keyword Research and Tools, SEO Analytics and Metrics, Google Search Console, Introduction to SEM, Google Ads Campaigns, Pay-Per-Click (PPC) Advertising, Bidding Strategies						
UNIT 3	SOCIAL MEDIA MARKETING (SMM) AND CONTENT MARKETING					9
Introduction to Social Media Platforms, Building Brand Presence, Social Media Campaign Planning, Measuring Social Media ROI, Influencer Marketing, Principles of Content Marketing, Blogging, Video Content, Content Strategy, Email Marketing Essentials						
UNIT 4:	WEB ANALYTICS AND PERFORMANCE MEASUREMENT					9
Introduction to Web Analytics, Google Analytics Basics, Traffic Sources, Audience Analysis, Conversion Tracking, Key Performance Indicators (KPIs), A/B Testing, Tools for Digital Marketing Analytics, Dashboards and Reporting						
UNIT 5:	ADVANCED DIGITAL MARKETING STRATEGIES AND APPLICATIONS					9
Mobile Marketing, Affiliate Marketing, Remarketing and Retargeting, Marketing Automation, E-commerce Marketing, Digital Marketing Ethics and Legal Aspects, Case Studies in Digital Marketing, Future Trends: AI in Marketing, Chatbots, Voice Search Optimization						
45 PERIODS						
COURSE OUTCOMES:						
Upon successful completion of the course, students will be able to:						
CO1:	Explain the concepts, frameworks, and scope of digital marketing.					
CO2:	Apply SEO and SEM techniques for improving website visibility and online reach.					
CO3:	Design and manage social media and content marketing campaigns effectively.					
CO4:	Analyze marketing performance using web analytics tools and KPIs.					
CO5:	Implement advanced digital marketing strategies and evaluate their impact in real-world scenarios.					
TEXT BOOKS						
1.	Philip Kotler, Hermawan Kartajaya, Iwan Setiawan, Marketing 4.0: Moving from Traditional to Digital, Wiley, 2017.					
2.	Seema Gupta, Digital Marketing, McGraw Hill Education, 2020.					
REFERENCES						
1.	Dave Chaffey, Fiona Ellis-Chadwick, Digital Marketing: Strategy, Implementation and Practice, Pearson, 7th Edition, 2019.					

2.	Ryan Deiss, Russ Henneberry, Digital Marketing for Dummies, Wiley, 2017.
3.	Damian Ryan, Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page, 4th Edition, 2016.

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	3	3	3	3	3	1	1	1	1	1	1	2	3	3
CO2:	3	3	3	3	3	1	1	1	1	1	1	2	3	3
CO3:	3	3	3	3	3	1	1	1	1	1	1	2	3	3
CO4:	3	3	3	3	3	1	1	1	1	1	1	2	3	3
CO5:	3	3	3	3	3	1	1	1	1	1	1	2	3	3
AVG	3.0	3.0	3.0	3.0	3.0	1.0	1.0	1.0	1.0	1.0	1.0	2	3.0	3.0

1 - low, 2 - medium, 3 - high