# KONGU ENGINEERING COLLEGE

**(Autonomous Institution Affiliated to Anna University, Chennai)**

**PERUNDURAI ERODE – 638 060**

**TAMILNADU INDIA**

Estd : 1984

## REGULATIONS, CURRICULUM & SYLLABI - 2020

**(CHOICE BASED CREDIT SYSTEM &**
**OUTCOME BASED EDUCATION)**

**(For the students admitted during 2020 - 2021 and onwards)**

## BACHELOR OF ENGINEERING DEGREE
## IN
## COMPUTER SCIENCE AND DESIGN

## DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

KONGU
*Assuring the Best*

# INDEX

**KONGU ENGINEERING COLLEGE**
**PERUNDURAI ERODE – 638 060**
**(Autonomous)**

## INSTITUTE VISION

To be a centre of excellence for development and dissemination of knowledge in Applied Sciences, Technology, Engineering and Management for the Nation and beyond.

## INSTITUTE MISSION

We are committed to value based Education, Research and Consultancy in Engineering and Management and to bring out technically competent, ethically strong and quality professionals to keep our Nation ahead in the competitive knowledge intensive world.

## QUALITY POLICY

We are committed to

- Provide value based quality education for the development of students as competent and responsible citizens.
- Contribute to the nation and beyond through research and development
- Continuously improve our services

## DEPARTMENT OF COMPUTER SCIENCE AND DESIGN

## VISION

To be a centre of excellence for nurturing competent computer professionals with enriched interactive design skills, high caliber and quality for catering to the ever-changing needs of the industry and society.

## MISSION

Department of Computer Science and Design is committed to:

MS1: Develop innovative, competent and ethically strong computer engineers with design skills to meet global challenges.

MS2: Foster consultancy and basic as well as applied research activities to solve real world problems.

MS3: Endeavour for constant upgradation of technical expertise to cater to the needs of the industry and society.

## PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

**Graduate of Computer Science and Design programme will:**

PEO1: Utilize the fundamental knowledge of basic sciences and engineering to succeed in their professional career.

PEO2: Analyze, designing interface, develop and verify effective interactive computer-based solutions to real world problems.

PEO3: Exhibit soft skills, ethical code of conduct and ability for life-long learning.

## MAPPING OF MISSION STATEMENTS (MS) WITH PEOs

| MS\PEO | PEO1 | PEO2 | PEO3 |
|---|---|---|---|
| **MS1** | 2 | 2 | 3 |
| **MS2** | 3 | 3 | 2 |
| **MS3** | 3 | 2 | 3 |

1 – Slight, 2 – Moderate, 3 – Substantial

## PROGRAM OUTCOMES (POs)

Graduates of Computer Science and Design will**:**

**PO1** **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO2** **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO3** **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO4** **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO5** **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**PO6** **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO7** **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**PO8** **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9** **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10** **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**PO11** **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**PO12** **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## PROGRAM SPECIFIC OUTCOMES (PSOs)

Graduates of Computer Science and Design will**:**

**PSO1** **Foundations of Computer Science:** Ability to use the mathematical and computing knowledge to propose viable ideas and solutions to solve real world problems.

**PSO2** **Software design and Development:** Ability to develop computer based good user interactive systems using engineering skills, knowledge of Design, programming languages and tools.

**MAPPING OF PEOs WITH POs AND PSOs**

| **PEO\ PO** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PEO1 | 3 | 2 | - | - | - | - | 2 | - | - | - | 1 | 2 | 3 | 1 |
| PEO2 | - | 3 | 3 | 3 | 2 | - | 1 | - | - | - | 2 | 2 | 1 | 3 |
| PEO3 | - | - | - | - | - | 3 | - | 3 | 3 | 3 | - | 3 | 1 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial

**KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638060**

**(Autonomous)**

**REGULATIONS 2020**

**CHOICE BASED CREDIT SYSTEM AND OUTCOME BASED EDUCATION**

**BACHELOR OF ENGINEERING (BE) / BACHELOR OF TECHNOLOGY (BTech) DEGREE PROGRAMMES**

**These regulations are applicable to all candidates admitted into BE/BTech Degree programmes from the academic year 2020 – 2021 onwards.**

## 1. DEFINITIONS AND NOMENCLATURE

In these Regulations, unless otherwise specified:

i. "University" means ANNA UNIVERSITY, Chennai.

ii. "College" means KONGU ENGINEERING COLLEGE.

iii. "Programme" means Bachelor of Engineering (BE) / Bachelor of Technology (BTech) Degree programme

iv. "Branch" means specialization or discipline of BE/BTech Degree programme, like Civil Engineering, Information Technology, etc.

v. "Course" means a Theory / Theory cum Practical / Practical course that is normally studied in a semester like Mathematics, Physics etc.

vi. "Credit" means a numerical value allocated to each course to describe the candidate's workload required per week.

vii. "Grade" means the letter grade assigned to each course based on the marks range specified.

viii. "Grade point" means a numerical value (0 to 10) allocated based on the grade assigned to each course.

ix. "Principal" means Chairman, Academic Council of the College.

x. "Controller of Examinations" means authorized person who is responsible for all examination related activities of the College.

xi. "Head of the Department" means Head of the Department concerned of the College.

## 2. PROGRAMMES AND BRANCHES OF STUDY

The following programmes and branches of study approved by Anna University, Chennai and All India Council for Technical Education, New Delhi are offered by the College.

| Programme | Branch |
|---|---|
| BE | Civil Engineering |
| | Mechanical Engineering |
| | Electronics and Communication Engineering |
| | Computer Science and Engineering |
| | Electrical and Electronics Engineering |
| | Electronics and Instrumentation Engineering |
| | Mechatronics Engineering |
| | Automobile Engineering |
| | Computer Science and Design |
| BTech | Chemical Engineering |
| | Information Technology |
| | Food Technology |
| | Artificial Intelligence and Data Science |
| | Artificial Intelligence and Machine Learning |

## 3. ADMISSION REQUIREMENTS

### 3.1 First Semester Admission

The candidates seeking admission to the first semester of the eight semester BE / BTech Degree Programme:

Should have passed the Higher Secondary Examination (10 + 2) in the academic stream with Mathematics, Physics and Chemistry as three of the four subjects of study under Part-III subjects of the study conducted by the Government of Tamil Nadu or any examination of any other University or authority accepted by the Anna University, Chennai as equivalent thereto.

(OR)

Should have passed the Higher Secondary Examination of Vocational stream (Vocational groups in Engineering / Technology) as prescribed by the Government of Tamil Nadu.

They should also satisfy other eligibility conditions as prescribed by the Anna University, Chennai and Directorate of Technical Education, Chennai from time to time.

### 3.2 Lateral Entry Admission

The candidates who hold a Diploma in Engineering / Technology awarded by the State Board of Technical Education, Tamilnadu or its equivalent are eligible to apply for Lateral entry admission to the third semester of BE / BTech in relevant branches of study.

(OR)

The candidates who hold a BSc degree (10+2+3 stream) with mathematics as one of the subjects at the BSc level from a recognised University are eligible to apply for Lateral entry admission to the third semester of BE / BTech. Such candidates shall undergo two additional Engineering course(s) in the third and fourth semesters as prescribed by the College.

They should satisfy other eligibility conditions prescribed by the Anna University, Chennai and Directorate of Technical Education, Chennai from time to time.

## 4. STRUCTURE OF PROGRAMMES

### 4.1 Categorisation of Courses

The BE / BTech programme shall have a curriculum with syllabi comprising of theory, theory cum practical, practical courses in each semester, professional skills training, project work, internship, etc. that have been approved by the respective Board of Studies and Academic Council of the College. All the programmes have well defined Programme Outcomes (PO), Programme Specific Outcomes (PSO) and Programme Educational Objectives (PEOs) as per Outcome Based Education (OBE). The content of each course is designed based on the Course Outcomes (CO). The courses shall be categorized as follows:

i. Humanities and Social Sciences (HS) including Management Courses

ii. Basic Science (BS) Courses

iii. Engineering Science (ES) Courses

iv. Professional Core (PC) Courses

v. Professional Elective (PE) Courses

vi. Open Elective (OE) Courses

vii. Employability Enhancement Courses (EC) like Project work, Professional Skills, Comprehensive Test & Viva, Entrepreneurships/Start ups and Internship in Industry or elsewhere

viii. Audit Courses (AC)

ix. Mandatory Courses (MC) like Student Induction Program and Environmental Science.

x. Honours Degree Courses (HC)

### 4.2 Credit Assignment and Honours Degree

#### 4.2.1. Credit Assignment

Each course is assigned certain number of credits as follows:

| Contact period per week | Credits |
|---|---|
| 1 Lecture / Tutorial Period | 1 |
| 2 Practical Periods | 1 |
| 2 Project Work Periods | 1 |
| 40 Training / Internship Periods | 1 |

The minimum number of credits to complete the BE/BTech programme is 169.

#### 4.2.2. Honours Degree

If a candidate earns 18 to 20 additional credits in an emerging area, then he/she can be awarded with Honours degree mentioning that emerging area as his/her specialization. The respective board of studies shall recommend the specializations for honours degree and appropriate additional courses to be studied by the candidate which shall get approval from Academic Council of the institution. A candidate shall have not less than 8.0 CGPA and no history of arrears during the entire programme to opt for the honours degree.

Various specializations for various branches recommended by the respective boards of studies are given below:

| S. No. | Specializations for Honours degree in emerging areas | To be offered as Honours, Only for the following branches mentioned against the specialization |
|---|---|---|
| 1. | Construction Technology | Civil Engineering |
| 2. | Robotics | Mechanical Engineering |
| 3. | Electric Vehicles | Mechanical Engineering |
| 4. | Artificial Intelligence and Machine Learning | Mechatronics Engineering |
| 5. | Electric Vehicles | Automobile Engineering |
| 6. | Artificial Intelligence and Machine Learning | Electronics and Communication Engineering |
| 7. | Electric Vehicles | Electrical and Electronics Engineering |
| 8. | Control Systems and Sensors Technology | Electronics and Instrumentation Engineering |
| 9. | Cyber Security | Computer Science and Engineering |
| 10. | Data Science | Computer Science and Engineering |
| 11. | Cyber Security | Information Technology |
| 12. | Data Science | Information Technology |
| 13. | Waste Technology | Chemical Engineering |
| 14. | Food Processing and Management | Food Technology |

The courses specified under Honours degree in the emerging area may include theory, theory cum practical, practical, project work, etc. under the particular specialization. A candidate can choose and study these specified courses from fourth semester onwards and he/she shall successfully complete the courses within the stipulated time vide clause 5. Total number of credits earned in each semester may vary from candidate to candidate based on the courses chosen. The registration, assessment & evaluation pattern and classification of grades of these courses shall be the same as that of the courses in the regular curriculum of the programme of the candidate vide clause 6, clause 7 and clause 15 respectively. A candidate can earn Honours degree in only one specialization during the entire duration of the programme.

### 4.3 Employability Enhancement Courses

A candidate shall be offered with the employability enhancement courses like project work, internship, professional skills training, comprehensive test & viva, internship and entrepreneurships/start ups during the programme to gain/exhibit the knowledge/skills.

### 4.3.1 Professional Skills Training/ Entrepreneurships/Start Ups

A candidate may be offered with appropriate training courses imparting programming skills, communication skills, problem solving skills, aptitude skills etc. It is offered in two phases as phase I in fifth semester and phase II in sixth semester including vacation periods and each phase can carry two credits.

(or)

A candidate may be allowed to go for training at research organizations or industries for a required number of hours in sixth semester vacation period. Such candidate can earn two credits for this training course in place of Professional Skills Training course II in sixth semester. He/She shall attend Professional Skills Training Phase I in fifth semester and can earn two credits.

(or)

A candidate may be allowed to set up a start up and working part-time for the start ups by applying his/her innovations and can become a student entrepreneur during BE/BTech programme. Candidates can set up their start up from fifth semester onwards either inside or outside of the college. Such student entrepreneurs may earn a maximum of 2 credits per semester for two semesters each in place of either Professional Skills Training I or Professional Skills Training II. The area in which the candidate wants to initiate a start up may be interdisciplinary or multidisciplinary. The progress of the startup shall be evaluated by a panel of members constituted by the Principal through periodic reviews.

### 4.3.2 Comprehensive Test & Viva

The overall knowledge of the candidate in various courses he/she studied shall be evaluated by (i) conducting comprehensive tests with multiple choice questions generally with pattern similar to GATE and/or (ii) viva-voce examination conducted by a panel of experts assigned by the Head of the department. The members can examine the knowledge of the candidate by asking questions from various domains and the marks will be assigned based on their answers. This course shall carry two credits.

### 4.3.3 Internships

The curriculum enables a candidate to go for full time projects through internship during a part of seventh semester and/or entire final semester and can earn credits vide clause 7.6 and clause 7.11.

A candidate is permitted to go for full time projects through internship in seventh semester with the following condition: The candidate shall complete a part of the seventh semester courses with a total credit of about 50% of the total credits of seventh semester including Project Work I Phase II in the first two months from the commencement of the seventh semester under fast track mode. The balance credits required to complete the seventh semester shall be earned by the candidate through either approved Value Added Courses /Online courses / Self Study Courses or Add/Drop courses as per clause 4.4 and clause 4.5 respectively.

A candidate is permitted to go for full time projects through internship during eighth semester. Such candidate shall earn the minimum number of credits required to complete eighth semester other than project through either approved Value Added Courses /Online courses / Self Study Courses or Add/Drop courses as per clause 4.4 and clause 4.5 respectively.

Assessment procedure is to be followed as specified in the guidelines approved by the Academic Council.

**4.4 Value Added Courses / Online Courses / Self Study Courses**

The candidates may optionally undergo Value Added Courses / Online Courses / Self Study Courses as elective courses.

**4.4.1** **Value Added Courses:** Value Added courses each with One / Two credits shall be offered by the college with the prior approval from respective Board of Studies. A candidate can earn a maximum of six credits through value added courses during the entire duration of the programme.

**4.4.2** **Online Courses:** Candidates may be permitted to earn credits for online courses, offered by NPTEL / SWAYAM / a University / Other Agencies, approved by respective Board of Studies.

**4.4.3** **Self Study Courses:** The Department may offer an elective course as a self study course. The syllabus of the course shall be approved by the respective Board of Studies. However, mode of assessment for a self study course will be the same as that used for other courses. The candidates shall study such courses on their own under the guidance of member of the faculty following due approval procedure. Self study course is limited to one per semester.

**4.4.4** The elective courses in the final year may be exempted if a candidate earns the required credits vide clause 4.4.1, 4.4.2 and 4.4.3 by registering the required number of courses in advance.

**4.4.5** A candidate can earn a maximum of 30 credits through all value added courses, online courses and self study courses.

**4.5 Flexibility to Add or Drop Courses**

**4.5.1** A candidate 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. However, if the candidate wishes, then the candidate is permitted to earn more than the total number of credits prescribed in the curriculum of the candidate's programme.

**4.5.2** From the first to eighth semesters the candidates have the option of registering for additional elective/Honours courses or dropping of already registered additional elective/Honours courses within two weeks from the start of the semester. Add / Drop is only an option given to the candidates. Total number of credits of such courses during the entire programme of study cannot exceed eight.

**4.6** Maximum number of credits the candidate can enroll in a particular semester cannot exceed 30 credits.

**4.7** The blend of different courses shall be so designed that the candidate at the end of the programme would have been trained not only in his / her relevant professional field but also would have developed to become a socially conscious human being.

**4.8** The medium of instruction, examinations and project report shall be English.

## 5. DURATION OF THE PROGRAMME

**5.1** A candidate is normally expected to complete the BE / BTech Degree programme in 8 consecutive semesters/4 Years (6 semesters/3 Years for lateral entry candidate), but in any case not more than 14 semesters/7 Years (12 semesters/6 Years for lateral entry candidate).

**5.2** Each semester shall consist of a minimum of 90 working days including continuous assessment test period. The Head of the Department shall ensure that every teacher imparts instruction as per the number of periods specified in the syllabus for the course being taught.

**5.3** The total duration for completion of the programme reckoned from the commencement of the first semester to which the candidate was admitted shall not exceed the maximum duration specified in clause 5.1 irrespective of the period of break of study (vide clause 11) or prevention (vide clause 9) in order that the candidate may be eligible for the award of the degree (vide clause 16). Extension beyond the prescribed period shall not be permitted.

## 6. COURSE REGISTRATION FOR THE EXAMINATION

**6.1** Registration for the end semester examination is mandatory for courses in the current semester as well as for the arrear courses failing which the candidate will not be permitted to move on to the higher semester. This will not be applicable for the courses which do not have an end semester examination.

**6.2** The candidates who need to reappear for the courses which have only continuous assessment shall enroll for the same in the subsequent semester, when offered next, and repeat the course. In this case, the candidate shall attend the classes, satisfy the attendance requirements (vide clause 8), earn continuous assessment marks. This will be considered as an attempt for the purpose of classification.

**6.3** If a candidate is prevented from writing end semester examination of a course due to lack of attendance, the candidate has to attend the classes, when offered next, and fulfill the attendance requirements as per clause 8 and earn continuous assessment marks. If the course, in which the candidate has a lack of attendance, is an elective, the candidate may register for the same or any other elective course in the subsequent semesters and that will be considered as an attempt for the purpose of classification.

**6.4** A candidate shall register for the chosen courses as well as arrear courses (if any vide clause 6.2 and 6.3) from the list of courses specified under Honours degree.

## 7. ASSESSMENT AND EXAMINATION PROCEDURE FOR AWARDING MARKS

**7.1** The BE/BTech programmes consist of Theory Courses, Theory cum Practical courses, Practical courses, Project Work, Professional Skills Training / Industrial Training, Internship and Entrepreneurships/ Start ups. Performance in each course of study shall be evaluated based on (i) Continuous Assessments (CA) throughout the semester and (ii) End Semester Examination (ESE) at the end of the semester except for the courses which are evaluated based on continuous assessment only. Each course shall be evaluated for a maximum of 100 marks as shown below:

| Sl. No. | Category of Course | Continuous Assessment Marks | End Semester Examination Marks |
|---|---|---|---|
| 1. | Theory / Practical | 50 | 50 |
| 2. | Theory cum Practical | The distribution of marks shall be decided based on the credit weightage assigned to theory and practical components. | |
| 3. | Professional Skills Training / / Comprehensive Test & Viva / Entrepreneurships / Start ups / Project Work 1 / Industrial Training / Mandatory Course | 100 | --- |
| 4. | Project Work 2 Phase I / Project Work 2 Phase II / Internships | 50 | 50 |
| 5. | Value Added Course | The distribution of marks shall be decided based on the credit weightage | --- |
| 6. | All other Courses | | |

**7.2** Examiners for setting end semester examination question papers for theory courses, theory cum practical courses and practical courses and evaluating end semester examination answer scripts, project works, internships and entrepreneurships/start ups shall be appointed by the Controller of Examinations after obtaining approval from the Principal.

### 7.3 Theory Courses

For all theory courses out of 100 marks, the continuous assessment shall be 50 marks and the end semester examination shall be for 50 marks. However, the end semester examinations shall be conducted for 100 marks and the marks obtained shall be reduced to 50. The continuous assessment tests shall be conducted as per the schedule laid down in the academic schedule. Three tests shall be conducted for 50 marks each and reduced to 30 marks each. The total of the continuous assessment marks and the end semester examination marks shall be rounded off to the nearest integer.

**7.3.1** The assessment pattern for awarding continuous assessment marks shall be as follows:

| Sl. No. | Type | Max. Marks | Remarks |
|---|---|---|---|
| 1. | Test - I | 30 | Average of best two |
| | Test - II | 30 | |
| | Test - III | 30 | |
| 2. | Tutorial | 15 | Should be of Open Book/Objective Type. Average of best 4 (or more, depending on the nature of the course, as may be approved by Principal) |
| 3. | Assignment / Paper Presentation in Conference / Seminar / Comprehension / Activity based learning / Class notes | 05 | To be assessed by the Course Teacher based on any one type. |
| | Total | 50 | Rounded off to the one decimal place |

However, the assessment pattern for awarding the continuous assessment marks may be changed based on the nature of the course and is to be approved by the Principal.

**7.3.2** A reassessment test or tutorial covering the respective test or tutorial portions may be conducted for those candidates who were absent with valid reasons (Sports or any other reason approved by the Principal).

**7.3.3** The end semester examination for theory courses shall be for a duration of three hours and shall be conducted between November and January during odd semesters and between April and June during even semesters every year.

## 7.4 Theory cum Practical Courses

For courses involving theory and practical components, the evaluation pattern as per the clause 7.1 shall be followed. Depending on the nature of the course, the end semester examination shall be conducted for theory and the practical components. The apportionment of continuous assessment and end semester examination marks shall be decided based on the credit weightage assigned to theory and practical components approved by Principal.

## 7.5 Practical Courses

For all practical courses out of 100 marks, the continuous assessment shall be for 50 marks and the end semester examination shall be for 50 marks. Every exercise / experiment shall be evaluated based on the candidate's performance during the practical class and the candidate's records shall be maintained.

**7.5.1** The assessment pattern for awarding continuous assessment marks for each course shall be decided by the course coordinator based on rubrics of that particular course, and shall be based on rubrics for each experiment.

## 7.6 Project Work II Phase I / Project Work II Phase II

**7.6.1** Project work shall be assigned to a single candidate or to a group of candidates not exceeding 4 candidates in a group. The project work is mandatory for all the candidates.

**7.6.2** The Head of the Department shall constitute review committee for project work. There shall be two assessments by the review committee during the semester. The candidate shall make presentation on the progress made by him/her before the committee.

**7.6.3** The continuous assessment and end semester examination marks for Project Work II (both Phase I and Phase II) and the Viva-Voce Examination shall be distributed as below:

| Continuous Assessment (Max. 50 Marks) | | | | | | End Semester Examination (Max. 50 Marks) | | | |
|---|---|---|---|---|---|---|---|---|---|
| Zeroth Review | | Review I (Max.. 20 Marks) | | Review II (Max. 30 Marks) | | Report Evaluation (Max. 20 Marks) | Viva - Voce (Max. 30 Marks) | | |
| Rv. Com | Guide | Review Committee (excluding guide) | Guide | Review Committee (excluding guide) | Guide | Ext. Exr. | Guide | Exr.1 | Exr.2 |
| 0 | 0 | 10 | 10 | 15 | 15 | 20 | 10 | 10 | 10 |

**7.6.4** The Project Report prepared according to approved guidelines and duly signed by the Supervisor shall be submitted to Head of the Department. The candidate(s) must submit the project report within the specified date as per the academic schedule of the semester. If the project report is not submitted within the specified date then the candidate is deemed to have failed in the Project Work and redo it in the subsequent semester.

**7.6.5** If a candidate fails to secure 50% of the continuous assessment marks in the project work, he / she shall not be permitted to submit the report for that particular semester and shall have to redo it in the subsequent semester and satisfy attendance requirements.

**7.6.6** The project work shall be evaluated based on the project report submitted by the candidate in the respective semester and viva-voce examination by a committee consisting of two examiners and guide of the project work.

**7.6.7** If a candidate fails to secure 50 % of the end semester examination marks in the project work, he / she shall be required to resubmit the project report within 30 days from the date of declaration of the results and a fresh viva-voce examination shall be conducted as per clause 7.6.6.

**7.6.8** A copy of the approved project report after the successful completion of viva-voce examination shall be kept in the department library.

### 7.7 Project Work I Phase I / Industrial Training

The evaluation method shall be same as that of the Project Work II as per clause 7.6 excluding 7.6.3, 7.6.5, 7.6.6 and 7.6.7. The marks distribution is given below:

| Continuous Assessment (Max. 100 Marks) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Zeroth Review | | Review I (Max.. 20 Marks) | | Review II (Max.. 30 Marks) | | Review III (Max. 50 Marks) | | |
| | | | | | | Report Evaluation (Max. 20 Marks) | Viva - Voce (Max. 30 Marks) | |
| Review Committee | Guide | Review Committee (excluding guide) | Guide | Review Committee (excluding guide) | Guide | Review Committee | Guide | Review Committee |
| 0 | 0 | 10 | 10 | 15 | 15 | 20 | 10 | 20 |

If a candidate fails to secure 50 % of the continuous assessment marks in this course, he / she shall be required to resubmit the project report within 30 days from the date of declaration of the results and a fresh viva-voce examination shall be conducted.

### 7.8 Professional Skills Training

Phase I training shall be conducted for minimum of 80 hours in 4$^{th}$ semester vacation and during 5$^{th}$ semester. Phase II training shall be conducted for minimum of 80 hours in 5$^{th}$ semester vacation and during 6$^{th}$ semester. The evaluation procedure shall be approved by the Principal.

### 7.9 Comprehensive Test/Viva

A candidate can earn 2 credits by successfully completing this course. The evaluation procedures shall be approved by the Principal.

### 7.10 Entrepreneurships/ Start ups

A start up/business model may be started by a candidate individually or by a group of maximum of three candidates during the programme vide clause 4.3.1. The head of the department concerned shall assign a faculty member as a mentor for each start up.

A review committee shall be formed by the Principal for reviewing the progress of the Start ups / Business models, innovativeness, etc. The review committee can recommend the appropriate grades for academic performance for the candidate(s) involved in the start ups. This course shall carry a maximum of two credits in fifth semester and two credits in sixth semester respectively and shall be evaluated through continuous assessments for a maximum of 100 marks vide clause 7.1. A report about the start ups is to be submitted to the review committee for evaluation for each start up and the marks will be given to Controller of Examinations after getting approval from Principal.

### 7.11 Projects through Internships

Each candidate shall submit a brief report about the internship undergone and a certificate issued from the organization concerned at the time of Viva-voce examination to the review committee. The evaluation method shall be same as that of the Project Work II as per clause 7.6.

### 7.12 Value Added Course

Minimum of two assessments shall be conducted during the value added course duration by the offering department concerned.

### 7.13 Online Course

The Board of Studies will provide methodology for the evaluation of the online courses. The Board can decide whether to evaluate the online courses through continuous assessment and end semester examination or through end semester examination only. In case of credits earned through online mode from NPTEL / SWAYAM / a University / Other Agencies approved by Chairman, Academic Council, the credits may be transferred and grades shall be assigned accordingly.

### 7.14 Self Study Course

The member of faculty approved by the Head of the Department shall be responsible for periodic monitoring and evaluation of the course. The course shall be evaluated through continuous assessment and end semester examination. The evaluation methodology shall be the same as that of a theory course.

### 7.15 Audit Course

A candidate may be permitted to register for specific course not listed in his/her programme curriculum and without undergoing the rigors of getting a 'good' grade, as an Audit course, subject to the following conditions.

The candidate can register only one Audit course in a semester starting from second semester subject to a maximum of two courses during the entire programme of study. Such courses shall be indicated as 'Audit' during the time of registration itself. Only courses currently offered for credit to the candidates of other branches can be audited.

A course appearing in the curriculum of a candidate cannot be considered as an audit course. However, if a candidate has already met the Professional Elective and Open Elective credit requirements as stipulated in the curriculum, then, a Professional Elective or an Open Elective course listed in the curriculum and not taken by the candidate for credit can be considered as an audit course.

Candidates registering for an audit course shall meet all the assessment and examination requirements (vide clause 7.3) applicable for a credit candidate of that course. Only if the candidate obtains a performance grade, the course will be listed in the semester Grade Sheet and in the Consolidated Grade Sheet along with the grade SF (Satisfactory). Performance grade will not be shown for the audit course.

Since an audit course has no grade points assigned, it will not be counted for the purpose of GPA and CGPA calculations.

### 7.16 Mandatory Course

A candidate shall attend and complete the induction training program of duration three weeks at the beginning of the first semester. It is mandatory for all candidates who have joined in various branches of all BE/BTech programmes. The induction training program includes the courses recommended by AICTE. Apart from this induction program, a candidate shall undergo the courses listed by AICTE as mandatory courses during their programme. No credits shall be given for such courses and shall be evaluated through continuous assessment tests only vide clause 7.1 for a maximum of 100 marks each. Since these courses have no grade points assigned, these courses will not be counted for the purpose of GPA and CGPA calculations.

### 7.17 Yoga and Values for Holistic Development (YVHD) and Universal Human Values (UHV)

Courses such as YVHD and UHV shall be offered to all candidates of all BE/BTech programmes. These courses shall carry a maximum of 100 marks each and shall be evaluated through continuous assessment tests only vide clause 7.1. The candidate(s) can earn 2 credits for UHV and 1 credit for YVHD by successfully completing these courses. Two continuous assessment tests will be conducted and the average marks will be taken for the calculation of grades.

## 8. REQUIREMENTS FOR COMPLETION OF A SEMESTER

**8.1** A candidate who has fulfilled the following conditions shall be deemed to have satisfied the requirements for completion of a semester and permitted to appear for the examinations of that semester.

**8.1.1** Ideally, every candidate is expected to attend all classes and secure 100 % attendance. However, a candidate shall secure not less than 80 % (after rounding off to the nearest integer) of the overall attendance taking into account the total number of working days in a semester.

**8.1.2** A candidate who could not satisfy the attendance requirements as per clause 8.1.1 due to medical reasons (hospitalization / accident / specific illness) but has secured not less than 70 % in the current semester may be permitted to appear for the current semester examinations with the approval of the Principal on payment of a condonation fee as may be fixed by the authorities from time to time. The medical certificate needs to be submitted along with the leave application. A candidate can avail this provision only twice during the entire duration of the degree programme.

A candidate who could not satisfy the attendance requirements as per clause 8.1.1 due to his/her entrepreneurships/ start ups activities, but has secured not less than 60 % in the current semester can be permitted to appear for the current semester examinations with the recommendation of review committee and approval from the Principal.

**8.1.3** In addition to clause 8.1.1 or 8.1.2, a candidate shall secure not less than 60 % attendance in each course.

**8.1.4** A candidate shall be deemed to have completed the requirements of study of any semester only if he/she has satisfied the attendance requirements (vide clause 8.1.1 to 8.1.3) and has registered for examination by paying the prescribed fee.

**8.1.5** Candidate's progress is satisfactory.

**8.1.6** Candidate's conduct is satisfactory and he/she was not involved in any indisciplined activities in the current semester.

**8.2.** The candidates who do not complete the semester as per clauses from 8.1.1 to 8.1.6 except 8.1.3 shall not be permitted to appear for the examinations at the end of the semester and not be permitted to go to the next semester. They have to repeat the incomplete semester in next academic year.

**8.3** The candidates who satisfy the clause 8.1.1 or 8.1.2 but do not complete the course as per clause 8.1.3 shall not be permitted to appear for the end semester examination of that course alone. They have to repeat the incomplete course in the subsequent semester when it is offered next.

## 9. REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION

**9.1** A candidate shall normally be permitted to appear for end semester examination of the current semester if he/she has satisfied the semester completion requirements as per clause 8, and has registered for examination in all courses of that semester. Registration is mandatory for current semester examinations as well as for arrear examinations failing which the candidate shall not be permitted to move on to the higher semester.

**9.2** When a candidate is deputed for a National / International Sports event during End Semester examination period, supplementary examination shall be conducted for such a candidate on return after participating in the event within a reasonable period of time. Such appearance shall be considered as first appearance.

**9.3** A candidate who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of letter grades / marks.

## 10. PROVISION FOR WITHDRAWAL FROM EXAMINATIONS

**10.1** A candidate may, for valid reasons, be granted permission to withdraw from appearing for the examination in any regular course or all regular courses registered in a particular semester. Application for withdrawal is permitted only once during the entire duration of the degree programme.

**10.2** The withdrawal application shall be valid only if the candidate is otherwise eligible to write the examination (vide clause 9) and has applied to the Principal for permission prior to the last examination of that semester after duly recommended by the Head of the Department.

**10.3** The withdrawal shall not be considered as an appearance for deciding the eligibility of a candidate for First Class with Distinction/First Class.

**10.4** If a candidate withdraws a course or courses from writing end semester examinations, he/she shall register the same in the subsequent semester and write the end semester examinations. A final semester candidate who has withdrawn shall be permitted to appear for supplementary examination to be conducted within reasonable time as per clause 14.

**10.5** The final semester candidate who has withdrawn from appearing for project viva-voce for genuine reasons shall be permitted to appear for supplementary viva-voce examination within reasonable time with proper application to Controller of Examinations and on payment of prescribed fee.

## 11. PROVISION FOR BREAK OF STUDY

**11.1** A candidate is normally permitted to avail the authorised break of study under valid reasons (such as accident or hospitalization due to prolonged ill health or any other valid reasons) and to rejoin the programme in a later semester. He/She shall apply in advance to the Principal, through the Head of the Department, stating the reasons therefore, in any case, not later than the last date for registering for that semester examination. A candidate is permitted to avail the authorised break of study only once during the entire period of study for a maximum period of one year. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for the break of study.

**11.2** The candidates permitted to rejoin the programme after break of study / prevention due to lack of attendance shall be governed by the rules and regulations in force at the time of rejoining.

**11.3** The candidates rejoining in new Regulations shall apply to the Principal in the prescribed format through Head of the Department at the beginning of the readmitted semester itself for prescribing additional/equivalent courses, if any, from any semester of the regulations in-force, so as to bridge the curriculum in-force and the old curriculum.

**11.4** The total period of completion of the programme reckoned from the commencement of the semester to which the candidate was admitted shall not exceed the maximum period specified in clause 5 irrespective of the period of break of study in order to qualify for the award of the degree.

**11.5** If any candidate is prevented for want of required attendance, the period of prevention shall not be considered as authorized break of study.

**11.6** If a candidate has not reported to the college for a period of two consecutive semesters without any intimation, the name of the candidate shall be deleted permanently from the college enrollment. Such candidates are not entitled to seek readmission under any circumstances.

## 12. PASSING REQUIREMENTS

**12.1** A candidate who secures not less than 50 % of total marks (continuous assessment and end semester examination put together) prescribed for the course with a minimum of 45 % of the marks prescribed for the end semester examination in all category of courses vide clause 7.1 except for the courses which are evaluated based on continuous assessment only shall be declared to have successfully passed the course in the examination.

**12.2** A candidate who secures not less than 50 % in continuous assessment marks prescribed for the courses which are evaluated based on continuous assessment only shall be declared to have successfully passed the course. If a candidate secures less than 50% in the

continuous assessment marks, he / she shall have to re-enroll for the same in the subsequent semester and satisfy the attendance requirements.

**12.3** For a candidate who does not satisfy the clause 12.1, the continuous assessment marks secured by the candidate in the first attempt shall be retained and considered valid for subsequent attempts. However, from the fourth attempt onwards the marks scored in the end semester examinations alone shall be considered, in which case the candidate shall secure minimum 50 % marks in the end semester examinations to satisfy the passing requirements, but the grade awarded shall be only the lowest passing grade irrespective of the marks secured.

## 13. REVALUATION OF ANSWER SCRIPTS

A candidate shall apply for a photocopy of his / her semester examination answer script within a reasonable time from the declaration of results, on payment of a prescribed fee by submitting the proper application to the Controller of Examinations. The answer script shall be pursued and justified jointly by a faculty member who has handled the course and the course coordinator and recommended for revaluation. Based on the recommendation, the candidate can register for revaluation through proper application to the Controller of Examinations. The Controller of Examinations will arrange for revaluation and the results will be intimated to the candidate concerned. Revaluation is permitted only for Theory courses and Theory cum Practical courses where end semester examination is involved.

## 14. SUPPLEMENTARY EXAMINATION

If a candidate fails to clear all courses in the final semester after the announcement of final end semester examination results, he/she shall be allowed to take up supplementary examinations to be conducted within a reasonable time for the courses of final semester alone, so that he/she gets a chance to complete the programme.

The candidates who have failed in the courses Professional Skill Training I/II and Comprehensive Test/Viva shall be permitted to take up supplementary examinations.

## 15. AWARD OF LETTER GRADES

| Range of % of Total Marks | Letter Grade | Grade Point |
|---|---|---|
| 91 to 100 | O (Outstanding) | 10 |
| 81 to 90 | A+ (Excellent) | 9 |
| 71 to 80 | A (Very Good) | 8 |
| 61 to 70 | B+ (Good) | 7 |
| 50 to 60 | B (Average) | 6 |
| Less than 50 | RA (Reappear) | 0 |
| Satisfactory | SF | 0 |
| Withdrawal | W | - |
| Absent | AB | - |
| Shortage of Attendance in a course | SA | - |

The Grade Point Average (GPA) is calculated using the formula:

$$\text{GPA} = \frac{\sum[(\text{course credits})\times(\text{grade points})] \text{ for all courses in the specific semester}}{\sum(\text{course credits}) \text{ for all courses in the specific semester}}$$

The Cumulative Grade Point Average (CGPA) is calculated from first semester (third semester for lateral entry candidates) to final semester using the formula

$$\text{CGPA} = \frac{\sum[(\text{course credits})\times(\text{grade points})] \text{ for all courses in all the semesters so far}}{\sum(\text{course credits}) \text{ for all courses in all the semesters so far}}$$

The GPA and CGPA are computed only for the candidates with a pass in all the courses.

The GPA and CGPA indicate the academic performance of a candidate at the end of a semester and at the end of successive semesters respectively.

A grade sheet for each semester shall be issued containing Grade obtained in each course, GPA and CGPA.

A duplicate copy, if required can be obtained on payment of a prescribed fee and satisfying other procedure requirements.

Withholding of Grades: The grades of a candidate may be withheld if he/she has not cleared his/her dues or if there is a disciplinary case pending against him/her or for any other reason.

## 16. ELIGIBILITY FOR THE AWARD OF DEGREE

A candidate shall be declared to be eligible for the award of the BE / BTech Degree provided the candidate has

i. Successfully completed all the courses under the different categories, as specified in the regulations.

ii. Successfully gained the required number of total credits as specified in the curriculum corresponding to the candidate's programme within the stipulated time (vide clause 5).

iii. Successfully passed any additional courses prescribed by the respective Board of Studies whenever readmitted under regulations other than R-2020 (vide clause 11.3)

iv. No disciplinary action pending against him / her.

## 17. CLASSIFICATION OF THE DEGREE AWARDED

**17.1 First Class with Distinction:**

**17.1.1** A candidate who qualifies for the award of the degree (vide clause 16) and who satisfies the following conditions shall be declared to have passed the examination in First class with Distinction:

- Should have passed the examination in all the courses of all the eight semesters (six semesters for lateral entry candidates) in the **First Appearance** within eight consecutive semesters (six consecutive semesters for lateral entry candidates) excluding the authorized break of study (vide clause 11) after the commencement of his / her study.
- Withdrawal from examination (vide clause 10) shall not be considered as an appearance.
- Should have secured a CGPA of not less than 8.50

(OR)

**17.1.2** A candidate who joins from other institutions on transfer and who gets readmitted and has to move from one regulations to another regulations and who qualifies for the award of the degree (vide clause 16) and satisfies the following conditions shall be declared to have passed the examination in First class with Distinction:

- Should have passed the examination in all the courses of all the eight semesters (six semesters for lateral entry candidates) in the **First Appearance** within eight consecutive semesters (six consecutive semesters for lateral entry candidates) excluding the authorized break of study (vide clause 11) after the commencement of his / her study.
- Submission of equivalent course list approved by the respective Board of studies.
- Withdrawal from examination (vide clause 10) shall not be considered as an appearance.
- Should have secured a CGPA of not less than 9.00

**17.2 First Class:**

A candidate who qualifies for the award of the degree (vide clause 16) and who satisfies the following conditions shall be declared to have passed the examination in First class:

- Should have passed the examination in all the courses of all eight semesters (six semesters for lateral entry candidates) within ten consecutive semesters (eight consecutive semesters for lateral entry candidates) excluding authorized break of study (vide clause 11) after the commencement of his / her study.
- Withdrawal from the examination (vide clause 10) shall not be considered as an appearance.
- Should have secured a CGPA of not less than 7.00

**17.3 Second Class:**

All other candidates (not covered in clauses 17.1 and 17.2) who qualify for the award of the degree (vide clause 16) shall be declared to have passed the examination in Second Class.

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

**17.5 Honours Degree:**

A candidate who qualifies for the award of the degree (vide clause 16) and who satisfies the following conditions shall be declared to have earned the BE/BTech degree with Honours (vide clause 16 and clause 4.2.2):

- Should have passed the examination in all the courses of all the eight semesters (six semesters for lateral entry candidates) in the **First Appearance** within eight consecutive semesters (six consecutive semesters for lateral entry candidates) excluding the authorized break of study (vide clause 11) after the commencement of his / her study.
- Withdrawal from examination (vide clause 10) shall not be considered as an appearance.
- Should have secured a CGPA of not less than 8.00

## 18. MALPRACTICES IN TESTS AND EXAMINATIONS

If a candidate indulges in malpractice in any of the tests or end semester examinations, he/she shall be liable for punitive action as per the examination rules prescribed by the college from time to time.

## 19. AMENDMENTS

Notwithstanding anything contained in this manual, the Kongu Engineering College through the Academic council of the Kongu Engineering College, reserves the right to modify/amend without notice, the Regulations, Curricula, Syllabi, Scheme of Examinations, procedures, requirements, and rules pertaining to its BE / BTech programme.

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**CURRICULUM BREAKDOWN STRUCTURE**

**Summary of Credit Distribution**

| Category | Semester | | | | | | | | Total number of credits | Curriculum Content (% of total number of credits of the program) |
|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | | |
| **HS** | 3 | 4 | 3 | | | | 3 | | 13 | 7.69 |
| **BS** | 11 | 4 | 4 | | | | | | 19 | 11.24 |
| **ES** | 8 | 5 | | 4 | | 4 | | | 21 | 12.42 |
| **PC** | | 11 | 15 | 16 | 12 | 9 | 3 | | 66 | 39.05 |
| **PE** | | | | | 3 | | 12 | 3 | 18 | 10.65 |
| **OE** | | | | 4 | 4 | 3 | | 3 | 14 | 8.28 |
| **EC** | | | | | 2 | 6 | 3 | 7 | 18 | 10.65 |
| **Semesterwise Total** | 22 | 24 | 22 | 24 | 21 | 22 | 21 | 13 | 169 | **100.00** |

| Category | Abbreviation |
|---|---|
| Lecture hours per week | **L** |
| Tutorial hours per week | **T** |
| Practical, Project work, Internship, Professional Skill Training, Industrial Training hours per week | **P** |
| Credits | **C** |

**CATEGORISATION OF COURSES (follow the order of courses in semesterwise curriculm)**

**HUMANITIES AND SOCIAL SCIENCE INCLUDING MANAGEMENT (HS)**

| S. No. | Course Code | Course Name | L | T | P | C | Sem |
|---|---|---|---|---|---|---|---|
| 1. | 20EGT11 | English Language Skills | 3 | 0 | 0 | 3 | I |
| 2. | 20EGT21 | Advanced Communication Skills | 3 | 0 | 0 | 3 | II |
| 3. | 20VEC11 | Yoga and Values for Holistic Development | 1 | 0 | 1 | 1 | II |
| 4. | 20EGL31 | English for Workplace Communication Laboratory | 0 | 0 | 2 | 1 | III |
| 5. | 20GET31 | Universal Human Values | 2 | 0 | 0 | 2 | III |
| 6. | 20GET71 | Engineering Economics & Management | 3 | 0 | 0 | 3 | VII |
| | | **Total Credits to be earned** | | | | **13** | |

| BASIC SCIENCE (BS) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **L** | **T** | **P** | **C** | **Sem** |
| 1. | 20MAC11 | Matrices and Differential Equations | 3 | 1* | 2* | 4 | I |
| 2. | 20PHT11 | Applied Physics | 3 | 0 | 0 | 3 | I |
| 3. | 20CYT11 | Applied Chemistry | 3 | 0 | 0 | 3 | I |
| 4. | 20PHL11 | Physical Sciences Laboratory I | 0 | 0 | 2 | 1 | I |
| 5. | 20MAC21 | Multivariable Calculus and Complex Analysis | 3 | 1* | 2* | 4 | II |
| 6. | 20MAT34 | Discrete Mathematical Structures | 3 | 1 | 0 | 4 | III |
| **Total Credits to be earned** | | | | | | **19** | |

| ENGINEERING SCIENCE (ES) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **L** | **T** | **P** | **C** | **Sem** |
| 1. | 20CDT11 | Problem solving and Programming | 3 | 0 | 0 | 3 | I |
| 2. | 20CDL11 | Problem solving and Programming Laboratory | 0 | 0 | 2 | 1 | I |
| 3. | 20CDC11 | Basics of Electrical and Electronics Engineering (BEEE) | 3 | 0 | 2 | 4 | I |
| 4. | 20MEL11 | Engineering Practices Laboratory | 0 | 0 | 2 | 1 | II |
| 5. | 20CDC21 | Digital Principles and Design | 3 | 0 | 2 | 4 | II |
| 6. | 20CDT42 | Python Programming and Frameworks | 3 | 0 | 2 | 4 | IV |
| 7. | 20CDT63 | Mobile Interactive Design | 3 | 1 | 0 | 4 | VI |
| **Total Credits to be earned** | | | | | | **21** | |

| PROFESSIONAL CORE (PC) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **L** | **T** | **P** | **C** | **Sem** | **Domain/ Stream** |
| 1. | 20CDT21 | Programming and Linear Data Structures | 3 | 0 | 0 | 3 | II | SD |
| 2. | 20CDT22 | Human Computer Interaction | 3 | 0 | 0 | 3 | II | ID |
| 3. | 20CDT23 | Design Thinking | 3 | 1 | 0 | 4 | III | ID |
| 4. | 20CDL21 | Programming and Linear Data Structures | 0 | 0 | 2 | 1 | III | SD |
| 5. | 20CDT31 | Data Structures | 3 | 0 | 0 | 3 | III | SD |
| 6. | 20CDT32 | Object Oriented Programming | 3 | 0 | 0 | 3 | III | SD |
| 7. | 20CDT33 | Computer Organization | 3 | 1 | 0 | 4 | III | SD |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 8. | 20CDT34 | Operating System | 3 | 0 | 0 | 3 | III | SD |
| 9. | 20CDL31 | Data Structures Laboratory | 0 | 0 | 2 | 1 | III | SD |
| 10. | 20CDL32 | Object Oriented Programming Laboratory | 0 | 0 | 2 | 1 | III | SD |
| 11. | 20CDT41 | Database Management Systems | 3 | 0 | 0 | 3 | IV | SD |
| 12. | 20CDT42 | User Experience Design | 3 | 1 | 0 | 4 | IV | ID |
| 13. | 20CDT43 | Agile Methodologies | 3 | 0 | 0 | 3 | IV | SDE |
| 14. | 20CDT44 | Design and Analysis of Algorithms | 3 | 1 | 0 | 4 | IV | SD |
| 15. | 20CDL41 | Database Management Systems Laboratory | 0 | 0 | 2 | 1 | V | SD |
| 16. | 20CDL42 | Design Tools Laboratory | 0 | 0 | 2 | 1 | V | ID |
| 17. | 20CDT51 | Computer Networks and IoT | 3 | 0 | 0 | 3 | V | SD |
| 18. | 20CDT52 | User Interface Design | 3 | 0 | 0 | 3 | V | ID |
| 19. | 20CDT53 | Virtual Reality and Augmented Reality | 3 | 0 | 0 | 3 | V | ID |
| 20. | 20CDL51 | Computer Networks and IoT Laboratory | 0 | 0 | 2 | 1 | V | SD |
| 21. | 20CDL52 | User Interface Design Laboratory | 0 | 0 | 2 | 1 | V | ID |
| 22. | 20CDL53 | Virtual Reality and Augmented Reality Laboratory | 0 | 0 | 2 | 1 | V | ID |
| 23. | 20CDT61 | Machine Learning | 3 | 0 | 0 | 3 | VI | SD |
| 24. | 20CDT62 | Game Design, Prototyping and Development | 3 | 0 | 0 | 3 | VI | ID |
| 25. | 20CDL61 | Machine Learning Laboratory | 0 | 0 | 2 | 1 | VI | SD |
| 26. | 20CDL62 | Game Design, Prototyping and Development Laboratory | 0 | 0 | 2 | 1 | VI | ID |
| 27. | 20CDL63 | Open Source Systems Laboratory | 0 | 0 | 2 | 1 | VI | SD |
| 28. | 20CDC71 | Cloud Computing | 2 | 0 | 2 | 3 | VII | SD |
| | | | | | | **66** | | |

| **PROFESSIONAL ELECTIVE (PE)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **L** | **T** | **P** | **C** | **Sem** | **Domain/ Stream** |
| | | Elective 1 | | | | | | |
| 1. | 20CDE01 | Compiler Design | 3 | 0 | 0 | 3 | V | SD |
| 2. | 20CDE02 | Data science | 3 | 0 | 0 | 3 | V | AI |
| 3. | 20CDE03 | Artificial Intelligence | 3 | 0 | 0 | 3 | V | AI |
| 4. | 20CDE04 | Advanced Java Programming | 2 | 0 | 2 | 3 | V | SD |
| 5. | 20CDE05 | Optimization Techniques | 3 | 0 | 0 | 3 | V | SD |
| 6. | 20CDE06 | Information Security | 3 | 0 | 0 | 3 | V | NS |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Elective 2 | | | | | | |
| 7. | 20CDE07 | Computer Graphics | 3 | 0 | 0 | 3 | VII | ID |
| 8. | 20CDE08 | Introduction to 3D design | 3 | 0 | 0 | 3 | VII | ID |
| 9. | 20CDE09 | Animation Basics | 3 | 0 | 0 | 3 | VII | ID |
| 10 | 20CDE10 | Information Design | 3 | 0 | 0 | 3 | VII | ID |
| 11 | 20CDE11 | Creative Thinking | 3 | 0 | 0 | 3 | VII | ID |
| 12 | 20CDE12 | Special Effects | 3 | 0 | 0 | 3 | VII | ID |
| | | Elective 3 | | | | | | |
| 13. | 20CDE13 | Usability Studies and Evaluation | 3 | 0 | 0 | 3 | VII | ID |
| 14. | 20CDE14 | Responsive Web Design | 3 | 0 | 0 | 3 | VII | ID |
| 15. | 20CDE15 | Visual Design and Communication | 3 | 0 | 0 | 3 | VII | ID |
| 16. | 20CDE16 | Environmental Information Design | 2 | 0 | 2 | 3 | VII | ID |
| 17. | 20CDE17 | Managing Design Process | 3 | 0 | 0 | 3 | VII | ID |
| 18. | 20CDE18 | Multimedia Tools and Applications | 3 | 0 | 0 | 3 | VII | ID |
| | | Elective 4 | | | | | | |
| 19. | 20CDE19 | Motion Graphics | 3 | 0 | 0 | 3 | VII | ID |
| 20. | 20CDE20 | Interactive Visual Data Analysis for Designer | 3 | 0 | 0 | 3 | VII | ID |
| 21. | 20CDE21 | Designing Human Centered Systems | 3 | 0 | 0 | 3 | VII | ID |
| 22. | 20CDE22 | Design of Interactive Systems | 3 | 0 | 0 | 3 | VII | ID |
| 23. | 20CDE23 | Mobile Application Design System | 3 | 0 | 0 | 3 | VII | ID |
| 24. | 20CDE24 | Aesthetics of Video Editing | 3 | 0 | 0 | 3 | VII | ID |
| | | Elective 5 | | | | | | |
| 25. | 20CDE25 | Deep Learning | 2 | 0 | 2 | 3 | VII | AI |
| 26. | 20CDE26 | Business Intelligence and its Applications | 3 | 0 | 0 | 3 | VII | SDE |
| 27. | 20CDE27 | Web Mining | 3 | 0 | 0 | 3 | VII | SDE |
| 28. | 20CDE28 | Big Data Analytics | 2 | 0 | 2 | 3 | VII | NS |
| 29. | 20GEE01 | Fundamentals of Research | 3 | 0 | 0 | 3 | VII | SD |
| 30. | 20CDE29 | Software Quality and Testing | 3 | 0 | 0 | 3 | VII | SDE |
| | | Elective 6 | | | | | | |
| 31. | 20CDE30 | Data Visualization Techniques | 3 | 0 | 0 | 3 | VIII | AI |
| 32. | 20CDE31 | Total Quality Management | 3 | 0 | 0 | 3 | VIII | GE |
| 33. | 20CDE32 | Cyber Forensics | 3 | 0 | 0 | 3 | VIII | NS |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 34 | 20CDE33 | BlockChain Technologies | 3 | 0 | 0 | 3 | VIII | SDE |
| 35. | 20CDE34 | Digital Marketing | 3 | 0 | 0 | 3 | VIII | SDE |
| 36. | 20CDE35 | Software Defined Networks | 3 | 0 | 0 | 3 | VIII | NS |
| Total | | | | | | **18** | | |

***** AI – Artificial Intelligence, SD-Systems Development, SDE – Software Development and Engineering, NS- Networks and Security, FCS – Formal Courses on Computer Science, GE – General Engineering, ID – Interface Design

| **EMPLOYABILITY ENHANCEMENT COURSES (EC)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **L** | **T** | **P** | **C** | **Sem** | **Domain/ Stream** |
| 1. | 20GEL51 / 20GEI51 | Professional Skills Training I / Industrial Training I | 0 | 0 | 0 | 2 | V | -- |
| 2. | 20GEL61 / 20GEI61 | Professional Skills Training II / Industrial Training II | 0 | 0 | 0 | 2 | VI | -- |
| 3. | 20GEP61 | Comprehensive Test / Viva | 0 | 0 | 0 | 2 | VI | -- |
| 4. | 20CDP61 | Project Work 1 | 0 | 0 | 4 | 2 | VI | -- |
| 5. | 20CDP71 | Project Work 2 Phase I | 0 | 0 | 6 | 3 | VII | -- |
| 6. | 20CDP81 | Internship/Project Work 2 Phase 2 | -- | -- | 14 | 7 | VIII | -- |
| **Total Credits to be earned** | | | | | | **18** | | |

| **OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE)** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **L** | **T** | **P** | **C** | **Sem** |
| 1. | 20CDO01 | Fundamentals of User Experience Design | 3 | 1 | 0 | 4 | IV |
| 2. | 20CDO02 | Fundamentals of User Interactive Design | 3 | 0 | 2 | 4 | V |
| 3. | 20CDO03 | Introduction to Mobile Game Design | 3 | 0 | 0 | 3 | VI |
| 4. | 20CDO04 | Introduction to Graphics Design | 3 | 0 | 0 | 3 | VIII |

## KEC R2020: SCHEDULING OF COURSES – BE (Computer Science and design) Total Credits :169

| Sem | Course1 | Course2 | Course3 | Course4 | Course5 | Course6 | Course7 | Course8 | Course9 | Course10 | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| I | 20EGT11 English Language Skills (3- 0- 0-3) | 20MAC11 Matrices and Differential Equations (3-1*-2*-4) | 20PHT11 Applied Physics (3-0-0-3) | 20CYT11 Applied Chemistry (3-0-0-3) | 20CDT11 Problem Solving and Programming (3-0-0-3) | 20CDC11 Basics of Electrical and Electronics Engineering (BEEE) (3-0-2-4) | 20CDL11 Problem solving and Programming Laboratory (0-0-2-1) | 20PHL11 Physical Sciences Laboratory I (0-0-2-1) | 20MNT11 Induction Training Program (0-0-0-0) | | **22** |
| II | 20EGT21 Advanced Communication Skills (3-0-0-3) | 20MAC21 Multivariable Calculus and Complex Analysis (3-1*-2*-4) | 20CDT21 Programming and Linear Data Structures (3-0-0-3) | 20CDT22 Human Computer Interaction (3-0-0-3) | 20CDC21 Digital Principles and Design (3-0-2-4) | 20CDT23 Design Thinking (3-1-0-4) | 20MEL11 Engineering Practices Laboratory (0-0-2-1) | 20CDL21 Programming and Linear Data Structures Laboratory (0-0-2-1) | 20VEC11 Yoga and Values for Holistic Development (1-0-1-1) | | **24** |
| III | 20MAT34 Discrete Mathematics (3-1-0-4) | 20CDT31 Data Structures (3-0-0-3) | 20CDT32 Object Oriented Programming (3-0-0-3) | 20CDT33 Computer Organization (3-1-0-4) | 20CDT34 Operating Systems (3-0-0-3) | 20EGL31 English for Workplace Communication Laboratory (0-0-2-1) | 20CDL31 Data Structures Laboratory (0-0-2-1) | 20CDL32 Object Oriented Programming Laboratory (0-0-2-1) | 20GET31 Universal Human Values (2-0-0-2) | | **22** |
| IV | 20CDT41 Database Management Systems (3-0-0-3) | 20CDC41 Python Programming ad Frameworks (3-0-2-4) | 20CDT42 User Experience Design (3-1-0-4) | 20CDT43 Agile Methodologies (3-0-0-3) | 20CDT44 Design and Analysis of Algorithms (3-1-0-4) | Open Elective -1 (3 -1/0 -0/2- 4) | 20CDL41 Database Management Systems Laboratory (0-0-2-1) | 20CDL42 Design Tools Laboratory (0-0-2-1) | 20MNT31 Environmental Science (2-0-0-0) | | **24** |
| V | 20CDT51 Computer Networks and IoT (3-0-0-3 | 20CDT52 User Interface Design (3-0-0-3) | 20CDT53 Virtual Reality and Augmented Reality (3-0-0-3) | Professional Elective -1 (3-0-0-3) | Open Elective – 2 (3 -1/0 -0/2- 4) | 20CDL51 Computer Networks and IoT Laboratory (0-0-2-1) | 20CDL52 UI Design Laboratory (0-0-2-1) | 20CDL53 Virtual Reality and Augmented Reality Laboratory (0-0-2-1) | 20GEL51 / 20GEI51 Professional Skills Training I / Industrial Training I (0-0-0-2) | | **21** |
| VI | 20CDT61 Machine Learning (3-0-0-3) | 20CDT62 Game Design, prototyping and development (3-0-0-3) | 20CDT63 Mobile Interactive Design (3-1-0-4) | Open Elective – 3 (3-0-0-3) | 20CDL61 Machine Learning Laboratory (0-0-2-1) | 20CDL62 Game Design, prototyping and development Laboratory (0-0-2-1) | 20CDL63 Open Source Systems Laboratory (0-0-2-1) | 20GEP61 Comprehensive Test / Viva (0-0-0-2) | 20GEL61 / 20GEI61 Professional Skills Training II / Industrial Training II (0-0-0-2) | 20CDP61 Project Work 1 (0-0-4-2) | **22** |
| VII | 20GET71 Engineering Economics and Management (3-0-0-3) | 20CDC71 Cloud Computing (2-0-2-3) | Professional Elective II (3-0-0-3) | Professional Elective III (3-0-0-3) | Professional Elective IV (3-0-0-3) | Professional Elective V (3-0-0-3) | 20CDP71 Project Work 2 Phase I (0-0-6-3) | | | | **21** |
| VIII | Open Elective IV (3-0-0-3) | Professional Elective VI (3-0-0-3) | 20CDP81 Internship / Project Work II Phase 2 (0-0-14-7) | | | | | | | | **13** |

## MAPPING OF COURSES WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

| Sem. | Course Code | Course Title | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 20EGT11 | English Language Skills | | | | | | ✓ | | | ✓ | ✓ | ✓ | ✓ | | |
| 1 | 20MAC11 | Matrices and Differential Equations | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 1 | 20PHT11 | Applied Physics | ✓ | ✓ | ✓ | | | | | | | | | | | |
| 1 | 20CYT11 | Applied Chemistry | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |
| 1 | 20CDT11 | Problem solving and Programming | ✓ | ✓ | ✓ | | ✓ | | | | | | | | ✓ | ✓ |
| 1 | 20CDC11 | Basics of Electrical and Electronics Engineering | ✓ | ✓ | ✓ | | ✓ | | | | | | | | ✓ | ✓ |
| 1 | 20CDL11 | Problem solving and Programming Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | ✓ | | | | |
| 1 | 20PHL11 | Physical Sciences Laboratory I | | | | ✓ | | | | | | | | | | |
| 2 | 20EGT21 | Advanced Communication Skills | | | | | | ✓ | | | ✓ | ✓ | ✓ | ✓ | | |
| 2 | 20MAC21 | Multivariable Calculus and Complex Analysis | ✓ | ✓ | ✓ | | ✓ | | | | | | | | | |
| 2 | 20CDT21 | Programming and Linear Data Structures | ✓ | ✓ | ✓ | ✓ | | | | | | | | | ✓ | ✓ |
| 2 | 20CDT22 | Human Computer Interaction | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 2 | 20CDC21 | Digital Principles and Design | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | ✓ | | | ✓ | ✓ |
| 2 | 20CDT23 | Design Thinking | ✓ | ✓ | ✓ | ✓ | | | | | ✓ | ✓ | ✓ | | ✓ | ✓ |
| 2 | 20MEL11 | Engineering Practices Laboratory | ✓ | | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | | ✓ | | |
| 2 | 20CDL21 | Programming and Linear Data Structures Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 2 | 20VEC11 | Yoga and Values for Holistic Development | | | | | | ✓ | | ✓ | ✓ | | | ✓ | | |
| 3 | 20MAT34 | Discrete Mathematical Structures | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | |
| 3 | 20CDT31 | Data Structures | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 3 | 20CDT32 | Object Oriented Programming | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 3 | 20CDT33 | Computer Organization | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 3 | 20CDT34 | Operating Systems | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |

| Sem. | Course Code | Course Title | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 20EGL31 | English for Workplace Communication Laboratory | | | | | | | | | ✓ | ✓ | | ✓ | | |
| 3 | 20CDL31 | Data Structures Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 3 | 20CDL32 | Object Oriented Programming Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 3 | 20GET31 | Universal Human Values | | | | | | ✓ | | ✓ | | | | | | |

| Sem. | Course Code | Course Title | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 20CDT41 | Database Management Systems | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 4 | 20CDC41 | Python Programming and Frameworks | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 4 | 20CDT42 | User Experience Design | ✓ | ✓ | ✓ | ✓ | | | | | ✓ | ✓ | ✓ | | ✓ | ✓ |
| 4 | 20CDT43 | Agile Methodologies | ✓ | ✓ | ✓ | | | | | | ✓ | ✓ | | | ✓ | ✓ |
| 4 | 20CDT44 | Design and Analysis of Algorithms | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 4 | 20CDL41 | Database Management Systems Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | ✓ | ✓ | | ✓ | ✓ |
| 4 | 20CDL42 | Design Tools Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | | | | ✓ | ✓ |
| 4 | 20MNT31 | Environmental Science | ✓ | ✓ | ✓ | | | | ✓ | | | | | | | |
| 5 | 20CDT51 | Computer Networks and IoT | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 5 | 20CDT52 | User Interface Design | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 5 | 20CDT53 | Virtual Reality and Augmented Reality | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 5 | 20CDL51 | Computer Networks and IoT Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 5 | 20CDL52 | User Interface Design Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 5 | 20CDL53 | Virtual Reality and Augmented Reality Laboratory | ✓ | | ✓ | ✓ | ✓ | ✓ | | | | | | ✓ | ✓ | ✓ |
| 5 | 20CDT61 | Machine Learning | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 6 | 20CDT62 | Game Design, Prototyping and Development | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 6 | 20CDT63 | Mobile Interactive Design | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |

| Sem. | Course Code | Course Title | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 20CDL61 | Machine Learning Laboratory | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 6 | 20CDL62 | Game Design, Prototyping and Development Laboratory | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 6 | 20CDL63 | Free and Open Source Systems Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 6 | 20GET71 | Engineering Economics & Management | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 6 | 20CDC71 | Cloud Computing | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |

| Sem. | Course Code | Course Title | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Professional Elective Courses | | | | | | | | | | | | | | |
| 5 | 20CDE01 | Compiler Design | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 5 | 20CDE02 | Data science | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 5 | 20CDE03 | Artificial Intelligence | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 5 | 20CDE04 | Advanced Java Programming | | | ✓ | | ✓ | | | | | | | ✓ | ✓ | ✓ |
| 5 | 20CDE05 | Optimization Techniques | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 5 | 20CDE06 | Information Security | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | 20CDE07 | Computer Graphics | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | 20CDE08 | Introduction to 3D design | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | 20CDE09 | Animation Basics | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | 20CDE10 | Information Design | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | 20CDE11 | Creative Thinking | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | 20CDE12 | Special Effects | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | 20CDE13 | Usability Studies and Evaluation | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | 20CDE14 | Responsive Web Design | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | 20CDE15 | Visual Design and Communication | ✓ | | ✓ | | | | | | | ✓ | | | ✓ | ✓ |
| 7 | 20CDE16 | Environmental Information Design | ✓ | | ✓ | | ✓ | | ✓ | | | | | | ✓ | ✓ |

| Sem. | Course Code | Course Title | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 20CDE17 | Managing Design Process | ✓ | ✓ | ✓ | ✓ | | | | | | | | | ✓ | ✓ |
| 7 | 20CDE18 | Multimedia Tools and Applications | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | 20CDE19 | Motion Graphics | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | 20CDE20 | Interactive Visual Data Analysis for Designer | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | 20CDE21 | Designing Human Centered Systems | ✓ | ✓ | ✓ | | | ✓ | | | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 7 | 20CDE22 | Design of Interactive Systems | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | 20CDE23 | Mobile Application Design System | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | 20CDE24 | Aesthetics of Video Editing | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | 20CDE25 | Deep Learning | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | 20CDE26 | Business Intelligence and its Applications | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | 20CDE27 | Web Mining | ✓ | ✓ | ✓ | | ✓ | | | | | | | | ✓ | ✓ |
| 7 | 20CDE28 | Big Data Analytics | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 7 | 20GEE01 | Fundamentals of Research | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 7 | 20CDE29 | Software Quality and Testing | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 8 | 20CDE30 | Data Visualization Techniques | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 8 | 20CDE31 | Total Quality Management | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 8 | 20CDE32 | Cyber Forensics | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 8 | 20CDE33 | BlockChain Technologies | ✓ | ✓ | ✓ | | ✓ | | | | | | | | ✓ | ✓ |
| 8 | 20CDE34 | Digital Marketing | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 8 | 20CDE35 | Software Defined Networks | ✓ | ✓ | ✓ | | ✓ | | | | | | | | ✓ | ✓ |

**B.E. DEGREE IN COMPUTER SCIENCE AND DESIGN**
**CURRICULUM UNDER REGULATIONS 2020**
**(For the candidates admitted from academic year 2020-21 onwards)**

| **SEMESTER – I** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Hours/ Week** | | | **Credit** | **Maximum Marks** | | | **Category** |
| | | **L** | **T** | **P** | | **CA** | **ESE** | **Total** | |
| **Theory/Theory with Practical** | | | | | | | | | |
| 20EGT11 | English Language Skills | 3 | 0 | 0 | 3 | 50 | 50 | 100 | HS |
| 20MAC11 | Matrices and Differential Equations | 3 | 1* | 2* | 4 | 50 | 50 | 100 | BS |
| 20PHT11 | Applied Physics | 3 | 0 | 0 | 3 | 50 | 50 | 100 | BS |
| 20CYT11 | Applied Chemistry | 3 | 0 | 0 | 3 | 50 | 50 | 100 | BS |
| 20CDT11 | Problem solving and Programming | 3 | 0 | 0 | 3 | 50 | 50 | 100 | ES |
| 20CDC11 | Basics of Electrical and Electronics Engineering | 3 | 0 | 2 | 4 | 50 | 50 | 100 | ES |
| **Practical / Employability Enhancement** | | | | | | | | | |
| 20CDL11 | Problem solving and Programming Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | ES |
| 20PHL11 | Physical Sciences Laboratory I | 0 | 0 | 2 | 1 | 50 | 50 | 100 | BS |
| 20MNT11 | Induction Training Program # | --- | --- | --- | 0 | 100 | 0 | 100 | MC |
| **Total Credits to be earned** | | | | | **22** | | | | |

*** Alternate week**

| **SEMESTER – II** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Hours/ Week** | | | **Credit** | **Maximum Marks** | | | **Category** |
| | | **L** | **T** | **P** | | **CA** | **ESE** | **Total** | |
| **Theory/Theory with Practical** | | | | | | | | | |
| 20EGT21 | Advanced Communication Skills | 3 | 0 | 0 | 3 | 50 | 50 | 100 | HS |
| 20MAC21 | Multivariable Calculus and Complex Analysis | 3 | 1* | 2* | 4 | 50 | 50 | 100 | BS |
| 20CDT21 | Programming and Linear Data Structures | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 20CDT22 | Human Computer Interaction | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 20CDC21 | Digital Principles and Design | 3 | 0 | 2 | 4 | 50 | 50 | 100 | ES |
| 20CDT23 | Design Thinking | 3 | 1 | 0 | 4 | 50 | 50 | 100 | PC |
| **Practical / Employability Enhancement** | | | | | | | | | |
| 20MEL11 | Engineering Practices Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | ES |
| 20CDL21 | Programming and Linear Data Structures Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | PC |
| 20VEC11 | Yoga and Values for Holistic Development | 1 | 0 | 1 | 1 | 100 | 0 | 100 | HS |
| **Total Credits to be earned** | | | | | **24** | | | | |

***Alternate week**

| SEMESTER – III | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Title | / Week | | | Credit | Maximum Marks | | | Category |
| | | L | T | P | | CA | ESE | Total | |
| **Theory/Theory with Practical** | | | | | | | | | |
| 20MAT34 | Discrete Mathematical Structures | 3 | 1 | 0 | 4 | 50 | 50 | 100 | BS |
| 20CDT31 | Data Structures | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 20CDT32 | Object Oriented Programming | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 20CDT33 | Computer Organization | 3 | 1 | 0 | 4 | 50 | 50 | 100 | PC |
| 20CDT34 | Operating Systems | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| **Practical / Employability Enhancement** | | | | | | | | | |
| 20EGL31 | English for Workplace Communication Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | HS |
| 20CDL31 | Data Structures Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | PC |
| 20CDL32 | Object Oriented Programming Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | PC |
| 20GET31 | Universal Human Values | 2 | 0 | 0 | 2 | 100 | 0 | 100 | HS |
| **Total Credits to be earned** | | | | | **22** | | | | |

| SEMESTER – IV | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Title | / Week | | | Credit | Maximum Marks | | | Category |
| | | L | T | P | | CA | ESE | Total | |
| **Theory/Theory with Practical** | | | | | | | | | |
| 20CDT41 | Database Management Systems | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 20CDC41 | Python Programming and Frameworks | 3 | 0 | 2 | 4 | 50 | 50 | 100 | ES |
| 20CDT42 | User Experience Design | 3 | 1 | 0 | 4 | 50 | 50 | 100 | PC |
| 20CDT43 | Agile Methodologies | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 20CDT44 | Design and Analysis of Algorithms | 3 | 1 | 0 | 4 | 50 | 50 | 100 | PC |
| | Open Elective -1 | 3 | 1/0 | 0/2 | 4 | 50 | 50 | 100 | OE |
| **Practical / Employability Enhancement** | | | | | | | | | |
| 20CDL41 | Database Management Systems Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | PC |
| 20CDL42 | Design Tools Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | PC |
| 20MNT31 | Environmental Science | 2 | 0 | 0 | 0 | 100 | 0 | 100 | MC |
| **Total Credits to be earned** | | | | | **24** | | | | |

| SEMESTER – V | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Title | / Week | | | Credit | Maximum Marks | | | Category |
| | | L | T | P | | CA | ESE | Total | |
| **Theory/Theory with Practical** | | | | | | | | | |
| 20CDT51 | Computer Networks and IoT | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 20CDT52 | User Interface Design | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 20CDT53 | Virtual Reality and Augmented Reality | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| | Professional Elective -1 | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PE |
| | Open Elective – 2 | 3 | 1/0 | 0/2 | 4 | 50 | 50 | 100 | OE |
| **Practical / Employability Enhancement** | | | | | | | | | |
| 20CDL51 | Computer Networks and IoT Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | PC |
| 20CDL52 | User Interface Design Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | PC |
| 20CDL53 | Virtual Reality and Augmented Reality Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | PC |
| 20GEL51 / 20GEI51 | Professional Skills Training 1 / Industrial Training 1 | -- | -- | -- | 2 | 100 | 0 | 100 | EC |
| **Total Credits to be earned** | | | | | **21** | | | | |

| SEMESTER – VI | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Title | / Week | | | Credit | Maximum Marks | | | Category |
| | | L | T | P | | CA | ESE | Total | |
| **Theory/Theory with Practical** | | | | | | | | | |
| 20CDT61 | Machine Learning | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 20CDT62 | Game Design, Prototyping and Development | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 20CDT63 | Mobile Interactive Design | 3 | 1 | 0 | 4 | 50 | 50 | 100 | ES |
| | Open Elective – 3 | 3 | 0 | 0 | 3 | 50 | 50 | 100 | OE |
| **Practical / Employability Enhancement** | | | | | | | | | |
| 20CDL61 | Machine Learning Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | PC |
| 20CDL62 | Game Design, Prototyping and Development Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | PC |
| 20CDL63 | Open Source Systems Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | PC |
| 20GEP61 | Comprehensive Test and Viva | --- | --- | --- | 2 | 100 | 0 | 100 | EC |
| 20GEL61 / 20GEI61 | Professional Skills Training 2 / Industrial Training 2 | --- | --- | --- | 2 | 100 | 0 | 100 | EC |
| 20CDP61 | Project Work 1 | 0 | 0 | 4 | 2 | 100 | 0 | 100 | EC |
| **Total Credits to be earned** | | | | | **22** | | | | |

| SEMESTER – VII | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Title | / Week | | | Credit | Maximum Marks | | | Category |
| | | L | T | P | | CA | ESE | Total | |
| **Theory/Theory with Practical** | | | | | | | | | |
| 20GET71 | Engineering Economics & Management | 3 | 0 | 0 | 3 | 50 | 50 | 100 | HS |
| 20CDC71 | Cloud Computing | 2 | 0 | 2 | 3 | 50 | 50 | 100 | PC |
| | Professional Elective – 2 | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PE |
| | Professional Elective – 3 | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PE |
| | Professional Elective – 4 | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PE |
| | Professional Elective – 5 | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PE |
| **Practical / Employability Enhancement** | | | | | | | | | |
| 20CDP71 | Project Work 2 Phase I | 0 | 0 | 6 | 3 | 50 | 50 | 100 | EC |
| **Total Credits to be earned** | | | | | **21** | | | | |

| SEMESTER – VIII | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Title | / Week | | | Credit | Maximum Marks | | | Category |
| | | L | T | P | | CA | ESE | Total | |
| **Theory/Theory with Practical** | | | | | | | | | |
| | Professional Elective -6 | 3 | 0 | 0 | 3 | 50 | 50 | 100 | OE |
| | Open Elective – 4 | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PE |
| **Practical / Employability Enhancement** | | | | | | | | | |
| 20CDP81 | Internship/Project Work 2 Phase 2 | -- | -- | 14 | 7 | 100 | 100 | 200 | EC |
| **Total Credits to be earned** | | | | | **13** | | | | |

| LIST OF PREOFESSIONAL ELECTIVES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sl.No.** | **Course Code** | **Course Name** | **L** | **T** | **P** | **C** | **Sem** | **Domain/Stream** |
| **ELECTIVE 1** | | | | | | | | |
| 1. | 20CDE01 | Compiler Design | 3 | 0 | 0 | 3 | V | SD |
| 2. | 20CDE02 | Data science | 3 | 0 | 0 | 3 | V | AI |
| 3. | 20CDE03 | Artificial Intelligence | 3 | 0 | 0 | 3 | V | AI |
| 4. | 20CDE04 | Advanced Java Programming | 2 | 0 | 2 | 3 | V | SD |
| 5. | 20CDE05 | Optimization Techniques | 3 | 0 | 0 | 3 | V | SD |
| 6. | 20CDE06 | Information Security | 3 | 0 | 0 | 3 | V | NS |
| **ELECTIVE 2** | | | | | | | | |
| 7. | 20CDE07 | Computer Graphics | 3 | 0 | 0 | 3 | VII | ID |
| 8. | 20CDE08 | Introduction to 3D design | 3 | 0 | 0 | 3 | VII | ID |
| 9. | 20CDE09 | Animation Basics | 3 | 0 | 0 | 3 | VII | ID |
| 10. | 20CDE10 | Information Design | 3 | 0 | 0 | 3 | VII | ID |
| 11. | 20CDE11 | Creative Thinking | 3 | 0 | 0 | 3 | VII | ID |
| 12. | 20CDE12 | Special Effects | 3 | 0 | 0 | 3 | VII | ID |
| **ELECTIVE 3** | | | | | | | | |
| 13. | 20CDE13 | Usability Studies and Evaluation | 3 | 0 | 0 | 3 | VII | ID |
| 14. | 20CDE14 | Responsive Web Design | 3 | 0 | 0 | 3 | VII | ID |
| 15. | 20CDE15 | Visual Design and Communication | 3 | 0 | 0 | 3 | VII | ID |
| 16. | 20CDE16 | Environmental Information Design | 3 | 0 | 0 | 3 | VII | ID |
| 17. | 20CDE17 | Managing Design Process | 3 | 0 | 0 | 3 | VII | ID |
| 18. | 20CDE18 | Multimedia Tools and Applications | 3 | 0 | 0 | 3 | VII | ID |
| **ELECTIVE 4** | | | | | | | | |
| 19. | 20CDE19 | Motion Graphics | 3 | 0 | 0 | 3 | VII | ID |
| 20. | 20CDE20 | Interactive Visual Data Analysis for Designer | 3 | 0 | 0 | 3 | VII | ID |
| 21. | 20CDE21 | Designing Human Centered Systems | 3 | 0 | 0 | 3 | VII | ID |
| 22. | 20CDE22 | Design of Interactive Systems | 3 | 0 | 0 | 3 | VII | ID |
| 23. | 20CDE23 | Mobile Application Design System | 3 | 0 | 0 | 3 | VII | ID |
| 24. | 20CDE24 | Aesthetics of Video Editing | 3 | 0 | 0 | 3 | VII | ID |
| **ELECTIVE 5** | | | | | | | | |
| 25. | 20CDE25 | Deep Learning | 2 | 0 | 2 | 3 | VII | AI |
| 26. | 20CDE26 | Business Intelligence and its Applications | 3 | 0 | 0 | 3 | VII | SDE |
| 27. | 20CDE27 | Web Mining | 3 | 0 | 0 | 3 | VII | SDE |
| 28. | 20CDE28 | Big Data Analytics | 2 | 0 | 2 | 3 | VII | NS |
| 29. | 20GEE01 | Fundamentals of Research | 3 | 0 | 0 | 3 | VII | SD |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 30. | 20CDE29 | Software Quality and Testing | 3 | 0 | 0 | 3 | VII | SDE |
| **ELECTIVE 6** | | | | | | | | |
| 31. | 20CDE30 | Data Visualization Techniques | 3 | 0 | 0 | 3 | VIII | AI |
| 32. | 20CDE31 | Total Quality Management | 3 | 0 | 0 | 3 | VIII | GE |
| 33. | 20CDE32 | Cyber Forensics | 3 | 0 | 0 | 3 | VIII | NS |
| 34. | 20CDE33 | BlockChain Technologies | 3 | 0 | 0 | 3 | VIII | SDE |
| 35. | 20CDE34 | Digital Marketing | 3 | 0 | 0 | 3 | VIII | SDE |
| 36. | 20CDE35 | Software Defined Networks | 3 | 0 | 0 | 3 | VIII | NS |
| Total Credits to be earned | | | | | | 18 | | |

***** AI – Artificial Intelligence, SD-Systems Development, SDE – Software Development and Engineering, NS- Networks and Security, FCS – Formal Courses on Computer Science, GE – General Engineering, ID – Interface Design

**OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE)**

**(**Common to all departments except offering department)

| S. No. | Course Code | Course Name | L | T | P | C | Pre-requisites | Sem |
|---|---|---|---|---|---|---|---|---|
| 1 | 20CDO01 | Fundamentals of User Experience Design | 3 | 1 | 0 | 4 | NIL | IV |
| 2 | 20CDO02 | Fundamentals of User Interactive Design | 3 | 0 | 2 | 4 | NIL | V |
| 3 | 20CDO03 | Introduction to Mobile Game Design | 3 | 0 | 0 | 3 | NIL | VI |
| 4 | 20CDO04 | Introduction to Graphics Design | 3 | 0 | 0 | 3 | NIL | VIII |

**20EGT11 ENGLISH LANGUAGE SKILLS**

(Common to all Engineering and Technology Branches)

| Programme & Branch | All BE/BTech branches | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 1 | HS | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course is designed to impart required levels of fluency in using the English Language at A2/B1 Level in the Common European Framework (CEFR). | |
| **Unit - I** | **Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – I** | **9** |
| Listening - Talking about past experiences - listening to descriptions - Speaking - Exchanging personal information - Talking about cities and transportation - Reading - Life and achievements of a famous personality - Global transport systems - Writing - Childhood experiences - Process Description – Grammar & Vocabulary – Past tense – Expressions of quantity – Indirect questions. | | |
| **Unit - II** | **Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – II** | **9** |
| Listening - Information about hotels and accommodation - Recipes and food items - Speaking - Life style changes and making comparisons - Talking about food - Reading - Habit formation and changing habits - International cuisine - Writing - Personal email - emails about food and recipes – Grammar & Vocabulary – Evaluations and Comparisons with adjectives – Simple past and present perfect tenses. | | |
| **Unit - III** | **Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – III** | **9** |
| Listening - Information about travel - descriptions / conversations about family life - Speaking - Vacations and Holidays - Requests, complaints and offering explanations - Reading - Tourist places and travel experiences - Group behaviour and politeness - Writing - Personal letter about travelling - Writing guidelines and checklists – Grammar & Vocabulary – Future tense – Modals – Two-part verbs. | | |
| **Unit - IV** | **Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – IV** | **9** |
| Listening - Descriptions about festivals - Presentations on technology - Speaking - About technology - festivals, special events and traditions - Reading - Sports, hobbies and past time - About different cultures - Writing - Product Description - Writing web content – Grammar & Vocabulary – Infinitives and Gerunds for uses and purposes – Imperatives for giving suggestions – Relative clauses of time. | | |
| **Unit - V** | **Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – V** | **9** |
| Listening - Talking about changes - Job preferences - Speaking - Comparing different periods or phases in life – Changes that happen - Skills and abilities, Personality Development - Employability Skills – Reading - Reading about life experiences - Emotions and feelings – Job preferences – Jobs and Personality – Writing - Writing about one's past, present and future – Researching job options – Choosing the right job – Grammar & Vocabulary – Time contrasts – Conditional sentences with "if clauses" – Gerunds – short responses. | | |

**Total: 45**

**TEXT BOOK:**


1. Jack C. Richards, Jonathan Hull, and Susan Proctor, "Interchange - Student's Book 2", 4th Edition, Cambridge University Press, New York, 2017.


**REFERENCES:**


1. Sanjay Kumar and Pushp Lata, "Communication Skills", 2nd Edition, Oxford University Press, New Delhi, 2015.
2. Pamela Hartmann and Brenda Wegmann, "New Interactions English Language Learning and Assessment Platform ( Level Intro - Level IV )", McGraw Hill India, 2020.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | use language effectively and accurately acquiring vocabulary from real-life context | Applying (K3) |
| CO2 | listen/view and comprehend different spoken discourses / excerpts in different accents | Applying (K3) |
| CO3 | read different genres of texts adopting various reading strategies | Analyzing (K4) |
| CO4 | write cohesively, coherently and flawlessly avoiding grammatical errors, using a wide range of vocabulary, organizing their ideas logically on a topic | Creating (K6) |
| CO5 | speak clearly, confidently, comprehensibly and communicate with others using appropriate communicative strategies | Creating (K6) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | 2 | | | 2 | 3 | 2 | 2 | | |
| CO2 | | | | | | | | | 2 | 3 | | 1 | | |
| CO3 | | | | | | 1 | | | | 3 | 1 | 1 | | |
| CO4 | | | | | | | | | | 3 | | 1 | | |
| CO5 | | | | | | | | | 2 | 3 | | 2 | | |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | | 16 | 30 | 37 | | 17 | 100 |
| CAT2 | | 17 | 30 | 37 | | 16 | 100 |
| CAT3 | | 13 | 33 | 37 | | 17 | 100 |
| ESE | | 7 | 21 | 37 | | 35 | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20MAC11 - MATRICES AND DIFFERENTIAL EQUATIONS**

(Common to All Engineering and Technology Branches)

| Programme & Branch | All BE/BTech branches | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 1 | BS | 3 | 1* | 2* | 4 |

| | | |
|---|---|---|
| Preamble | To provide the skills to the students for solving different real time problems by applying matrices and differential equations. | |
| **Unit - I** | **Matrices:** | **9** |
| Introduction – Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors (without proof) – Cayley - Hamilton theorem (Statement and applications only) – Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form – Nature of Quadratic forms - Reduction of quadratic form to canonical form by orthogonal transformation. | | |
| **Unit - II** | **Ordinary Differential Equations:** | **9** |
| Introduction – Solutions of First order differential equations: Exact differential equations – Leibnitz's Linear Equation – Bernoulli's equation – Clairaut's equation. | | |
| **Unit - III** | **Ordinary Differential Equations of Higher Order:** | **9** |
| Linear differential equations of second and higher order with constant coefficients - Particular Integrals for the types: $e^{ax}$ – cosax / sinax – $x^n$ – $e^{ax}x^n$, $e^{ax}$sinbx and $e^{ax}$cosbx – $x^n$sinax and $x^n$cosax – Differential Equations with variable coefficients: Euler-Cauchy's equation – Legendre's equation. | | |
| **Unit - IV** | **Applications of Ordinary Differential Equations:** | **9** |
| Method of variation of parameters – Simultaneous first order linear equations with constant coefficients – Applications of differential equations: Simple harmonic motion – Electric circuits (Differential equations and associated conditions need to be given). | | |
| **Unit - V** | **Laplace Transform&Inverse Laplace Transform:** | **9** |
| Laplace Transform: Conditions for existence – Transform of elementary functions – Basic properties – Derivatives and integrals of transforms – Transforms of derivatives and integrals – Transform of unit step function – Transform of periodic functions. Inverse Laplace transform: Inverse Laplace transform of elementary functions – Partial fraction method – Convolution theorem (Statement only) – Solution of linear ODE of second order with constant coefficients. | | |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Introduction to MATLAB |
| 2. | Computation of eigen values and eigen vectors |
| 3. | Plotting and visualizing single variable functions |
| 4. | Solving first and second order ordinary differential equations |
| 5. | Solution of Simultaneous first order ODEs |
| 6. | Solving second order ODE by variation of parameters |
| 7. | Determining Laplace and inverse Laplace transform of basic functions |
| 8. | Solution of Second order ODE by employing Laplace transforms |

***Alternate week**

**Lecture: 45, Tutorial and Practical:15, Total:60**

**TEXT BOOK:**


1. Ravish R. Singh, Mukul Bhatt "Engineering Mathematics", 1st Edition, McGraw Hill Education, New Delhi, 2016.


**REFERENCES:**


1. Kreyszig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley Sons, 2011.
2. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics For First Year B.E/B.Tech", Reprint Edition 2014, S.Chand and Co., New Delhi.
3. Duraisamy C., Vengataasalam S., Arun Prakash K. and Suresh M., "Engineering Mathematics – I", 2nd Edition, Pearson India Education, New Delhi, 2018.
4. MATLAB Manual.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | solve engineering problems which needs matrix computations. | Applying (K3) |
| CO2 | identify the appropriate method for solving first order ordinary differential equations. | Applying (K3) |
| CO3 | solve higher order linear differential equations with constant and variable coefficients. | Applying (K3) |
| CO4 | apply the concept of ordinary differential equations for modeling and finding solutions to engineering problems. | Applying (K3) |
| CO5 | apply Laplace Transform to find solutions of Linear Ordinary Differential Equations | Applying (K3) |
| CO6 | know the basics of MATLAB and computing eigen values and eigen vectors of real matrix by MATLAB. | Understanding (K2), Manipulation (S2) |
| CO7 | solve ordinary differential equations with constant and variable coefficients and simultaneous first order ordinary differential equations using MATLAB. | Applying (K3), Manipulation (S2) |
| CO8 | compute Laplace and inverse Laplace Transform of basic functions and solve Second Order ODE by using Laplace Transform with MATLAB. | Applying (K3), Manipulation (S2) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 1 | | | | | | | | | | |
| CO2 | 3 | 3 | 2 | 1 | | | | | | | | | | |
| CO3 | 3 | 3 | 2 | 1 | | | | | | | | | | |
| CO4 | 3 | 3 | 2 | | | | | | | | | | | |
| CO5 | 3 | 3 | 2 | 1 | | | | | | | | | | |
| CO6 | | | | | 3 | | | | | | | | | |
| CO7 | | | | | 3 | | | | | | | | | |
| CO8 | | | | | 3 | | | | | | | | | |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 10 | 20 | 70 | | | | 100 |
| CAT2 | 10 | 20 | 70 | | | | 100 |
| CAT3 | 10 | 20 | 70 | | | | 100 |
| ESE | 10 | 20 | 70 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20PHT11 - APPLIED PHYSICS**

(Common to All Engineering and Technology Branches)

| Programme & Branch | All BE/BTech Branches | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 1 | BS | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course aims to impart the essential concepts of propagation of elastic waves, acoustics, ultrasonics, laser and fiber optics, quantum physics, crystal structure and crystal defects. It also describes the physical phenomena related to the aforementioned concepts and their applications in engineering and provides motivation towards innovations | |
| **Unit - I** | **Propagation of Elastic Waves:** | **9** |
| Oscillatory Motion: Introduction to simple harmonic motion - Damping velocity - Damping coefficient - Differential equation of simple harmonic motion - Velocity and acceleration - Restoring force - Vibration of a spring and mass system - Frequency response - Phase response - Resonance - Wave motion: Definition of a plane progressive wave - Attenuation of waves - Differential equation of a plane progressive wave - Phase velocity - Phase and phase difference - Solution of the differential equation of a plane progressive wave. | | |
| **Unit - II** | **Acoustics and Ultrasonics:** | **9** |
| Acoustics: Introduction - Reverberation and reverberation time - Growth and decay of sound - Sabine's formula for reverberation time – Determination of sound absorption coefficient – Design of an auditorium: Factors affecting acoustics of buildings and the remedies. Ultrasonics: Introduction – Properties of ultrasonic waves – Generation of ultrasonic waves: Magnetostrictive generator and Piezoelectric generator - Determination of velocity of ultrasonics in a liquid: Acoustic grating – Industrial application: Non-destructive testing - Other applications of ultrasonic waves (qualitative). | | |
| **Unit - III** | **Laser and Fiber Optics:** | **9** |
| Laser and Applications: Introduction – Interaction of light with matter - Three quantum process: Stimulated absorption, spontaneous emission and stimulated emission - Population inversion - Einstein's coefficients and their relations - Pumping methods - Nd:YAG laser - $CO_2$ laser - Holography. Fiber Optics and Applications: Introduction - Numerical aperture and acceptance angle - Classification of optical fibers based on refractive index, modes and materials - Fiber optics communication system (qualitative) - Fiber optic sensors: Temperature and displacement sensors. | | |
| **Unit - IV** | **Quantum Physics:** | **9** |
| Introduction - Blackbody radiation - Planck's quantum hypothesis - Compton scattering (qualitative) - de Broglie's hypothesis - Properties of matter waves - Application of Heisenberg uncertainty principle - Schrodinger's time independent and time dependent wave equations - Physical significance of wave function - The free particle - Potential energy step - Infinite potential well (one - dimensional). | | |
| **Unit - V** | **Crystal Physics:** | **9** |
| Introduction - Classification of solids - Space lattice - Crystal structure - Unit cell - Bravais lattice - Single and polycrystalline materials - Lattice planes - Miller indices - Indices of crystal direction - Interplanar spacing in cubic system - Hexagonal close packed crystal structure and c/a ratio - Symmetry -Symmetry elements in cubic crystal - Crystal imperfections: line, surface and volume imperfections - Features of crystal imperfections (qualitative). | | |

**Total: 45**

**TEXT BOOK:**


1. Avadhanulu M.N., Kshirsagar P.G. and Arun Murthy T.V.S., "A Textbook of Engineering Physics",11th Edition, S. Chand & Company Pvt. Ltd., New Delhi, 2019.


**REFERENCES:**


1. Purnima Khare and Swarup A.,"Engineering Physics: Fundamentals and Modern Applications", 1st Edition, Jones and Bartlett Publishers, Sudbury, Massachusetts, 2009.
2. Gaur R.K. and Gupta S.L., "Engineering Physics", 8th Edition, Dhanpat Rai and Sons, New Delhi, 2009.
3. Tamilarasan K. and Prabu K., "Engineering Physics – I", 3rd Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2014.

| | **COURSE OUTCOMES:** On completion of the course, the students will be able to | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | make use of the concepts of oscillatory and wave motion to comprehend the phenomena related to the propagation of elastic waves. | Applying (K3) |
| CO2 | apply the concepts of growth and decay of sound energy in a hall to compute Sabine's formula to recognize the requirements of acoustically good buildings, and to describe the production of ultrasonic wave, working of acoustic grating & non-destructive testing using ultrasonic waves. | Applying (K3) |
| CO3 | apply the concepts of stimulated emission to explain the working and the applications of laser in engineering and technology, and to apply the principle of propagation of light through optical fiber to compute acceptance angle and numerical aperture to comprehend the loss in optical fiber, fiber optic communication system and working of fiber optic sensors. | Applying (K3) |
| CO4 | use the concepts of quantum mechanics to describe the behavior of electrons in a metal by solving Schrodinger's wave equation for particle motion in infinite potential well. | Applying (K3) |
| CO5 | utilize the concepts of the seven crystal systems to obtain interplanar spacing in cubic lattice and c/a ratio of HCP crystal structure, and to comprehend symmetry elements, reciprocal lattice and the types of crystal imperfections and their impacts. | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | | |
| CO2 | 3 | 2 | 1 | | | | | | | | | | | |
| CO3 | 3 | 2 | 1 | | | | | | | | | | | |
| CO4 | 3 | 2 | 1 | | | | | | | | | | | |
| CO5 | 3 | 2 | 1 | | | | | | | | | | | |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 20 | 40 | 40 | | | | 100 |
| CAT2 | 20 | 35 | 45 | | | | 100 |
| CAT3 | 25 | 35 | 40 | | | | 100 |
| ESE | 20 | 40 | 40 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CYT11 - APPLIED CHEMISTRY**

(Common to All Engineering and Technology Branches)

| Programme & Branch | All BE/BTech Branches | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 1 | BS | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | Applied Chemistry course explores the basic principles and advancements of chemistry in the field of engineering and technology. It aims to impart the fundamentals of chemistry towards innovations in science and technology and also for societal applications. | |
| **Unit - I** | **Water Technology:** | **9** |
| Introduction - sources of water - impurities in water - types of water - hardness of water- expression of hardness (simple problems) - units of hardness –estimation of hardness of water by EDTA method – determination of alkalinity - disadvantages of using hard water in Industries - boiler troubles - scale and sludge, boiler corrosion, caustic embrittlement, priming and foaming - softening of water: i) Internal treatment process - carbonate and calgon conditioning ii) External treatment method -demineralization process iii) Treatment of water for municipal water supply (Removal of suspended particles and disinfection methods, Break-point of chlorination). | | |
| **Unit - II** | **Electrochemistry:** | **9** |
| Introduction – electrochemical cells - applications of electrochemical series - reference electrode - standard calomel electrode - ion selective electrode - glass electrode - concentration cells - electrode and electrolyte concentration cells (simple problems) -applications- potentiometric titrations - acid-base, redox, precipitation titrations - advantages- conductometric titrations - strong acid vs strong base, weak acid vs strong base, mixture of weak and strong acid vs strong base- advantages of conductometric titrations. | | |
| **Unit - III** | **Corrosion and its Control:** | **9** |
| Introduction – causes and effects of corrosion - types of corrosion - chemical corrosion – Pilling Bed-worth rule - electrochemical corrosion –types **-** galvanic corrosion, concentration cell corrosion – other types of corrosion -stress, intergranular and microbiological corrosion- galvanic series - factors influencing rate of corrosion – corrosion control methods - design and material selection, anodic protection, corrosion inhibitors, protective coatings - i) metallic coatings : hot dipping (tinning and galvanizing) ii) non-metallic coating : anodizing iii) organic coating : paints – constituents and their functions. | | |
| **Unit - IV** | **Fuels and Combustion:** | **9** |
| Introduction – classification of fuels - characteristics of a good fuel - combustion - calorific values – gross and net calorific values - Dulong's formula (simple problems) - Flue gas analysis by Orsat's method - ignition temperature - spontaneous ignition temperature - explosive range - solid fuels - coal and its varieties – proximate and ultimate analysis – significance – metallurgicalcoke - Otto-Hoffman byproduct method - liquid fuel - refining of petroleum – manufacture of synthetic petrol - hydrogenation of coal - Bergius process - knocking - octane number – cetane number - gaseous fuel - water gas. | | |
| **Unit - V** | **Polymers:** | **9** |
| Introduction – terminology - classification - polymerization - types of polymerization (definition only)- polymerisation techniques- bulk, solution, suspension and emulsion polymerisation - plastics- difference between thermoplastics and thermosetting plastics - compounding of plastics- plastic moulding methods - compression, injection, extrusion and blow moulding methods - industrial polymers: preparation, properties and applications of PVC, PAN, polyurethane, polyesters –biodegradable polymers-classification and applications. | | |

**Total: 45**

**TEXT BOOKS:**


1. Wiley Editorial Board, "Wiley Engineering Chemistry", 2nd Edition, Wiley India Pvt. Ltd, New Delhi, Reprint 2019.


**REFERENCES:**


1. Palanisamy P.N., Manikandan P., Geetha A.& Manjula Rani K., "Applied Chemistry", 6th Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2019.
2. Payal B. Joshi, Shashank Deep, "Engineering Chemistry", Oxford University Press, New Delhi, 2019.
3. Palanna O., "Engineering Chemistry", McGraw Hill Education, New Delhi, 2017.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | apply the suitable water softening methods to avoid boiler troubles. | Applying (K3) |
| CO2 | apply the principle of electrochemistry for various applications. | Applying (K3) |
| CO3 | make use of corrosion control methods to solve corrosion related problems. | Applying (K3) |
| CO4 | illustrate the quality of fuels from its characteristics. | Understanding (K2) |
| CO5 | explain the types of polymers, plastics and fabrication methods. | Understanding (K2) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | | | | | | | | | | |
| CO2 | 3 | 2 | 1 | 1 | | | | | | | | | | |
| CO3 | 3 | 2 | 1 | 1 | | | | | | | | | | |
| CO4 | 3 | 1 | | | | | | | | | | | | |
| CO5 | 3 | 1 | | | | | | | | | | | | |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 25 | 35 | 40 | | | | 100 |
| CAT2 | 25 | 35 | 40 | | | | 100 |
| CAT3 | 25 | 35 | 40 | | | | 100 |
| ESE | 25 | 35 | 40 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDT11 - PROBLEM SOLVING AND PROGRAMMING**

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 1 | ES | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | Problem solving skill is the most important skill to be possessed by any student. Most of the time, the emphasis is on learning a programming language rather than on inculcating the problem solving skills. This course is designed for use by freshmen students taking their first course in programming. It deals with the techniques needed to practice computational thinking, the art of using computers to solve problems and the ways the computers can be used to solve problems. This course also focuses on developing programming skills using C language. | |
| **Unit - I** | **Introduction to Computer and Problem Solving:** | **9** |
| Overview of computers: Types, Generations, Characteristics, Basic computer Organization – Programming methodologies – Structured programming Problem solving techniques: Algorithms - Flowcharts – Pseudo codes – Structuring the logic: Sequential, selection and repetitive structure. | | |
| **Unit - II** | **Introduction to C and Control Statements:** | **9** |
| Introduction to C and Control Statements: The life cycle of a C program – features of C - Data - Variables – Declaring, assigning and printing variables – Data Classification : integer, float and character types – constants – operators and expressions – Control Structures : decision making and looping statements – Input and output functions. | | |
| **Unit - III** | **Arrays and Functions:** | **9** |
| Arrays: Declaring and initializing 1D array - Two dimensional arrays – Multidimensional arrays. Functions: Basics, the anatomy of a function – Types of functions based on arguments and return types – Passing 1D and 2D arrays as arguments to functions – Calling function from another function – recursive functions -Variable scope and lifetime - Storage classes. | | |
| **Unit - IV** | **Pointers and Strings:** | **9** |
| Pointers: Memory access and pointers, pointer basics, declaring, initializing and dereferencing a pointer, parameter passing mechanisms , operations on pointers. Strings : Basics, declaring and initializing strings – pointers for string manipulation – string handling functions : standard and user defined functions – character oriented functions, Two dimensional array of strings | | |
| **Unit - V** | **User-defined data types:** | **9** |
| Structure basics –declaring and defining a structure - attributes of structures – nested structures – arrays as structure members – arrays of structure – Passing structures as arguments to functions - Unions – Bit Fields -Enumerated type. | | |

**Total:45**

**TEXT BOOKS:**


1. Sumitabha Das, “Computer Fundamentals and C Programming”, 1st Edition, McGraw Hill, 2018.


**REFERENCES:**


1. YashavantKanetkar, "Let us C", 16th Edition, BPB Publications, 2018.
2. ReemaThareja., “Programming in C ”, 2nd Edition, Oxford University Press, New Delhi, 2018.

| Mapping of COs with POs and PSOs | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| CO1 | 3 | 2 | | | 2 | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 2 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 2 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 2 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 2 | | | | | | | | | | 3 | 1 |
| 1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy | | | | | | | | | | | | | | |

| ASSESSMENT PATTERN - THEORY | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | 20 | 30 | 50 | | | | 100 |
| CAT2 | 10 | 30 | 60 | | | | 100 |
| CAT3 | 10 | 30 | 60 | | | | 100 |
| ESE | 10 | 30 | 60 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDC11 - BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

| Programme & Branch | BE – Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 1 | ES | 3 | 0 | 2 | 4 |

| | | |
|---|---|---|
| Preamble | To provide comprehensive idea about power Systems, AC and DC circuit analysis, working principles and applications of basic machines in electrical engineering. | |
| **Unit - I** | **Introduction to Power Systems:** | **9** |
| Fundamentals of electricity:Definition – Symbol and unit of Quantities-Work - Power and Energy -Power Generation – Transmission system – Comparison of Overhead and Underground Systems - Star to Delta and to Star Transformations - House Wiring: Materials and Accessories –Types of wiring – Principles of Earthing. | | |
| **Unit - II** | **DC Circuits and AC Circuits:** | **9** |
| DC Circuits and AC Circuits: Resistance: Resistors in Series and Parallel - Network Reduction - Voltage and Current Division Rule - Ohm's Law- Method of solving a circuit by Kichoff's laws. AC Circuits: Alternating (Sinusoidal) Voltage and Current, R.M.S and Average Value, Power Factor, Form Factor and Peak Factor –Analysis of AC Circuit. | | |
| **Unit - III** | **Electrical Machines:** | **9** |
| DC Machines: Construction, Principle of Operation of DC Motor-Types and Applications. AC Machines: Construction and Working Principle of AC Generator, Single Phase Transformer, Three Phase Induction Motor and Single Phase Induction Motor (Split Phase and Capacitor Start Induction Motor) - Applications. | | |
| **Unit - IV** | **Basic Electronics:** | **9** |
| Theory of PN Junction Diode - Operation of Rectifiers (Half wave, Full wave) and Filters - Zener Diodes - Zener Diode as Voltage Regulator - Transistors: Types - Operation of NPN Transistor - Transistor as an Amplifier - Operation and Characteristics of Thyristor: Silicon Controlled Rectifier – Triac. | | |
| **Unit - V** | **Fundamentals of Communication Engineering:** | **9** |
| Introduction – Communication System - Need for Modulation –Basic principles of Modulation: Amplitude Modulation – Frequency Modulation – Comparison of AM & FM - Communication Systems (Block Diagram approach): Radio Broadcast, TV: Standards, Transmitter and Receiver- Satellite and Optical Fibre Communication | | |

**List of Experiments / Exercises:**

| | |
|---|---|
| 1. | Verification of Ohm's Law and Kichoff's Law |
| 2. | Measurement of real power, reactive power, power factor and impedance of RC, RL and RLC circuits. |
| 3. | Load test on DC shunt motor |
| 4. | Performance characteristics of single phase Transformer |
| 5. | Load test on single phase induction motor |
| 6. | VI characteristics of PN junction diode. |
| 7. | VI characteristics of Zener diode. |
| 8. | Voltage Regulator using Zener diode. |
| 9. | Voltage regulator using 78XX |
| 10. | Study of Mixie, Ceiling Fan and Vacuum Cleaner |

**Lecture: 45, Practical: 30, Total: 75**

**TEXT BOOK:**


| | |
|---|---|
| 1. | Muthusubramanian R. and Salivahanan S., "Basics of Electrical and Electronics Engineering", 18th Reprint, Tata McGraw Hill, 2014. |


**REFERENCES:**


| | |
|---|---|
| 1. | Jegathesan V., Vinoth Kumar K. and Saravanakumar R., "Basic Electrical and Electronics Engineering", 1st Edition, Wiley India, 2011. |
| 2. | Sukhija M.S. and Nagsarkar T.K., "Basics of Electrical and Electronics Engineering", 1st Edition, Oxford University Press, 2012. |
| 3. | Laboratory Manual |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | interpret the basic concepts of electrical power systems | Applying (K3) |
| CO2 | analyze the DC and AC circuits | Analyzing (K4) |
| CO3 | interpret the construction and working of different types of electric machines | Applying (K3) |
| CO4 | demonstrate the basic functions of electronic components | Applying (K3) |
| CO5 | apply the basic concepts of Communication Engineering in simple applications. | Applying (K3) |
| CO6 | experiment the electric circuits by applying various theorems | Applying (K3), Manipulation (S2) |
| CO7 | test basic electrical machines like transformer, DC motors and induction motor | Applying (K3), Precision (S3) |
| CO8 | analyze the characteristics of semiconductor devices | Analyzing (K4), Precision (S3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO6 | 3 | 2 | 1 | | 1 | | | | | | | | 2 | 1 |
| CO7 | 3 | 2 | 1 | | 1 | | | | | | | | 2 | 1 |
| CO8 | 3 | 2 | 1 | | 1 | | | | | | | | 2 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 10 | 40 | 40 | 10 | | | 100 |
| CAT2 | 10 | 40 | 40 | 10 | | | 100 |
| CAT3 | 10 | 60 | 30 | | | | 100 |
| ESE | 10 | 40 | 40 | 10 | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDL11 - PROBLEM SOLVING AND PROGRAMMING LABORATORY

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 1 | ES | 0 | 0 | 2 | 1 |

| | |
|---|---|
| Preamble | The purpose of the course is to introduce problem solving aspects and inculcate the logical thinking capability to solve a given problem. The course will also introduce to students to the field of programming using C language. The students will be able to enhance their analyzing and problem solving skills and use the same for writing programs in C. |

**List of Exercises / Experiments:**

| | Electric Circuits |
|---|---|
| 1. | Writing algorithms and drawing flowcharts using Raptor Tool for problems involving sequential structures |
| 2. | Writing algorithms and drawing flowcharts using Raptor Tool for problems involving selective structures |
| 3. | Writing algorithms and Drawing flowcharts using Raptor Tool for problems involving repetitive structures |
| 4. | Programs for demonstrating the use of different types of operators like arithmetic, logical, relational and ternary operators (Sequential structures) |
| 5. | Programs to Illustrate the different formatting options for input and output |
| 6. | Programs using decision making statements like 'if', 'else if', 'switch', conditional and unconditional 'goto' (Selective structures) |
| 7. | Programs for demonstrating repetitive control statements like 'for', 'while' and 'do-while' (Iterative structures) |
| 8. | Programs for demonstrating one-dimensional and two-dimensional numeric array |
| 9. | Programs to demonstrate modular programming concepts using functions (Using built-in and user-defined functions) |
| 10. | Programs to implement various character and string operations with and without built-in library functions. |
| 11. | Programs to demonstrate the use of pointers |
| 12. | Programs to illustrate the use of user-defined data types |

**Total: 30**

**REFERENCES /MANUALS/SOFTWARES:**

| | |
|---|---|
| 1. | Raptor and C Compiler |

| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|---|---|---|
| CO1 | demonstrate the execution of flowchart for the given problem using Raptor | Applying (K3), Precision (S3) |
| CO2 | demonstrate the application of sequential, selective and repetitive control structures | Applying (K3), Precision (S3) |
| CO3 | implement solutions to the given problem using derived and user defined data types and functions | Applying (K3), Precision (S3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | | | | | 1 | | | | |
| CO2 | 3 | 2 | 1 | 1 | 1 | | | | | 1 | | | | |
| CO3 | 3 | 2 | 1 | 1 | 1 | | | | | 1 | | | | |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

## 20PHL11 - PHYSICAL SCIENCES LABORATORY I

(Common to All Engineering and Technology Branches)

| Programme & Branch | All BE/BTech Branches | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 1 | BS | 0 | 0 | 2 | 1 |

| | |
|---|---|
| Preamble | This course aims to impart hands on training in the determination of the physical parameters such as Young's modulus, rigidity modulus, frequency of vibration, velocity of ultrasonic waves, compressibility of water, wavelength of laser, acceptance angle and the numerical aperture of an optical fiber, and to develop the skills in handling different basic instruments and also aims to impart the basic concepts of volumetric, conductometric and pH meter experiments and thereby, to improve the analytical capability. |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Determination of the Young's modulus of the material of a given beam using uniform bending method. |
| 2. | Determination of the rigidity modulus of the material of a given wire using torsional pendulum. |
| 3. | Determination of frequency of electrically vibrating rod by forming standing waves using Melde's apparatus. |
| 4. | Determination of the velocity of ultrasonic waves in a liquid and the compressibility of a liquid using ultrasonic interferometer. |
| 5. | Determination of (i) the wavelength of a semiconductor laser and (ii) the acceptance angle and the numerical aperture of a given optical fiber. |
| 6. | Estimation of total, temporary and permanent hardness of water by EDTA method. |
| 7. | Estimation of $Ca^{2+}$and $Mg^{2+}$hardness separately by EDTA method. |
| 8. | Estimation of alkalinity of the given water sample. |
| 9. | Conductometric titration -Mixture of acids. |
| 10. | Estimation of hydrochloric acid using pH meter. |

**Total: 30**

**REFERENCES:**


| | |
|---|---|
| 1. | Tamilarasan K. and Prabu K.,"Physics Laboratory Manual', 1st Edition, SCM Publishers, Erode, 2020. |
| 2. | Palanisamy P.N., Manikandan P., Geetha A. and Manjula Rani K., "Chemistry Laboratory Manual", 1st Edition, Rajaganapathy Publishers, Erode, 2020. |


| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|---|---|---|
| CO1 | determine the Young's modulus of a material using the concepts of elasticity and bending moment of a beam and to determine the rigidity modulus of a wire using the concepts of twisting couple and to compute the frequency of electrically vibrating rod using the concept of standing waves formed in fixed vibrating string. | Applying (K3), Precision (S3) |
| CO2 | determine the wavelength of a semiconductor laser beam using the concept of diffraction of light, and to compute the acceptance angle and the numerical aperture of an optical fiber using the concepts of total internal reflection and divergence of light in air and estimate the amount of hardness for the given water sample by EDTA method, and the amount of alkalinity for the given water sample. | Applying (K3), Precision (S3) |
| CO3 | demonstrate the conductivity meter and pH meter to estimate the amount of the given solution. | Applying (K3), Precision (S3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | 3 | | | | | | | | | | |
| CO2 | | | | 3 | | | | | | | | | | |
| CO3 | | | | 3 | | | | | | | | | | |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

## 20EGT21 - ADVANCED COMMUNICATION SKILLS

(Common to all Engineering and Technology Branches)

| Programme & Branch | All BE/BTech branches | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | 20EGT11 – English Language Skills | 2 | HS | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course is designed to impart required levels of fluency in using the English Language at B1Level in the Common European Framework (CEFR). | |
| **Unit - I** | **Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase –VI** | **9** |
| **Listening –** Job and career related descriptions and conversations – requests of different kinds and the responses – **Speaking -** Career choices and professional skills – making requests and responding to requests – **Reading** – Using texts about jobs and careers – about different societies and cultural differences – **Writing** – Resumes, CVs and job oriented advertisements – business and career related emails – **Grammar &Vocabulary** – Gerunds and elements of comparison – requests and indirect requests. | | |
| **Unit - II** | **Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – VII** | **9** |
| **Listening** – Expository and narrative descriptions – information about different cultures, nations and societies. **Speaking** – Narrating and describing – talking about other countries and other cultures – **Reading** – Using texts about media and information technology – living abroad and experiencing different cultures – **Writing** – Blog writing – brochures and tourist pamphlets – **Grammar & Vocabulary** – The past tense forms - noun phrases and relative clauses. | | |
| **Unit - III** | **Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – VIII** | **9** |
| **Listening**–Consumerism–productdescription–complaintsandredressal–environmentalissues–ecology – saving the planet – **Speaking** – Talking about problems, issues, complaints – solutions and redressal – talking about environmental issues – **Reading** – Using texts on segregating wastes – recycling and reusing – textsonenvironmentalissues–**Writing**–Onlinereviews,articlesandwritingwebcontent– **Grammar& Vocabulary** – Phrases and sentences used for describing problems – passives – prepositions and infinitives. | | |
| **Unit - IV** | **Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – IX** | **9** |
| **Listening**–Education,learningandthechoiceofcourses–variousservicesneededindailylife–self-improvement for success in life – **Speaking** - Discussions about educational and career oriented issues – talking about everyday services – giving advice and self improvement – **Reading** – Reading about learning strategiesandlearningstyles–usingtextsaboutpersonalitydevelopment–**Writing**–Writingabouthobbies – pastime and individual skills – writing short articles on everyday life and personality development – **Grammar & Vocabulary** – Using of "would" and certain gerund forms – use of modals, verbs, gerunds, negative questions and infinitives. | | |
| **Unit - V** | **Listening, Speaking, Reading, Writing and Grammar & Vocabulary. Activity Based Learning – Phase – X** | **9** |
| **Listening** – Historical narratives – biographies and learning about the future – important life events, milestones and happenings of the past – **Speaking** – Talking about the past, present and the future – talking about important events in life – **Reading** – Texts about new technologies and future science – using texts aboutsocialorganization,cultureandsocialpractices–**Writing**–Biographicalsketches–historicalevents– famous personalities, stages of life and getting along with people – **Grammar & Vocabulary** – Future tense forms – time clauses and certain "if clauses". | | |

**Total: 45**

**TEXT BOOK:**


1. Jack C. Richards, Jonathan Hull, and Susan Proctor, "Interchange - Student's Book 3", 4th Edition, Cambridge University Press, New York, 2017.


**REFERENCES:**


1. Sanjay Kumar and Pushp Lata, "Communication Skills: A Workbook based on AICTE Syllabus", Oxford University Press, 2018.
2. Board of Editors, "Skills Annexe: Functional English for Success", Orient BlackSwan, Hyderabad, 2013.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | use functional grammar for improving communication skills | Applying (K3) |
| CO2 | listen and comprehend different spoken excerpts critically andinfer Unspoken and implied meanings. | Applying (K3) |
| CO3 | read different genres of texts, infer implied meanings and critically analyze and evaluate them for ideas as well as for method of presentation. | Analyzing (K4) |
| CO4 | write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing. | Creating (K6) |
| CO5 | speak effectively, to express opinions clearly, initiate and sustain a discussion and also negotiate using appropriate communicative strategies. | Creating (K6) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | 2 | | | 1 | 3 | 1 | 1 | | |
| CO2 | | | | | | | | | 2 | 3 | | 1 | | |
| CO3 | | | | | | 1 | | | | 3 | 1 | 1 | | |
| CO4 | | | | | | | | | | 3 | | 2 | | |
| CO5 | | | | | | | | | 2 | 3 | | 2 | | |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | | 13 | 30 | 33 | - | 17 | 100 |
| CAT2 | | 13 | 33 | 37 | - | 17 | 100 |
| CAT3 | | 20 | 30 | 33 | - | 17 | 100 |
| ESE | | 6 | 40 | 36 | - | 18 | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20MAC21 - MULTIVARIABLE CALCULUS AND COMPLEX ANALYSIS

(Common to All Engineering and Technology Branches)

| Programme & Branch | All BE/BTech branches | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 2 | BS | 3 | 1* | 2* | 4 |

| | | |
|---|---|---|
| Preamble | To impart the knowledge of partial derivatives, evaluation of real and complex integrals, vector calculus and analytic functions to the students for solving the problems related to various engineering disciplines. | |
| **Unit - I** | **Functions of Several Variables:** | **9** |
| Functions of two or more variables – Partial derivatives – Total differential – Taylor's series for functions of two variables – Maxima and minima – Constrained maxima and minima – Lagrange's multiplier method | | |
| **Unit - II** | **Multiple Integrals:** | **9** |
| Double integration in cartesian coordinates – Change of order of integration – Application: Area between two curves – Triple integration in cartesian coordinates –Volume as triple integrals | | |
| **Unit - III** | **Vector Calculus:** | **9** |
| Directional derivative – Gradient of a scalar point function – Divergence of a vector point function – Curl of a vector – Solenoidal and Irrotational vectors – Green's, Stoke's and Gauss divergence theorems (without proof) – Verification of the above theorems and evaluation of integrals using them**.** | | |
| **Unit - IV** | **Analytic Functions:** | **9** |
| Functions of a complex variable – Analytic functions – Necessary and sufficient conditions (excluding proof) – Cauchy–Riemann equations (Statement only) – Properties of analytic function (Statement only) – Harmonic function – Construction of analytic function – Conformal mapping: w = z + a, az, 1/z – Bilinear transformation. | | |
| **Unit - V** | **Complex Integration:** | **9** |
| Introduction – Cauchy's theorem (without proof) – Cauchy's integral formula – Taylor's and Laurent series – Singularities – Classification – Cauchy's residue theorem (without proof) – Applications: Evaluation of definite integrals involving sine and cosine functions over the circular contour. | | |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Finding ordinary and partial derivatives |
| 2. | Computing extremes of a single variable function |
| 3. | Evaluating double and triple integrals |
| 4. | Finding the area between two curves |
| 5. | Computing gradient, divergence and curl of point functions |
| 6. | Applying Milne-Thomson method for constructing analytic function |
| 7. | Determination of Mobius transformation for the given set of points |
| 8. | Finding poles and residues of an analytic function |

***Alternate week**

**Lecture: 45, Tutorial and Practical:15, Total:60**

**TEXT BOOK:**


| | |
|---|---|
| 1. | Ravish R. Singh, Mukul Bhatt "Engineering Mathematics", 1st Edition, McGraw Hill Education, New Delhi, 2016. |


**REFERENCES:**


| | |
|---|---|
| 1. | Kreyszig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley Sons, 2011. |
| 2. | Dass H K, "Higher Engineering Mathematics", 3rd Revised Edition, S.Chand and Co., New Delhi, 2014. |
| 3. | Duraisamy C., Vengataasalam S., Arun Prakash K. and Suresh M., "Engineering Mathematics – I", 2nd Edition, Pearson India Education, New Delhi, 2018. |
| 4. | MATLAB Manual. |

| | **COURSE OUTCOMES:** On completion of the course, the students will be able to | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | compute extremal values which arise in function of several variables. | Applying (K3) |
| CO2 | solve Problems involving Double and Triple integrals. | Understanding (K2) |
| CO3 | apply the concept of vectors in engineering problems. | Applying (K3) |
| CO4 | identify, construct and apply analytic functions in electrostatics and fluid flow problems. | Applying (K3) |
| CO5 | evaluate complex integrals which are extensively applied in engineering. | Applying (K3) |
| CO6 | compute maxima and minima of a single variable function, gradient, curl and divergence of a vector function using MATLAB. | Understanding (K2), Manipulation (S2) |
| CO7 | evaluate Double, Triple integrals and determine area between two curves using MATLAB | Applying (K3), Manipulation (S2) |
| CO8 | construct analytic function, find bilinear transformation and compute poles and residues using MATLAB. | Applying (K3), Manipulation (S2) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | | | | | | | | | | | | |
| CO2 | 3 | 3 | 2 | | | | | | | | | | | |
| CO3 | 3 | 3 | | | | | | | | | | | | |
| CO4 | 3 | 3 | | | | | | | | | | | | |
| CO5 | 3 | 3 | 2 | | | | | | | | | | | |
| CO6 | | | | | 3 | | | | | | | | | |
| CO7 | | | | | 3 | | | | | | | | | |
| CO8 | | | | | 3 | | | | | | | | | |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 10 | 20 | 70 | | | | 100 |
| CAT2 | 10 | 20 | 70 | | | | 100 |
| CAT3 | 10 | 20 | 70 | | | | 100 |
| ESE | 10 | 20 | 70 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDT21 - Programming and Linear Data Structures

| Programme & Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Problem Solving and Programming | 2 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course helps the students to learn the advanced concepts of C language, and basic concepts and applications of Linear data Structures like linked list, stack and queue. | |
| **Unit - I** | **Pointers and Arrays, Pointers and Strings :** | **9** |
| Pointers- Introduction – Pointers and 1D array– passing an array to a function– returning an array from function – NULL pointers – Array of pointers – Pointer-to-pointer – Pointers and 2D array - Generic pointers –Dangling Pointer-Using Pointers for string manipulation – Two dimensional array of strings - array of pointers to strings. | | |
| **Unit - II** | **Dynamic memory allocation, Pointers and Functions, Pointers and structures**: | **9** |
| Dynamic memory allocation, Function pointers – calling a function using a function pointer– Structures – Introduction – Structures in Functions –Pointers to structures-Accessing structure members - Using pointer as a function argument - Array of structures – self referential structures. | | |
| **Unit - III** | **File Handling and Preprocessor Directives :** | **9** |
| File Handling Basics – opening and closing files – Detecting the end-of-file -File pointer and file buffer – File read/write functions – formatted functions fscanf() and fprintf() –Text and Binary files- Reading and writing binary files –Manipulating file position indicator - Renaming and Removing a file - Command line Arguments. Preprocessor - #define macros with and without arguments - #include directive-Conditional Compilation. | | |
| **Unit - IV** | **Data structures and Linked List**: | **9** |
| Introduction to Data Structures – Classification – Introduction to linked lists - Linked lists vs Arrays – Singly linked list-Creating a list-Traversing a list-Adding a node-Deleting a node-Sorting a list-Destroying a list-printing linked list in reverse order-reverse a singly list-copy a singly linked list. | | |
| **Unit - V** | **Stack and Queue**: | **9** |
| Introduction – Stack – Implementation of stack using array and linked list – Application of stack - Infix to Postfix expression conversion, Postfix expression evaluation – Queue – Implementation of Queue using array and linked list– Other variations of Queue – Applications of Queue. | | |

**TEXT BOOK:**


| | |
|---|---|
| 1. | Sumitabha Das, "Computer Fundamentals &C Programming", McGraw Hill Education(India) Private Limited, 1st Edition, 2018, for Unit I,II,III,IV. |
| 2. | PradipDey, Manas Ghosh, "Programming in C", Oxford Higher education, 2nd Edition, 2016, for Unit V. |


**REFERENCES:**


Yashavant Kanetkar, "Pointers in C", BPP Publications, 4th Edition, 2017.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1: | write C programs that use pointers to access arrays and strings | Understanding (K2) |
| CO2: | develop C programs using pointers to access functions and structures | Applying (K3) |
| CO3: | implement file operations and apply preprocessor directives to solve the given problems | Understanding (K2) |
| CO4: | explain memory allocation during runtime and implement linked list using pointers | Understanding (K2) |
| CO5: | outline the operations on stacks and queues and their usage | Understanding (K2) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | | | | | | | | | | 2 | 1 |
| CO2 | 3 | 2 | 1 | 1 | | | | | | | | | 2 | 2 |
| CO3 | 3 | 2 | | | | | | | | | | | 2 | 1 |
| CO4 | 3 | 2 | | | | | | | | | | | 2 | 1 |
| CO5 | 3 | 2 | | | | | | | | | | | 2 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 10 | 10 | 80 | | | | 100 |
| CAT2 | 10 | 10 | 80 | | | | 100 |
| CAT3 | 10 | 50 | 40 | | | | 100 |
| ESE | 10 | 30 | 60 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDT22 - HUMAN COMPUTER INTERACTION**

| Programme & Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 2 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course enables to design user interfaces for system based on the capabilities of computer technology and the needs of human factors. | |
| **Unit - I** | **Usability o fInteractive Systems and Guidelines** | **9** |
| Introduction–Usability Requirements andMeasures–UsabilityMotivations–UniversalUsability–Userswithdisabilities–Accommodatinghardwareandsoftwarediversity–Goals–Guidelines –Golden rules of Interface design– Principles–Theories. | | |
| **Unit - II** | **Managing Design Processes and Evaluating Interface Designs** | **9** |
| Managing design processes – Organizational Design to Support Usability – Pillars of Design – Development Methodologies - Social Impact Statement for Early Design Review. Evaluating Interface Designs: Expert Reviews–UsabilityTestingandLaboratories–EvaluationduringActiveUse–ControlledPsychologicallyOriented Experiments. | | |
| **Unit - III** | **Interaction Styles** | **9** |
| Direct Manipulation– Introduction – Examples of Direct Manipulation -3DInterfaces–VirtualandAugmentedReality.MenuSelection,FormFillingandDialogBoxes–Task related Menu organization – Single Menu - Content organization–Case Study. | | |
| **Unit - IV** | **Interaction Devices and Collaboration** | **9** |
| Introduction – Keyboards and Keypads–PointingDevices–SpeechandAuditoryInterfaces–DisplaysSmall and Large. Collaboration: Goals of Collaboration and Participation – Asynchronous Distributed Interfaces –Synchronous Distributed Interfaces–Face-to-Face Interfaces. | | |
| **Unit - V** | **Design Issues** | **9** |
| Quality of Service – Models of Response Time Impacts – Expectations and Attitudes – User Productivity – Variability in Response Time. User Manual: Shaping the content of the manual. Information Search: Searching in Textual Documents and Database Querying – Multimedia Document Searches. User Research: Planning, Objectives and legalities in user research – Market Research: Managing user research logistics. | | |

**Total:45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Ben Shneiderman, Catherine Plaisant, Maxine S. Cohen & Steven M. Jacobs, "Designing the User Interface: Strategies for Effective Human-Computer Interaction", 5th Edition, Addison Wesley, 2010. for unit I,II,III,IV |
| 2. | Stephanie Marsh, "User Research: A Practical Guide to Designing Better Products and Services ", 1st Edition, Kogan Page Publishers, 2018. for unit V |

**REFERENCES:**

| | |
|---|---|
| 1. | Alan Cooper, Robert Reinmann,David Cronin & Christopher Noessel, "About Face –The Essentials of Interaction Design", 4th Edition, Wiley, 2014. |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | make use of design principles for effective interface design | Applying (K3) |
| CO2 | explain the methodologies in development process and determine interface design | Applying (K3) |
| CO3 | apply an appropriate interaction style for a given real world problem | Applying (K3) |
| CO4 | make use of appropriate interaction devices to establish the social connections. | Applying (K3) |
| CO5 | identify the design issues and challenges in processing the information and apply the interface searching techniques in multimedia document | Applying (K3) |

| **Mapping of COs with POs and PSOs** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| CO1 | 3 | 2 | 3 | 3 | 2 | | | | | | | | 3 | 3 |
| CO2 | 3 | 2 | 3 | 3 | 2 | | | | | | | | 3 | 3 |
| CO3 | 3 | 2 | 3 | 1 | 2 | | | | | | | | 3 | 3 |
| CO4 | 3 | 2 | 3 | 1 | 2 | | | | | | | | 3 | 3 |
| CO5 | 3 | 2 | 3 | 3 | 2 | | | | | | | | 3 | 3 |
| 1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy | | | | | | | | | | | | | | |

| **ASSESSMENT PATTERN - THEORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | 15 | 25 | 60 | | | | 100 |
| CAT2 | 10 | 30 | 60 | | | | 100 |
| CAT3 | 10 | 20 | 70 | | | | 100 |
| ESE | 10 | 30 | 60 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDC21 - DIGITAL PRINCIPLES AND DESIGN**

| Programme & Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 2 | ES | 3 | 0 | 2 | 4 |

| | | |
|---|---|---|
| Preamble | This course enables the students to understand the basic principles of number system, Binary Codes, Boolean algebra, digital logic gates, combinational and sequential circuits. It also focuses on registers, counters and programmable logic devices. | |
| **Unit - I** | **Number Systems and Boolean Algebra** | **9** |
| Number Systems and Boolean Algebra: Number Systems and their conversions - Complements – Signed Binary Numbers – Binary Codes – Binary Logic - Boolean Algebra: Definitions – Basic and Axiomatic –Theorems of Boolean Algebra – Boolean functions: Realization of functions using Logic gates. | | |
| **Unit - II** | **Gate Level Minimization** | **9** |
| Gate Level Minimization: Canonical and Standard Forms of Boolean functions – Minimization of functions using Karnaugh Map – Don't–Care Conditions – NAND and NOR Implementation– Exclusive-OR function – Minimization of functions using Quine-McCluskey method. | | |
| **Unit - III** | **Combinational Logic** | **9** |
| Combinational Logic: Analysis procedure – Design procedure – Half Adder – Full Adder - Half Subtractor – Full Subtractor – Binary Adder - Subtractor – Magnitude Comparator – Decoders – Encoders – Multiplexers – Demultiplexers – Boolean Functions implementation using Multiplexers and Decoders. | | |
| **Unit - IV** | **Sequential Logic** | **9** |
| Sequential Logic: Introduction – Latches and Flip-flops – Triggering – Analysis of clocked sequential circuits: State Equations – State Table – State Diagram – State Reduction and Assignment– Mealy and Moore machines and their circuit design procedure. Introduction to Asynchronous Sequential Circuits: Analysis Procedure - Race conditions. | | |
| **Unit - V** | **Register, Counter and Programmable Logic** | **9** |
| Register, Counter and Programmable Logic: Shift Registers: Serial Transfer – Serial Addition – Universal Shift register – Synchronous Counters: Binary Ripple Counter – BCD Ripple Counter – Ring Counter – Johnson Counter – Programmable Logic devices: ROM – PLA – PAL. | | |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Simulation of Boolean functions using Virtual labs |
| 2. | Implement the following combinational logic circuits using logic gates |
| 3. | i) Half Adder and Full Adder ii) Half Subtractor and Full Subtractor |
| 4. | Design and Implement 4- Bit Adder /Subtractor. |
| 5. | Design and Implement BCD Adder /Subtractor. |
| 6. | Design and implement a 4-bit binary to gray and gray to binary code converter. |
| 7. | Simulation of Multiplexer and Demultiplexer circuits using Virtual labs |
| 8. | Design and implement decoders and encoders. |
| 9. | Implement various Flip-flops using Logic gates. |
| 10. | Design and implement various Shift Registers. |

**Lecture: 45, Practical:30, Total:75**

**TEXT BOOKS**

| | |
|---|---|
| 1. | Morris Mano M., Micheal D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog", 6th Edition, Pearson Education, 2018. |

**REFERENCES:**

| | |
|---|---|
| 1. | Morris Mano M., Micheal D. Ciletti, "Digital Design (Uttaranchal Technical University)", 4th Edition, Pearson Education, 2012. |
| 2. | Virtual Labs: http://vlabs.iitkgp.ac.in/dec/ |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | apply the different number systems and their conversion and boolean algebra | Applying (K3) |
| CO2 | evaluate boolean expression using map and tabulation technique and implement using logic gates | Applying (K3) |
| CO3 | make use of combinational logic circuits to evaluate the boolean expression | Applying (K3) |
| CO4 | apply the concepts of sequential logic circuits to implement boolean functions | Applying (K3) |
| CO5 | construct simple digital systems using registers, counters, and programmable logic devices | Applying (K3) |
| CO6 | design the combinational logic circuits for the given application using logic gates | Applying (K3), Manipulation (S2) |
| CO7 | build and execute sequential logic circuits for boolean expressions | Applying (K3), Manipulation (S2) |
| CO8 | design and implement converters, decoders and encoders | Applying (K3), Manipulation (S2) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO6 | 3 | 2 | 2 | 2 | 1 | | | | | 1 | | | 3 | 1 |
| CO7 | 3 | 2 | 2 | 2 | 1 | | | | | 1 | | | 3 | 1 |
| CO8 | 3 | 2 | 2 | 2 | 1 | | | | | 1 | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 10 | 45 | 45 | | | | 100 |
| CAT2 | 10 | 45 | 45 | | | | 100 |
| CAT3 | 10 | 45 | 45 | | | | 100 |
| ESE | 10 | 45 | 45 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDT23 - Design Thinking**

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 2 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Preamble** | Design Thinking is Human-centered problem solving tool which emphasize on Empathy, Collaboration, Co-creation and Stakeholder feedback to unlock Creativity and Innovation, which devises feasible and viable Big Idea/solutions. | |
| **Unit - I** | **Design Thinking and Explore** | **9** |
| **Design Thinking:** Key Principles and Mindset – Five Phases, Methods and Tools of Design Thinking – User Guide – Foundation Building for Design Thinking – **Explore:** Methods & Tools – STEEPAnalysis – Strategic Priorities – Activity System – Stakeholder Mapping – Opportunity Framing. | | |
| **Unit – II** | **Empathize** | **9** |
| **Empathize**: Methods & Tools – Field Observation – Deep User Interview – Empathy Map – User Journey Map - Need Finding – User Insights - User Persona Development. | | |
| **Unit – III** | **Experiment** | **9** |
| **Experiment**: Methods & Tools – Ideation – SCAMPER – Analogous Inspiration – Deconstruct & Reconstruct – User Experience Journey – Prototyping– Idea Refinement. | | |
| **Unit - IV** | **Engage** | **9** |
| **Engage:** Methods & Tools – Story Telling – Art of Story Telling – Storyboarding – Co-Creation with Users – Collect Feedback from Users. | | |
| **Unit – V** | **Evolve** | **9** |
| **Evolve:** Methods & Tools – Concept Synthesis – Strategic Requirements –EvolvedActivity Systems – Activity System Integration – Viability Analysis – Innovation Tools using User Needs, CAP, 4S – Change Management - Quick Wins. | | |

**Total:45**

**TEXT BOOK:**


1. Lee Chong Hwa, "Design Thinking The Guidebook", Design Thinking Master Trainers of Bhutan, 2017.


**REFERENCES:**


1. Jeanne Liedtka and Tim Ogilvie, "Designing for Growth: A Design Thinking Tool Kit for Managers", Columbia University Press, 2011.
2. Jeanne Liedtka, Tim Ogilvie, and Rachel Brozenske, "The Designing for Growth Field Book: A Step-by-Step Project Guide", Edition, Columbia University Press, 2014.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Prepare design challenge and reframe the design challenge into design opportunity | Applying (K3) |
| CO2 | Understand and share the feelings of users to foster deep user understanding and be able to uncover the deep user insights and needs. | Applying (K3) |
| CO3 | Discover huge quantity of ideas by brain storming using the ideation tools and create prototypes. | Applying (K3) |
| CO4 | Produce user walkthrough experience using ideal user experience journey. | Applying (K3) |
| CO5 | Develop smart strategies & implementation plan that will deliver/achieve the BigIdea/solution deduced from earlier phases | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 1 | | | | | 3 | 2 | 1 | | 3 | 1 |
| CO2 | 3 | 3 | 3 | 1 | | | | | 3 | 2 | 1 | | 3 | 1 |
| CO3 | 3 | 3 | 3 | 1 | | | | | 3 | 2 | 1 | | 3 | 1 |
| CO4 | 3 | 3 | 3 | 1 | | | | | 3 | 2 | 1 | | 3 | 1 |
| CO5 | 3 | 3 | 3 | 1 | | | | | 3 | 2 | 1 | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 10 | 20 | 70 | | | | 100 |
| CAT2 | 10 | 15 | 75 | | | | 100 |
| CAT3 | 10 | 15 | 75 | | | | 100 |
| ESE | 10 | 15 | 75 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20MEL11 - ENGINEERING PRACTICES LABORATORY

(Common to ECE, EEE, EIE, CSE, CSD & IT Branches)

| Programme & Branch | BE (ECE, EEE, EIE, CSE, CSD ) & BTech ( IT) | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 2 | ES | 0 | 0 | 2 | 1 |

| | |
|---|---|
| Preamble | This course is designed to provide a hands-on experience in basic of mechanical and electrical engineering practices. |

**List of Exercises / Experiments:**

| | |
|---|---|
| | **PART A – MECHANICAL ENGINEERING** |
| 1. | To prepare square or rectangular shaped MS plates using power tools for cutting, polishing and shaping to the required dimensions. |
| 2. | To carryout drilling, tapping and assembly on the given MS plates. |
| 3. | To carryout thread forming on a GI/PVC pipes and prepare water leak proof water line from overhead tank. |
| 4. | To prepare a wood or plywood box/tray/any innovative models using modern power tools like cutting machine, router, jigsaw, power screw driver etc. |
| 5. | Welding practice through arc welding / simulator |
| | **PART B – ELECTRICAL AND ELECTRONICS ENGINEERING** |
| 1. | Safety Aspects of Electrical Engineering, Electrical Symbols, Components Identification, Fuse selection and installation, Circuit Breakers selection |
| 2. | Wiring circuit for fluorescent lamp and Stair case wiring |
| 3. | Measurement of Earth resistance |
| 4. | Soldering of Simple Circuits and trouble shooting |
| 5. | Implementation of half wave and full wave Rectifier using diodes |

**Total: 30**

**REFERENCES /MANUAL / SOFTWARE:**

| | |
|---|---|
| 1. | Engineering Practices Laboratory Manual. |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | plan the sequence of operations for effective completion of the planned models/ innovative articles | Creating (K6), Precision (S3) |
| CO2 | identify and use appropriate modern power tools and complete the exercises/models accurately | Applying (K3), Precision (S3) |
| CO3 | select fuses and Circuit breakers | Understanding (K2), Manipulation (S2) |
| CO4 | perform house wiring and realize the importance of earthing | Applying (K3), Manipulation (S2) |
| CO5 | trouble shoot the electrical and electronic circuits | Applying (K3), Manipulation (S2) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | 3 | 3 | 2 | 1 | | | 3 | 3 | | 3 | | |
| CO2 | 2 | | 3 | 3 | 2 | | | | 3 | 3 | | 3 | | |
| CO3 | 3 | | 3 | 3 | 1 | | | | 2 | 2 | | 3 | | |
| CO4 | 3 | | 3 | 3 | 1 | | | | 2 | 3 | | 3 | | |
| CO5 | 3 | | 3 | 3 | 1 | | | | 2 | 2 | | 3 | | |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

## 20CDL21 - PROGRAMMING AND LINEAR DATA STRUCTURESLABORATORY

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | I | PC | 0 | 0 | 2 | 1 |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Program to access an array(1D and 2D) using pointers |
| 2. | Program to manipulate strings using pointers |
| 3. | Program to demonstrate dynamic memory allocation for 1D and 2D array |
| 4. | Program to pass an array as an argument to function and access the array using pointers |
| 5. | Programs using pointers and structures |
| 6. | Program to perform operations on files |
| 7. | Program using conditional preprocessor directives |
| 8. | Program to implement singly linked list |
| 9. | Program to implement stack using array and linked list |
| 10. | Program to implement Queue using array and linked list |

**Total:30**

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1: | use pointers to perform operations on arrays and structures | Applying (K3), Precision(S3) |
| CO2: | write programs to demonstrate the application of dynamic memory allocation and macros | Applying (K3), Precision(S3) |
| CO3: | compare and use appropriate data structure for a given application | Analyzing (K4), Precision(S3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | | | | | | | | | 2 | 2 |
| CO2 | 3 | 2 | 1 | 1 | | | | | | | | | 2 | 2 |
| CO3 | 3 | 3 | 2 | 1 | 1 | | | | | | | | 2 | 2 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**20VEC11 - YOGA AND VALUES FOR HOLISTIC DEVELOPMENT**

**(Common to all Engineering and Technology branches)**

| Programme & Branch | All BE/BTech Branches | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 2 | HS | 1 | 0 | 1 | 1 |

| | | |
|---|---|---|
| Preamble | Providing Value Education to improve the Students' character - understanding yogic life and physical health - maintaining youthfulness - Measure and method in five aspects of life | |
| **Unit - I** | **Physical Health:** | **4** |
| **Manavalakalai (SKY) Yoga:** Introduction - Education as a means for youth empowerment - Greatness of Education - Yoga for youth Empowerment. **Simplified Physical Exercises:** Need and Objectives of Simplified Physical Exercise - Hand, Leg, Breathing, Eye exercises - Kapalabathi, Makarasana Part I, Makarasana Part II, Body Massage, Acu pressure, Relaxation exercises - Benefits. **Yogasanas:** Pranamasana - Hastha Uttanasana - Pada Hasthasana - Aswa Sanjalana Asana - Thuvipatha asva Sanjalana asana - Astanga Namaskara - Bhujangasana - Atha Muktha Savasana - Aswa Sanjalana Asana - Pada Hasthasana - Hastha Uttanasana - Pranamasana. **Pranayama:** Naddi suddi - Clearance Practice - Benefits. | | |
| **Unit - II** | **Life Force:** | **4** |
| **Reasons for Diseases:** Body Function - Reason for Diseases and Prevention - Natural reasons (Genetic / imprints, Planetary Position, Natural calamities and climatic changes) - Unnatural reasons (Food habits, Thoughts, Deeds). **Philosophy of Kaya kalpa:** Enriching Bio-Magnetism - Physical body - Sexual vital fluid - Life force - Bio-Magnetism - Mind. **Maintaining youthfulness:** Postponing old age - Transformation of food into seven components - Importance of sexual vital fluid - Measure and method in five aspects of life - Controlling undue Passion. **Kayakalpa practice:** Aswini Mudra - Ojas breath - Benefits of Kaya Kalpa. | | |
| **Unit - III** | **Mental Health:** | **4** |
| **Mental Frequencies:** Beta, Apha, Theta and Delta wave - Agna Meditation explanation - benefits. **Shanti meditation:** Shanthi Meditation explanation – benefits. **Thuriya Meditation:** Thuriya Meditation explanation – benefits. **Benefits of Blessing:** Self blessing (Auto suggestion) - Family blessing - Blessing the others - World blessing - Divine protection. | | |
| **Unit - IV** | **Values:** | **4** |
| **Human Values:** Self control - Self confidence - Honesty Contentment - Humility – Modesty - Tolerance - Adjustment - Sacrifice – Forgiveness - Purity (Body, Dress, Environment) - Physical purity - Mental purity - Spiritual purity. **Social Values:** Non violence – Service. Patriotism – Equality. Respect for parents and elders - care and protection - Respect for teacher. Punctuality - Time Management. | | |
| **Unit - V** | **Morality (Virtues):** | **4** |
| **Importance of Introspection:** I - Mine (Ego, Possessiveness). Six Evil Temperaments - Greed - Anger - Miserliness - Immoral sexual passion - Inferiority and superiority Complex – Vengeance. Maneuvering of Six Temperaments: Contentment - Tolerance - Charity - Chastity - Equality - Pardon (Forgiveness). Five essential Qualities acquired through Meditation: Perspicacity - Magnanimity - Receptivity - Adaptability - Creativity ( Improved Memory Power). | | |

**Total:20**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Thathuvagnani Vethathiri Maharishi, "Yoga for Youth Empowerment", Vethathiri Publications, 2019. |

**REFERENCES:**

| | |
|---|---|
| 1. | Thathuvagnani Vethathiri Maharishi, "Yoga for Modern Age", Vethathiri Publications, 2019. |
| 2. | Thathuvagnani Vethathiri Maharishi, "Simplified Physical Exercises", Vethathiri Publications, 2019. |
| 3. | Neelam Sharma, "Holistic Education and Yoga", Shipra Publications, 2017. |
| 4. | Dr. Joseph Murphy, "The Power of Your Subconscious Mind", Pushpak Publication, 2019. |

| | **COURSE OUTCOMES:** On completion of the course, the students will be able to | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | understand the importance of physical health and practice simplified physical yoga exercise. | Applying (K3) |
| CO2 | understand the importance of Kayakalpa exercise to enrich Bio-Magnetism and practice it. | Applying (K3) |
| CO3 | understand the significance of meditation and do meditation to get sound mind. | Applying (K3) |
| CO4 | understand the human and social values to provide service to society. | Applying (K3) |
| CO5 | understand the evil temperaments and five essential qualities acquired through meditation | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | 3 | | 2 | 1 | | | 1 | | |
| CO2 | | | | | | 3 | | 2 | | | | 1 | | |
| CO3 | | | | | | 3 | | 3 | | | | 1 | | |
| CO4 | | | | | | 3 | | 2 | 1 | | | 1 | | |
| CO5 | | | | | | 3 | | 3 | | | | 1 | | |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | NA | | | | | | |
| CAT2 | NA | | | | | | |
| CAT3 | | | 100 | | | | 100 |
| ESE | NA | | | | | | |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20MAT34 - DISCRETE MATHEMATICAL STRUCTURES**

(Common to Computer Science and Engineering, Computer Science and Design & Information Technology branches)

| Programme & Branch | BE – Computer Science and Engineering, Computer Science and Design & B.Tech – Information Technology | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 3 | BS | 3 | 1 | 0 | 4 |

| | | |
|---|---|---|
| Preamble | To impart knowledge in mathematical logic, partial ordering and lattices, investigate various category of functions and develop skills to apply graph theoretic concepts in networking and group structures in coding theory. | |
| **Unit - I** | **Propositional Calculus:** | **9+3** |
| Propositions – Logical connectives – Compound propositions – Conditional and biconditional propositions – Truth tables – Tautologies and Contradictions – Inverse, Converse and Contrapositive – Logical equivalences and implications –Normal forms – Principal conjunctive normal form and Principal disjunctive normal form – Rules of inference – Arguments – Validity of arguments. | | |
| **Unit - II** | **Predicate Calculus:** | **9+3** |
| Predicates – Statement function – Variables – Quantifiers – Universe of discourse – Theory of inference – Rules of universal specification and generalization – Rules of Existential specification and generalization - Validity of arguments. | | |
| **Unit - III** | **Set Theory:** | **9+3** |
| Cartesian product of sets – Relations on sets – Types of relations and their properties – Matrix representation of a relation - Graph of a relation – Equivalence relations – Partial ordering – Poset – Hasse diagram – Lattices – Properties of lattices. | | |
| **Unit - IV** | **Functions:** | **9+3** |
| Definition – Classification of functions – Composition of functions – Inverse functions – Characteristic function of a set – Recurrence relations – Solution of recurrence relations – Generating Functions – Solving recurrence relation by generating functions. | | |
| **Unit - V** | **Group Theory:** | **9+3** |
| Groups and Subgroups (Definitions only) – Homomorphism – Cosets – Lagrange's theorem – Normal subgroups – Coding Theory : Group codes –Hamming distance – Basic notions of error correction – Error recovery in group codes (Excluding theorems in coding theory). | | |

**Lecture: 45, Tutorial: 15, Total: 60**

**TEXT BOOK:**


1. Veerarajan T., "Discrete Mathematics with Graph Theory and Combinatorics", Reprint Edition, Tata McGraw Hill Publishing Company, New Delhi, 2013.


**REFERENCES:**


1. Tremblay J.P. and Manohar R., "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw–Hill, New Delhi, Reprint 2010.
2. Kenneth H. Rosen, "Discrete Mathematics and its Applications", 7th Edition, Tata McGraw Hill Publishing Company, 2012.
3. Susanna S. Epp, "Discrete Mathematics with Applications", Metric Edition, Cengage Learning, USA, 2019.
4. Alan Doerr, Kenneth Levasseur, "Applied Discrete Structures", 3rd Edition, 2018.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | apply propositional logic to validate the arguments. | Applying (K3) |
| CO2 | apply the rules of inference and methods of proof in predicate calculus to verify the validity of arguments. | Applying (K3) |
| CO3 | possess knowledge of various set theoretic concepts. | Applying (K3) |
| CO4 | understand different types of functions and solve recurrence relations. | Understanding (K2) |
| CO5 | apply the concepts of group structures in coding theory. | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 1 | |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 1 | |
| CO3 | 3 | 2 | 1 | | | | | | | | | | | |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 1 | |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 1 | |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 15 | 20 | 65 | | | | 100 |
| CAT2 | 10 | 20 | 70 | | | | 100 |
| CAT3 | 10 | 40 | 60 | | | | 100 |
| ESE | 10 | 30 | 60 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDT31 - DATA STRUCTURES**

| Programme & Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 3 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | The course focuses on the basic concepts and applications of linear data structures and non linear data structures. | |
| **Unit - I** | **Linear Data Structures and its Applications:** | **9** |
| Overview of list, stack and Queue – Linked List – Doubly Linked List – Circular Linked List – Applications of List: Polynomial Addition – Representing Sparse matrices – Reversing a Linked List – Cloning a Linked List – Sorting of Linked List – Applications of Stack: Towers of Hanoi – Balancing Parenthesis – String Reversal – Applications of Queue: Reversing the Queue using Stack. | | |
| **Unit - II** | **Trees:** | **9** |
| Preliminaries: Implementation of trees –Tree Traversals with an Application – Binary trees: Implementation– Expression trees – The Search Tree ADT – Binary Search Trees: Construction – Searching – Insertion – Deletion – Find Min – Find Max – AVL trees: Rotation – Insertion – Deletion. | | |
| **Unit - III** | **Graphs:** | **9** |
| Definitions – Representation of Graphs – Types of Graph – Depth-first traversal – Breadth-first traversal – Topological Sort – Applications of DFS: Bi-connectivity – Euler circuits – Finding Strongly Connected Components – Applications of BFS: Bipartite graph – Graph Coloring. | | |
| **Unit - IV** | **Advanced Trees:** | **9** |
| Splay Trees: Splaying – B tree–Red-Black Trees: Rotation – Insertion – Deletion – Priority Queues(Heaps) – Binary heap – d-heaps – Leftist heaps – Skew heaps. | | |
| **Unit - V** | **Searching, Sorting and Hashing:** | **9** |
| Searching: Linear search – Binary Search – Sorting: Internal sorting: Bubble sort – Shell sort – Bucket sort – External sorting: Multiway Merge – Polyphase Hashing: Hash Functions – Separate Chaining – Open Addressing: Linear Probing – Quadratic Probing – Double Hashing – Rehashing – Extendible Hashing. | | |

**Lecture: 45, Total: 45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Weiss M. A., “Data Structures and Algorithm Analysis in C”, Second Edition, Pearson Education, 2016. (UNIT I,II,III,V) |
| 2. | Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, “Introduction to Algorithms”, Third Edition, Mcgraw Hill, 2009.(UNIT-IV) |

**REFERENCES:**

| | |
|---|---|
| 1. | Langsam Y.M., Augenstein J. and Tenenbaum A. M., “Data Structures using C and C++”, 2nd Edition, Pearson Education, 1996. |

| | **COURSE OUTCOMES:** On completion of the course, the students will be able to | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | solve the computational problems using linear data structures. | Applying (K3) |
| CO2 | determine the structure and operations on trees. | Applying (K3) |
| CO3 | apply appropriate graph algorithms for solving computing problems. | Applying (K3) |
| CO4 | implement the operations of special trees. | Applying (K3) |
| CO5 | demonstrate the concept of sorting, searching and hashing techniques. | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 5 | 20 | 75 | | | | 100 |
| CAT2 | 10 | 20 | 70 | | | | 100 |
| CAT3 | 10 | 20 | 70 | | | | 100 |
| ESE | 10 | 20 | 70 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDT32 - OBJECT ORIENTED PROGRAMMING

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 3 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides a concise introduction to the fundamental concepts of Java programming including inheritance, interfaces, exception handling and threads. JavaFX Event handling, components and controls are also focused. | |
| **Unit - I** | **Introduction to OOP, Java, Classes and Objects** | **9** |
| Overview of OOP – Object oriented programming paradigms – Features of Object Oriented Programming – Java Buzz words – Evolution of Java – Overview of Java–Data Types, Variables and Arrays – Operators – Control Statements – Classes: Class Fundamentals-objects–Assigning Object Reference Variables – Introducing Methods – Constructors – this keyword – Garbage Collection – Stack Class. | | |
| **Unit - II** | **Inheritance, Packages and Interfaces** | **9** |
| Overloading Methods – Objects as Parameters – Argument Passing – Returning Objects – Recursion – Access Control–Static – Nested and Inner Classes – Command–Line Arguments – Variable Length Arguments. Inheritance: Basics – Super keyword -Multilevel Hierarchy–Method Overriding – Dynamic Method Dispatch –Abstract Classes – final with Inheritance. Packages and Interfaces: Packages – Packages and Member Access –Importing Packages – Interfaces. | | |
| **Unit - III** | **Exception Handling and Multithreading** | **9** |
| Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in Exceptions – User defined Exception. Multithreaded Programming: Java Thread Model–Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread Communication- Suspending –Resuming, and Stopping Threads –Multithreading. Wrappers – Auto boxing. | | |
| **Unit - IV** | **I/O, Generics, String Handling and Collections** | **9** |
| I/O Basics – Reading and Writing Console I/O – Reading and Writing Files. Generics: Introduction – Example –Parameters – General Form – Generic Methods, Constructors and Interfaces. Strings: Basic String class, methods and String Buffer Class. Collection frameworks: Overview – Collection Classes – Collection Interfaces. | | |
| **Unit - V** | **Java FX Event Handling, Controls and Components** | **9** |
| Fundamentals – Events and Controls: Event Basics – Handling Key and Mouse Events. Controls: Checkbox, ToggleButton–RadioButtons– ListView–ComboBox–ChoiceBox– Text Cotrols–ScrollPane. Layouts – FlowPane–HBox and VBox–BorderPane–StackPane–GridPane. Menus – Basics – Menu – Menubars–MenuItem. | | |

**Total:45**

**TEXT BOOKS:**


1. Herbert Schildt., "Java: The Complete Reference", 11th Edition, McGraw Hill Education, New Delhi, 2019. for units I - IV
2. Herbert Schildt., "Introducing JavaFX 8 Programming", 1st Edition, McGraw Hill Education, New Delhi, 2015. for unit V


**REFERENCES:**


1. Cay S.Horstmann., "Core Java Fundamentals", Volume 1, 11th Edition, Prentice Hall, 2018

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | apply the concepts of classes and objects to solve simple problems | Applying (K3) |
| CO2 | develop programs using inheritance, packages and interfaces | Applying (K3) |
| CO3 | make use of exception handling mechanisms and multithreaded model to solve real world problems | Applying (K3) |
| CO4 | build Java applications with I/O packages, string classes, Collections and generics concepts | Applying (K3) |
| CO5 | integrate the concepts of event handling and JavaFX components and controls for developing GUI based applications | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 15 | 25 | 60 | | | | 100 |
| CAT2 | 15 | 20 | 65 | | | | 100 |
| CAT3 | 15 | 20 | 65 | | | | 100 |
| ESE | 10 | 20 | 70 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDT33 - Computer Organization**

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 3 | PC | 3 | 1 | 0 | 4 |

| | | |
|---|---|---|
| Preamble | This course provides knowledge on basics of computer organization, introduces various arithmetic operations and discusses the performance issues of processor, memory and I/O units. | |
| **Unit - I** | **Basic Structure of Computers and Machine Instructions** | **9+3** |
| Functional Units – Basic Operational Concepts – Number Representation and Arithmetic Operations – Performance – Memory Locations and Addresses – Memory Operations – Instruction and Instruction Sequencing – Addressing Modes – CISC Instruction Sets – RISC and CISC Styles. | | |
| **Unit - II** | **Arithmetic Unit** | **9+3** |
| Addition and Subtraction of Signed Numbers – Design of Fast Adders – Multiplication of Unsigned Numbers – Multiplication of Signed Numbers – Fast Multiplication – Integer Division – Floating Point Numbers and Operations. | | |
| **Unit - III** | **Processing Unit** | **9+3** |
| Fundamental Concepts – Instruction Execution – Hardware Components – Instruction Fetch and Execution Steps – Control Signals - Hardwired control – CISC Style Processors. Pipelining : Pipelining – Basic concepts – Pipeline Organization – Pipelining Issues - Data Dependencies – Memory Delay – Branch Delay – Performance Evaluation. | | |
| **Unit - IV** | **Memory System** | **9+3** |
| Basic Concepts – Semiconductor RAM Memories – Read-Only Memories – Direct Memory Access – Memory Hierarchy - Cache Memories : Mapping Functions – Performance Consideration – Virtual Memory – Secondary Storage : Magnetic Hard Disks. | | |
| **Unit - V** | **I/O Organization** | **9+3** |
| Accessing I/O Devices – Interrupts – Enabling and Disabling Interrupts – Handling Multiple Devices – Bus Structure – Bus Operation – Arbitration – Interface Circuits – Interconnection Standards : USB. | | |

**Lecture: 45, Tutorial:15, Total:60**

**TEXT BOOK:**


1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, “Computer Organization and Embedded Systems”, 6th Edition, McGraw Hill International Edition, 2012.


**REFERENCES:**


1. Patterson David, A. and Hennessy John L., “Computer Organization and Design: The Hardware / Software Interface”, 5th Edition, Harcourt Asia, Morgan Kaufmann, Singapore, 2014.
2. Stallings William, “Computer Organization and Architecture: Designing for Performance”, 9th Edition, Pearson Education, New Delhi, 2012.

| | **COURSE OUTCOMES:** On completion of the course, the students will be able to | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | describe the basic structure, arithmetic and memory operations of a digital computer and determine the addressing modes for the set of instructions. | Applying (K3) |
| CO2 | describe and apply algorithms for performing different arithmetic operations. | Applying (K3) |
| CO3 | make use of the data path in a processor to write the sequence of steps to fetch and execute a given instruction and apply the concepts of pipelining to determine and handle the hazards. | Applying (K3) |
| CO4 | distinguish between different types of memory, and apply the mapping functions between main memory and cache. | Applying (K3) |
| CO5 | demonstrate the need for and types of interrupts in I/O transfer and the role of different types of bus and arbitration in I/O operations. | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 20 | 50 | 30 | | | | 100 |
| CAT2 | 20 | 40 | 40 | | | | 100 |
| CAT3 | 30 | 45 | 25 | | | | 100 |
| ESE | 20 | 30 | 50 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDT34 - OPERATING SYSTEMS**

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 3 | PC | 3 | 1 | 0 | 4 |

| | | |
|---|---|---|
| Preamble | This course provides basic operating system abstractions, system call interface, process, threads, and inter-process communication. Various management functions of an operating system will also be explored. | |
| **Unit - I** | **Operating Systems Overview:** | **9+3** |
| Introduction – Computer System Organization – Computer System Architecture – Operations – Resource Management – Security and Protection – Virtualization – Computing Environments. Operating Systems Structures: Services – User and OS Interface – System Calls – Linkers and Loaders – Operating system Structure – Building and Booting OS. | | |
| **Unit - II** | **Process Management:** | **9+3** |
| Process Concept – Process Scheduling – Operations on Processes – Interprocess Communication – IPC in Shared Memory and Message Passing Systems. CPU Scheduling: Scheduling Criteria – Scheduling Algorithms. Multithreaded Programming: Threads Overview – Multicore Programming – Multithreading Models. | | |
| **Unit - III** | **Process Synchronization:** | **9+3** |
| The Critical Section Problem - Peterson's solution – Hardware support for Synchronization – Mutex Locks – Semaphores – Monitors. Deadlocks: Deadlock Characterization – Methods for handling deadlocks - Deadlock Prevention and Avoidance – Deadlock Detection – Recovery from Deadlock. | | |
| **Unit - IV** | **Memory Management:** | **9+3** |
| Main Memory: Background – Contiguous Memory Allocation – Segmentation – Paging – Swapping. Virtual Memory: Background – Demand Paging – Page Replacement – Case study: Intel 32 Architecture. | | |
| **Unit - V** | **Storage Management:** | **9+3** |
| Mass Storage Structure: Overview – HDD Scheduling. File System: File Concept – Access Methods – Directory Structure – Protection. File System Implementation: File System Structure – File System Operations – Directory Implementation – Allocation Methods - Free Space Management. – Security : The Security Problem – program Threats - Case study: Linux System. | | |

**Lecture:45, Tutorial:15, Total:60**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 10th Edition, John Wiley& Sons Inc., 2018. |

**REFERENCES:**

| | |
|---|---|
| 1. | William Stallings, "Operating Systems Internals and Design Principles", 9th Edition, Prentice Hall, 2018. |
| 2. | Andrew S. Tanenbaum, "Modern Operating Systems", 4th Edition, Pearson Education, 2016. |

| | **COURSE OUTCOMES:** On completion of the course, the students will be able to | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | explain operating system structure, services and system calls and identify appropriate system calls for a given service | Applying (K3) |
| CO2 | make use of process management strategies for scheduling processes | Applying (K3) |
| CO3 | apply different methods for process synchronization and deadlock handling | Applying (K3) |
| CO4 | make use of memory management strategies and apply page replacement policies to address demand paging | Applying (K3) |
| CO5 | apply various disk scheduling algorithms and elaborate file systems concepts | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 25 | 35 | 40 | | | | 100 |
| CAT2 | 20 | 20 | 60 | | | | 100 |
| CAT3 | 20 | 20 | 60 | | | | 100 |
| ESE | 25 | 25 | 50 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDL31 - DATA STRUCTURES LABORATORY

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 3 | PC | 0 | 0 | 2 | 1 |
| Preamble | This course provides knowledge to develop applications using the concepts of Linear and Non-linear Data Structures. | | | | | | |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Implementation of singly linked list and its operations |
| 2. | Implementation of doubly linked list and its operations |
| 3. | Implementation of circular linked list and its operations |
| 4. | Implementation of polynomial addition using linked list |
| 5. | Infix to postfix conversion using stack ADT |
| 6. | Implement the application for evaluating postfix expressions using array of stack ADT |
| 7. | Implementation of reversing a queue using stack |
| 8. | Implementation of binary search tree traversals |
| 9. | Implementation of graph traversal techniques |
| 10. | Implement the operations of Red Black tree: i) Store a number on to the tree ii) Delete a number from the tree iii) Display all the numbers in the tree |
| 11. | Implementation of sorting algorithms: Bubble sort and Shell sort |
| 12. | Implement the following operations in hash table using array<br>i) store the element in hash table<br>ii)Search an element from the table<br>iii)Delete an element from the table |

**Total: 30**

**REFERENCES/MANUAL/SOFTWARE:**

| | |
|---|---|
| 1. | Operating System : Windows/Linux |
| 2. | Software : C |
| 3. | Laboratory Manual |

| **COURSE OUTCOMES:**<br>On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | implement linear data structures and use it to solve the given problem | Applying (K3), Precision (S3) |
| CO2 | make use of linear data structures concepts to solve the problems on non linear data structures | Applying (K3), Precision (S3) |
| CO3 | implement searching, sorting and indexing operations | Applying (K3), Precision (S3) |

| Mapping of COs with POs and PSOs | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| CO1 | 3 | 2 | 1 | 2 | 1 | | | | | | | | 3 | 2 |
| CO2 | 3 | 2 | 1 | 2 | 1 | | | | | | | | 3 | 2 |
| CO3 | 3 | 2 | 1 | 2 | 1 | | | | | | | | 3 | 2 |
| 1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy | | | | | | | | | | | | | | |

## 20CDL32 - OBJECT ORIENTED PROGRAMMING LABORATORY

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 3 | PC | 0 | 0 | 2 | 1 |
| Preamble | This course provides knowledge to develop applications using java programming language. | | | | | | |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Write simple Java programs using operators, arrays and control statements. |
| 2. | Develop stack and queue data structures using classes and objects. |
| 3. | Demonstrate the concepts of inheritance & polymorphism. |
| 4. | Develop an application using interfaces by accessing super class constructors and methods. |
| 5. | Develop an employee payroll application using packages. |
| 6. | Implement exception handling and creation of user defined exception. |
| 7. | Implement program to demonstrate multithreading and inter thread communication. |
| 8. | Write a program to perform file operations. |
| 9. | Develop applications to demonstrate the features of generics classes and interfaces. |
| 10. | Implement the concepts of collection frameworks. |
| 11. | Demonstrate the handling of JavaFX I/O events. |
| 12. | Develop applications using JavaFX controls, layouts and menus. |

**Practical: 30, Total: 30**

**REFERENCES / MANUALS / SOFTWARES:**

| | |
|---|---|
| 1. | Linux / Windows |
| 2. | Eclipse IDE / Netbeans IDE |
| 3. | Lab manual |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | design and develop java programs using object oriented programming concepts | Applying (K3) |
| CO2 | develop simple applications using package, exceptions, multithreading, and generics concepts | Applying (K3) |
| CO3 | create GUIs and event driven programming applications for real world problems | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 2 | 1 | | | | | | | | 3 | 2 |
| CO2 | 3 | 2 | 2 | 2 | 1 | | | | | | | | 3 | 2 |
| CO3 | 3 | 2 | 2 | 2 | 1 | | | | | | | | 3 | 2 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**20EGL31 - ENGLISH FOR WORKPLACE COMMUNICATION LABORATORY**

(Common to all BE/BTech Engineering and Technology branches)

| Programme & Branch | All BE/BTech Engineering & Technology branches | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisite | Nil | 3 | HS | 0 | 0 | 2 | 1 |

| | | |
|---|---|---|
| **Preamble:** | This course is designed to impart required levels of fluency in using the English Language at B1/B2 level in the CEFR through activities, hands-on training and application. | |
| **Unit -I** | **Listening:** | **6** |
| Techniques for effective listening and note taking; listening to audio scripts, podcasts and TED talks; listening to discourse samples of native speakers and imitating; improving pronunciation; introduction to the basics of phonetics and understanding different accents. | | |
| **Unit -II** | **Reading:** | **6** |
| Speed reading skills; reading to gain knowledge; reading newspaper articles to improve writing; academic journals to enrich vocabulary and word power; reading aloud with proper stress and intonation; reading to draw inferences. | | |
| **Unit -III** | **Soft Skills:** | **6** |
| Importance of soft skills at workplace - understanding soft skills through case studies - developing positive attitude; goal setting; time management; team work; telephone etiquette; developing professionalism, interpersonal skills and work ethics. | | |
| **Unit -IV** | **Writing:** | **6** |
| Introduction to pre-writing, style and mechanics of writing; mind mapping; creating content from an outline; paragraph and resume writing; nuances of academic writing; writing Statement of Purpose (SOP), editing, revising and proof reading for clarity and readability; structural and grammatical accuracy. | | |
| **Unit -V** | **Speaking:** | **6** |
| Verbal and non-verbal communication; fluency and spoken English; introducing oneself and others; making presentations on topics using prepared material; mock interviews; dynamics of Group Discussion. | | |

**List of Exercises / Experiments :**

| | |
|---|---|
| 1. | Mock Interview |
| 2. | Presentation |
| 3. | Reading Aloud |
| 4. | Group Discussion |
| 5. | Soft Skills through Case Studies |
| 6. | Listening Test |

**Total: 30**

**REFERENCES/MANUAL/SOFTWARE:**


| | |
|---|---|
| 1. | Jeff Butterfield, “Soft Skills for Everyone”, 1st Edition, Cengage Learning, New Delhi, 2011. |
| 2. | Bob Dignen, Steve Flinders and Simon Sweeney, “Professional English for Work and Life, English 365, Student’s Book 2”, 1st Edition, Cambridge University Press, New Delhi, 2004. |


| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1: | acquire effective listening and reading skills | Understanding (K2), Imitation (S1) |
| CO2: | acquire and demonstrate appropriate professional skills for the workplace | Applying (K3), Naturalization (S5) |
| CO3: | speak fluently and write meaningfully in English in the given context | Applying (K3), Articulation (S4) |

| Mapping of COs with POs and PSOs | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| CO1 | | | | | | | | | 2 | 3 | | 2 | | |
| CO2 | | | | | | | | | 2 | 3 | | 2 | | |
| CO3 | | | | | | | | | 3 | 3 | | 3 | | |
| 1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy | | | | | | | | | | | | | | |

**20GET31 - UNIVERSAL HUMAN VALUES**
**(Common to All BE/BTech branches)**

| Programme & Branch | All BE/BTech Engineeirng & Technology branches | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 3 | HS | 2 | 0 | 0 | 2 |

| | | |
|---|---|---|
| Preamble | To make the student to know what they 'really want to be' in their life and profession, understand the meaning of happiness and prosperity for a human being. Also to facilitate the students to understanding of harmony at all the levels of human living, and live accordingly | |
| **Unit - I** | **Introduction:** | **9** |
| Need and Basic Guidelines of Value Education – Content and Process of Value Education – Self Exploration – purpose of self-Exploration – Content and Process of Self exploration – Natural Acceptance – Realization and Understanding – Basic Human Aspirations – Continuous Happiness and Prosperity – Exploring Happiness and Prosperity – Basic Requirement for Fulfillment of Human Aspirations – Relationships – Physical Facilities – Right Understanding. | | |
| **Unit - II** | **Harmony in the Self and Body:** | **9** |
| Human Begin and Body – Understanding Myself as Co–existence of Self ('I') and Body, Needs of the Self and Body, Activities in the Self and Body, Self ('I') as the Conscious Entity, the Body as the Material Entity – Exercise – Body as an Instrument– Harmony in the Self ('I) – Understanding Myself – Harmony with Body. | | |
| **Unit - III** | **Harmony in the Family and Society:** | **9** |
| Harmony in the Family – Justice – Feelings (Values) in Human Relationships – Relationship from Family to Society – Identification of Human Goal – Five dimensions of Human Endeavour. | | |
| **Unit - IV** | **Harmony in Nature and Existence:** | **9** |
| Order of Nature – Interconnectedness – Understanding the Four order – Innateness – Natural Characteristic – Basic Activity – Conformance – Introduction to Space – Co–existence of units of Space – Limited and unlimited – Active and No–activity – Existence is Co–existence. | | |
| **Unit - V** | **Implications of the above Holistic Understanding of Harmony on Professional Ethics:** | **9** |
| Values in different dimensions of Human Living – Definitiveness of Ethical Human Conduct –Implications of Value based Living – Identification of Comprehensive Human Goal – Humanistic Education – Universal Human Order – Competence and Issues in Professional Ethics. | | |

**Total: 45**

**TEXT BOOK:**


1. Gaur R.R., Sangal R., Bagaria G.P., "A Foundation Course in Human Values and Professional Ethics", 1st Edition, Excell Books Pvt. Ltd., New Delhi, 2016.


**REFERENCES:**


1. Ivan Illich, "Energy & Equity", The Trinity Press, USA, 1974.
2. Schumacher E.F., "Small is Beautiful: a study of economics as if people mattered", Britain, 1973.


| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society. | Understanding (K2) |
| CO2 | distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co–existence of Self and Body. | Understanding (K2) |
| CO3 | understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human–human relationships and explore their role in ensuring a harmonious society. | Understanding (K2) |
| CO4 | understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature. | Understanding (K2) |
| CO5 | distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work. | Understanding (K2) |

| Mapping of COs with POs and PSOs | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| CO1 | | | | | | 1 | | 3 | | | | | | |
| CO2 | | | | | | | | 2 | | | | | | |
| CO3 | | | | | | 1 | | 3 | | | | | | |
| CO4 | | | | | | | | 2 | | | | | | |
| CO5 | | | | | | | | 3 | | | | | | |
| 1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy | | | | | | | | | | | | | | |

| ASSESSMENT PATTERN - THEORY | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | 25 | 75 | | | | | 100 |
| CAT2 | 25 | 75 | | | | | 100 |
| CAT3 | NA | | | | | | |
| ESE | NA | | | | | | |

*** ±3% may be varied (CAT 1, 2 – 100 marks)**

**20CDT41- DATABASE MANAGEMENT SYSTEMS**

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 4 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course focuses on the fundamentals of data models and database system design along with file organization and query processing. | |
| **Unit - I** | **Data Models and Relational Model:** | **9** |
| Introduction – Database System Applications – Purpose of database systems – View of data – Database Languages – Relational Databases – Database Architecture – Database Users and administrators – Relational Model – Structure of Relational Databases – Database Schema – Keys – Schema Diagrams – Relational Query Languages – Relational Algebra – Fundamental Relational Operations – Additional relational operations. | | |
| **Unit - II** | **SQL and Database Design:** | **9** |
| Database Design – E-R model – Constraints – ER diagrams – Reduction to Relational Schema – ER design issues. SQL: Basic structure – Operations – Aggregate Functions – Sub queries – Nested Sub queries – modification of the database – Intermediate SQL: Joins – views – Index – Integrity Constraints – SQL data types and schemas – Authorization. | | |
| **Unit - III** | **Relational Database Design:** | **9** |
| Relational Database Design: Features of good relational designs – Functional dependency – Decomposition using functional dependencies – Normal Forms: 1NF, 2NF, 3NF, BCNF, 4NF, 5NF – Data Storage: RAID – Tertiary storage – Overview of query processing and query optimization - File Organization – Organization of Records in Files – Data dictionary storage. | | |
| **Unit - IV** | **Indexing, Hashing and Transactions:** | **9** |
| Indexing, Hashing and Transactions: Ordered indices – B tree index files – B+ Tree index files – Multiple key access – Static and Dynamic Hashing – Bitmap indices – Transaction concept – Transaction model – Storage structure – Transaction atomicity and durability – Isolation – Serializability. | | |
| **Unit - V** | **Concurrency Control and Recovery System:** | **9** |
| Concurrency Control and Recovery System: Lock-based Protocols – Deadlock Handling – Multiple Granularity – Timestamp and Validation Based Protocols – Failure classification – Storage – Recovery and atomicity – Algorithm – Buffer management – Failure with loss of nonvolatile storage – early lock release and logical undo operations. | | |

**Total: 45**

## TEXT BOOK:


1. Silberschatz Abraham, Korth Henry F. and Sudarshan S., "Database System Concepts", 7th Edition, McGraw Hill, New York, 2019.


## REFERENCES:


1. ElmasriRamez and Navathe Shamkant B., "Fundamental Database Systems", 6th Edition, Pearson Education, New Delhi, 2010.
2. Date C.J., Kannan A. and Swamynathan S., "An Introduction to Database Systems", 8th Edition, Pearson Education, New Delhi, 2006.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | outline the features, architecture, applications of database system and use relational algebra operations for writing queries | Applying (K3) |
| CO2 | design an ER model and use SQL statements for retrieving information from relational databases | Applying (K3) |
| CO3 | apply normalization methods for designing relational databases | Applying (K3) |
| CO4 | apply indexing and hashing techniques for effective transaction processing | Applying (K3) |
| CO5 | apply the concepts of concurrency control and recovery in a relational database | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 10 | 20 | 70 | | | | 100 |
| CAT2 | 10 | 20 | 70 | | | | 100 |
| CAT3 | 10 | 30 | 60 | | | | 100 |
| ESE | 10 | 30 | 60 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDC41 - PYTHON PROGRAMMING AND FRAMEWORKS

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 4 | ES | 3 | 0 | 2 | 4 |

| | | |
|---|---|---|
| Preamble | This course provides fundamental knowledge on Python programming and its frameworks. It also explores various packages for data manipulation and analysis. | |
| **Unit - I** | **Basic Concepts:** | **9** |
| Introduction – Variables, Expressions and Statements – Functions – Conditionals and recursion – Fruitful Functions – return values, parameters, local and global scope, function composition, recursion – Iteration Statements – Mutable vs Immutable data types – Strings – String slices – Searching – Looping and Counting – String methods – String Comparison. | | |
| **Unit - II** | **Data Structures:** | **9** |
| Lists – List operations – slices and methods – Dictionaries – Dictionaries as set of Counters – Looping and Dictionaries – Dictionaries and Lists – Tuples – Tuples Basics – Lists and Tuples – Dictionaries and Tuples – Sequences of sequences – Sets – Sets Basics – Set Operations – Case Study – Data Structure Selection – Files – Basic File Operations – File names and paths – Exception Handling. | | |
| **Unit - III** | **Object Oriented Programming & Python Database Integration:** | **9** |
| Classes and Objects – Classes and Functions – Classes and methods – Object-oriented features – __init__() method – __str__() method – Operator Overloading – Type-based dispatch – Polymorphism – Inheritance – Aggregation and Association – Need for database programming – Connect Database – CRUD operations – Cursor Attributes | | |
| **Unit - IV** | **Data Manipulation with NumPy Arrays:** | **9** |
| Python Environment & Frameworks: Anaconda – Jupyter notebook – NumPy: The Basics of NumPy Arrays – Computation on NumPy Arrays – Aggregations – Case Study Using Aggregation and Histogram – Computation on Arrays: Broadcasting – Comparisons, Masks and Boolean Logic – Sorting Arrays – Structured Arrays | | |
| **Unit - V** | **Data Manipulation with Pandas and Visualization:** | **9** |
| Data Manipulation with Pandas: Pandas Objects – Data Indexing and Selection – Operating on data – Handling missing data – Hierarchical Indexing – Concat and Append – Merge and Join – Aggregation and Grouping - Data Visualization with Matplotlib: Line plots: Line Colors and Styles – Axes Limits – Labeling Plots | | |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Implement user-defined functions with different types of argument passing methods |
| 2. | Demonstrate the various string manipulation functions |
| 3. | Demonstrate the various operations on List, Tuple, Dictionary and Sets |
| 4. | Implement the different file operations and exception handling |
| 5. | Implement the concept of constructors and different types of inheritance |
| 6. | Implement the concept of Aggregation, Association and Polymorphism |
| 7. | Develop an application to illustrate CRUD operations using python and MySQL |
| 8. | Develop an application to illustrate Array indexing, slicing, reshaping and sorting using NumPy |
| 9. | Demonstrate Data Manipulation with Pandas |
| 10. | Demonstrate Data Visualization using line plots and histogram in Matplotlib |

**Lecture: 45, Practical:30, Total:75**

**TEXT BOOK:**


| | |
|---|---|
| 1. | Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016 for Units I, II, III. |
| 2. | Jake Vander Plas, “Python Data Science Handbook Essential Tools for Working with Data”, 1st Edition, O’Reilly Publishers, 2016 for Units IV & V. |


**REFERENCES:**


| | |
|---|---|
| 1. | John V Guttag, “Introduction to Computation and Programming Using Python”, Revised and expanded Edition, MIT Press, 2013. |
| 2. | https://www.geeksforgeeks.org/difference-between-association-and-aggregation/ |
| 3. | https://www.i2tutorials.com/crud-operations-with-mysql-database-using-python/ |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | demonstrate the basic concepts, functions and string data structures of Python language | Applying (K3) |
| CO2 | make use of List, Dictionaries, Tuples and Sets data structures for developing appications | Applying (K3) |
| CO3 | implement Object Oriented Programming concepts and CRUD operations using MySQL | Applying (K3) |
| CO4 | perform data manipulation with NumPy Arrays | Applying (K3) |
| CO5 | perform data manipulation with Pandas and data visualization using Matplotlib | Applying (K3) |
| CO6 | write, test and debug simple Python programs using control structures and functions | Applying (K3), Precision(S3) |
| CO7 | develop real time applications using Object Oriented Programming concepts and database programming | Applying (K3), Precision(S3) |
| CO8 | demonstrate data manipulation and data visualization using NumPy, Pandas and Matplotlib | Applying (K3), Precision(S3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO6 | 3 | 2 | 1 | 1 | 1 | | | | | | | | 3 | 1 |
| CO7 | 3 | 2 | 1 | 1 | 1 | | | | | | | | 3 | 1 |
| CO8 | 3 | 2 | 1 | 1 | 1 | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 10 | 70 | 20 | | | | 100 |
| CAT2 | 5 | 15 | 80 | | | | 100 |
| CAT3 | | 20 | 80 | | | | 100 |
| ESE | 10 | 30 | 60 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDT42 - USER EXPERIENCE DESIGN

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Design Thinking | 4 | PC | 3 | 0 | 2 | 4 |

| | | |
|---|---|---|
| **Preamble** | This subject will teach how to create amazing user experiences for products from scratch, user personas and also understand the importance of a good UX design and the role of a UX designer. It deals different stages of designing a UX and the application of various principles of psychology in UX design. Also learn how to conduct user research and market research, which is crucial to creating a great UX. Learners can able to think like a UX designer and understand both sides of product development: design and coding. | |
| **Unit – I** | **UX Design Process:** | **9** |
| What is UX? – UX Design Vs UI Design – Why is UX so Important – Full Stack Design – UX Design Process – Discovery and Planning – The UX Strategy – UX Research: Discover – Explore – Test – Listen – UX Analysis – Design – Production. | | |
| **Unit – II** | **User Research and User Personas** | **9** |
| User Behavior Basics – The Gestalt Theory – Psychology in UX – User Research – Market Research Vs User Research – Benefits of User Research – Getting to Know Your Users – Grouping Customer Information – How to Conduct User Interviews? – User Personas: What are User Personas? – Creating a Persona – Four Different Perspectives on Personas – Benefits of Personas. | | |
| **Unit – III** | **Affinity Diagram, Information Architecture and Visual Design Principles:** | **9** |
| Affinity Diagrams: Affinity Diagram – Work Activity Affinity Diagram – Capture, Grouping and Labeling. Information Architecture: Navigation – Task Flow – Content Strategy – Site Map – Gestures – Basics of Visual Design – Lines – Shapes – Colors – Font/Typography – Textures – Forms – Design Principles – Alignment – Hierarchy – Contrast – Repetition – Proximity – Balance – Space – Visual Design Tools. | | |
| **Unit – IV** | **Wireframes and Prototyping** | **9** |
| What is Wireframe? – How to Create Wireframes? – Types of Wireframes – Wireframing Tools: Sketch Wireframes – Stenciling and Paper cutouts – Wireframing Software – What is Prototyping – Prototyping Methods – Paper Prototypes – Digital Prototypes – Coding Prototypes – The process of Creating Prototypes – Prototyping Tools. | | |
| **Unit – V** | **Post-launch UX Activities:** | **9** |
| Post-launch UX Activities – Collecting the Correct User Feedback: Customer Feedback Surveys – Emails and Contact Forms – Feedback through Social Media – User Accessibility Testing – A/B Testing – Tracking and Recording User UI Sessions – Creating and Analyzing Conversion Funnels. | | |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Perform user research to define the problem for your product or service. |
| 2. | Group customer information data for your product or service. |
| 3. | Conduct an interview with your customer. |
| 4. | Create user personas for your product or service. |
| 5. | Create user scenario/story telling for your product or service. |
| 6. | Create affinity diagram for your product or service by using Sticky Notes, White Board and Figjam. |
| 7. | Create low-fidelity wireframes for your product or service by using Pen and Paper/Stenciling or Paper cutouts. |
| 8. | Create medium-fidelity wireframes for your product or service by using Figma. |
| 9. | Create low-fidelity prototypes (paper prototypes) for your product or service by using pencil and paper. |
| 10. | Create medium-fidelity prototypes (digital prototypes) for your product or service by using Figma. |

**Lecture: 45, Practical:30, Total:75**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Elvis Canziba "Hands-On UX Design for Developers: Design, Prototype, and Implement Compelling User Experiences from Scratch", First Edition, Packet Publishing, 2018 for unit I-V |
| 2. | Rex Hartson, Pardha S. Pyla, "The UX BookProcess and Guidelines for Ensuringa Quality UserExperience", 1st Edition, Morgan Kaufmann Publisher, Elsevier, 2012 for unit II |
| 3. | https://www.netsolutions.com/insights/information-architecture/ for unit III |
| 4. | https://boldist.co/design/gesture-based-interfaces/ for unit III |
| 5. | https://www.usertesting.com/blog/affinity-mapping for unit III |

| **COURSE OUTCOMES:**<br>On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Utilize the UX design process on product or service. | Applying (K3) |
| CO2 | Apply principles and procedures to conduct user research and create user personas. | Applying (K3) |
| CO3 | Construct affinity diagram for the product or service and design information architecture based on various visual design principles. | Applying (K3) |
| CO4 | Create wireframes and prototypes for the product or service by using various tools and software. | Applying (K3) |
| CO5 | Make use of appropriate various post-launch UX activities to get feedback from the users. | Applying (K3) |
| CO6 | Interview with users to carry out the user research and organize the users data of product or service. | Applying (K3), Precision(S3) |
| CO7 | Develop user personas and construct affinity diagrams for the product or service. | Applying (K3), Precision(S3) |
| CO8 | Create wireframes and prototypes for the product or service. | Applying (K3), Precision(S3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 1 | | | | | 3 | 2 | 1 | | 3 | 1 |
| CO2 | 3 | 3 | 3 | 1 | | | | | 3 | 2 | 1 | | 3 | 1 |
| CO3 | 3 | 3 | 3 | 1 | | | | | 3 | 2 | 1 | | 3 | 1 |
| CO4 | 3 | 3 | 3 | 1 | | | | | 3 | 2 | 1 | | 3 | 1 |
| CO5 | 3 | 3 | 3 | 1 | | | | | 3 | 2 | 1 | | 3 | 1 |
| CO6 | 3 | 3 | 3 | 1 | | | | | 3 | 2 | 1 | | 3 | 1 |
| CO7 | 3 | 3 | 3 | 1 | | | | | 3 | 2 | 1 | | 3 | 1 |
| CO8 | 3 | 3 | 3 | 1 | | | | | 3 | 2 | 1 | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 20 | 20 | 60 | - | - | - | 100 |
| CAT2 | 10 | 20 | 70 | - | - | - | 100 |
| CAT3 | 15 | 20 | 65 | - | - | - | 100 |
| ESE | 15 | 20 | 65 | - | - | - | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDT43 - AGILE METHODOLOGIES

| Programme & Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 4 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course introduces software engineering concepts and agile principles at a higher level of abstraction which is to be acquired by software engineers and developers. | |
| | | |
| **Unit - I** | **Process Models, Analysis and Design** | **6** |
| Software process structure – Process models: Waterfall model – Incremental process models – Evolutionary process models - Requirements engineering - Requirements analysis - Scenario Based Modeling – Class-Based Modeling – Flow Oriented Models – Behavioral Models- Design Concepts | | |
| **Unit - II** | **Agile Principles and Scrum** | **6** |
| Understanding the Agile Values – Agile Principles – Agile Project - Scrum and Self-Organizing Teams - Basic pattern for a Scrum Project – Rules of Scrum – Self-Organizing Teams - Scrum Values – Daily Scrum – Sprints, Planning and Retrospectives - Scrum Planning and Collective Commitment - User stories – Conditions of Satisfaction – Story Points and Velocity – Burn down Charts – Planning and Running a Sprint – Generally Accepted Scrum Practices | | |
| **Unit - III** | **XP and Incremental Design, Lean, and Kanban** | **6** |
| Primary Practices of XP – The XP values help the team change their mindset – An effective mindset starts with the XP values – Understanding the XP principles – Feedback Loops- Lean Thinking – Commitment, Options Thinking and Set Based Development – Create Heroes and Magical Thinking – Eliminate Waste – Value Stream Map – Deliver As Fast As Possible – WIP Area Chart – Pull Systems – The Principles of Kanban – Improving Your Process with Kanban – Measure and Manage Flow – Little's Law – Emergent Behavior with Kanban | | |
| **Unit - IV** | **Software Testing Fundamentals** | **6** |
| Software testing strategies: Strategic approach – Issues – Test strategies for conventional and Object Oriented software – Validation and System testing – Debugging – Testing conventional applications: White box testing – Basis path testing – Control structure testing – Black box testing – Software configuration management – SCM repository – SCM process. | | |
| **Unit - V** | **Software Project Management** | **6** |
| Software Project Management Concepts – Process and Project Metrics – Estimation for Software Projects – Project Scheduling – Risk Management – Software Configuration Management – Software Process Improvements (SPI) – The SPI Process – Capability Maturity Model Integration (CMMI) – Other SPI Frameworks. | | |

**Lecture:30, Practical:30, Total:60**

**TEXT BOOK:**


1. Roger S. Pressman & Bruce R. Maxim, "Software Engineering: A Practitioner's Approach", 7th Edition, McGraw-Hill Education , 2019. For Units – I,IV,V
2. Andrew Stellman and Jennifer Greene, "Learning Agile: Understanding Scrum, XP, Lean and Kanban", First Edition, O'Reilly Media Inc, 2015. for units III, IV


**REFERENCES:**


1. Ian Sommerville, "Software Engineering", 10th Edition, Pearson Education, 2014.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | apply the requirement engineering tasks , design concepts and analyze the various software development models for a given scenario | analyzing (K4) |
| CO2 | Outline agile principles and apply Scrum for project development. | Applying (K3) |
| CO3 | model applications using XP, Lean and Kanban practices. | Applying (K3) |
| CO4 | make use of various software testing techniques to test the software systems. | Applying (K3) |
| CO5 | estimate the cost of software, risks of handling, do software planning and configuration management. | Applying (K3) |

**Mapping of Cos with Pos and PSOs**

| Cos/Pos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | | | | | | | | | | 3 | 2 |
| CO2 | 3 | 2 | 1 | | | | | | 2 | 1 | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | 2 | 1 | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 15 | 35 | 30 | 20 | | | 100 |
| CAT2 | 15 | 35 | 50 | | | | 100 |
| CAT3 | 15 | 35 | 50 | | | | 100 |
| ESE | 10 | 40 | 40 | 10 | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDT44 - DESIGN AND ANALYSIS OF ALGORITHMS**

| Programme & Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Data Structures | 4 | PC | 3 | 1 | 0 | 4 |

| | | |
|---|---|---|
| Preamble | This course offers formal introduction to common algorithm design techniques and methods for analyzing the performance of algorithms. | |
| **Unit - I** | **Introduction:** | **9** |
| Notion of an Algorithm - Fundamentals of Algorithmic Problem Solving - Important Problem Types - Fundamentals of the Analysis of Algorithm Efficiency - Analysis Framework - Asymptotic Notations and its properties - Mathematical analysis for Recursive and Non-recursive algorithms - Empirical analysis of algorithm - Algorithm visualization. | | |
| **Unit - II** | **Brute Force:** | **9** |
| Selection and Bubble Sort, Sequential search and String Matching - closest pair and convex hull problem- Divide and Conquer methodology: Merge sort - Quick sort - Binary search - Binary tree traversals and related properties - Multiplication of large integers and Strassen's Matrix Multiplication - closest pair and convex hull problem. | | |
| **Unit - III** | **Decrease and Conquer:** | **9** |
| Insertion sort -Topological Sorting - Fake coin problem - Computing a Median and the Selection Problem - Transform and conquer: Presorting - Balanced search trees - AVL trees -2-3Trees- Heaps and Heap sort. | | |
| **Unit - IV** | **Dynamic Programming:** | **9** |
| Warshall's and Floyd's algorithm - Optimal Binary Search Trees - Knapsack Problem and Memory functions - Greedy Technique: Prim's algorithm - Kruskal's Algorithm - Dijkstra's Algorithm - Huffman Trees. | | |
| **Unit - V** | **Backtracking:** | **9** |
| n-Queens problem - Hamiltonian Circuit Problem - Subset Sum Problem - Branch and Bound: Assignment problem - Knapsack Problem - Traveling Salesman Problem - Overview of P, NP and NP-Complete Problems – Randomized Algorithms. | | |

**Lecture: 45, Tutorial: 15, Total: 60**

**TEXT BOOK:**


1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson Education, 2012.


**REFERENCES:**


1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, Prentice Hall of India, 2009.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Reprint Edition, Pearson Education, 2006.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | analyse the efficiency of algorithms using various frameworks | Analyzing (K4) |
| CO2 | apply brute force and divide-and-conquer techniques to solve various problems and analyze their efficiency. | Analyzing (K4) |
| CO3 | utilize decrease-and-conquer and transform-and-conquer strategies for solving problems | Applying (K3) |
| CO4 | make use of dynamic programming and greedy techniques to solve problems | Applying (K3) |
| CO5 | solve difficult combinatorial problems with backtracking and branch & bound techniques | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | | | | | | | | | | 3 | 2 |
| CO2 | 3 | 3 | 2 | | | | | | | | | | 3 | 2 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 10 | 30 | 40 | 20 | | | 100 |
| CAT2 | 10 | 30 | 50 | 10 | | | 100 |
| CAT3 | 10 | 30 | 60 | | | | 100 |
| ESE | 10 | 20 | 50 | 20 | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDL41 - DATABASE MANAGEMENT SYSTEMS LABORATORY**

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 4 | PC | 0 | 0 | 2 | 1 |
| Preamble | This course helps to develop database applications for real world problems | | | | | | |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Demonstrate Data definition language and integrity constraints. |
| 2. | Demonstrate Data manipulation language, Data control language commands and TCL commands. |
| 3. | Execute nested and sub queries in SQL. |
| 4. | Demonstrate Join operations in SQL. |
| 5. | Create Views and index and perform SQL operations in it. |
| 6. | Demonstrate the concepts of looping using PL/SQL statements. |
| 7. | Implement Cursors and its operations. |
| 8. | Implement Triggers and its operations. |
| 9. | Develop Procedures and Functions to perform operations in SQL. |
| 10. | Mini project: (Application Development using Oracle/ SQL SERVER / MYSQL)<br>Sample Applications:<br>Inventory Control System<br>Hospital Management System<br>Railway Reservation System<br>Web Based User Identification System<br>Hotel Management System<br>Student Information System<br>Library Information System and etc., |

**Total: 30**

**REFERENCES/MANUAL/SOFTWARE:**

| | |
|---|---|
| 1. | Front End: Microsoft Visual Studio 6.0, Microsoft .NET Framework SDK v2.0, Java etc., |
| 2. | Back End : ORACLE / SQL SERVER / MYSQL |
| 3. | Manuals: https://docs.oracle.com/cd/E11882_01/server.112/e41085.pdf |
| 4. | Lab manual |

| **COURSE OUTCOMES:**<br>On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | create and manipulate databases using SQL and PL/SQL | Applying (K3), Precision (S3) |
| CO2 | execute queries using the concepts of embedded query languages | Applying (K3), Precision (S3) |
| CO3 | develop database applications for the real world problems | Applying (K3), Precision (S3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | | | | | 1 | 2 | | 3 | 1 |
| CO2 | 3 | 2 | 1 | 1 | 1 | | | | | 1 | 2 | | 3 | 1 |
| CO3 | 3 | 2 | 1 | 1 | 1 | | | | | 1 | 2 | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

## 20CDL42 - DESIGN TOOLS LABORATORY

| Programme & Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 4 | PC | 0 | 0 | 2 | 1 |
| Preamble | This course provides knowledge to develop logos, icons, shapes, images for an application as micro interactions using design tools. | | | | | | |

**List of Exercises / Experiments:**

| | |
|---|---|
| **Implement the following experiments using Adobe Illustrator:** | |
| 1.a | Creating shapes with various tools like Pen tool, Curvature tool, Line tool, Shape tool, Shape builder tool, Brush tool, Pencil tool |
| 1.b | Draw a modern fox illustration with a shape builder tool |
| 2.a | Demonstrate the Type tool using type on path, applying character and paragraph settings. |
| 2.b | Develop an outlined text of your name and apply a Neon effect. |
| 3.a | Demonstrate a color tool using fill tool, stroke tool, gradient tool |
| 3.b | Implement Steal a color using Adobe color tool from any image that you like and apply the same to your illustration. |
| 4.a | Implement Masking technique by masking an image inside any shape. |
| 4.b | Develop a logo for your brand using illustrator tool |
| 5. | Create a flower vector and export it as a vector image. |
| **Implement the following experiments using Framer:** | |
| 6. | Implement the following actions using action button in Framer tool<br>a. Create three circle-shaped buttons<br>b. Design two states for all layers<br>c. Add an event<br>*d.* Spring animation |
| 7. | Create and implement interactive switches for various switch interactions |
| 8. | Create and implement interactive switches for various switch interactions |
| 9. | Create various animations as micro interaction for button loader |
| 10. | Develop a prototype to implement micro interactions for pull to refresh and dragging interaction |

**Total: 30**

**REFERENCES / MANUALS / SOFTWARES:**

| | |
|---|---|
| 1. | Windows |
| 2. | Adobe illustrator and Framer |
| 3. | Lab manual |

| **COURSE OUTCOMES:**<br>On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | design and develop a concepts using various tools for image and shapes | Applying (K3), Precision(S3) |
| CO2 | choose an appropriate color scheme using adobe color tool | Applying (K3), Precision(S3) |
| CO3 | develop a unique shapes & icons and animate it. | Applying (K3), Precision(S3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 2 | 3 | | | | 2 | | | | 3 | 3 |
| CO2 | 3 | 2 | 2 | 2 | 3 | | | | 2 | | | | 3 | 3 |
| CO3 | 3 | 2 | 2 | 2 | 3 | | | | 2 | | | | 3 | 3 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**20MNT31 - ENVIRONMENTAL SCIENCE**

| Programme & Branch | All BE/BTech Engineering & Technology branches | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 3 / 4 | MC | 2 | 0 | 0 | 0 |

| | | |
|---|---|---|
| Preamble | This course provides an approach to understand the various natural resources, ecosystem, bio-diversity, pollution control & monitoring methods for sustainable life and also to provide knowledge and to create awareness for engineering students on biological sciences. | |
| **Unit - I** | **Environmental Studies and Natural Resources:** | **5** |
| Introduction to Environmental Science – uses, over-exploitation and conservation of forest, water, mineral, food, energy and land resources–case studies | | |
| **Unit - II** | **Ecosystem and Biodiversity:** | **5** |
| Ecosystems: concept and components of an ecosystem -structural and functional features – Functional attributes (Food chain and Food web only). Biodiversity: Introduction – Classification – Bio geographical classification of India- Value of biodiversity – Threats and Conservation of biodiversity - case studies. | | |
| **Unit - III** | **Environmental Pollution:** | **5** |
| Environmental Pollution: Definition – causes, effects and control measures of: (a) Air pollution - Climate change, global warming, acid rain, ozone layer depletion (b)Water pollution (c) Soil pollution - Role of an individual in prevention of pollution - case studies. | | |
| **Unit - IV** | **Environmental Monitoring:** | **5** |
| Sustainability -three pillars of sustainability- factors affecting environmental sustainability-approaches for sustainable development - Introduction to EIA - objectives of EIA - environment protection act – air (prevention and control of pollution) act – water (prevention and control of pollution) act. | | |
| **Unit - V** | **Introduction to Biological Science:** | **5** |
| Functions of Carbohydrates, lipids, proteins and nucleic acids - Cells and its organelles - plasma membrane, mitochondria and nucleus- Heredity and DNA - organization of DNA in cells - Genes and chromosomes- Cell division -Types of cell division- mitosis & meiosis - Cell cycle and molecules that control cell cycle. | | |

**Total: 25**

**TEXT BOOK:**


1. Anubha Kaushik, and Kaushik C.P., "Environmental Science and Engineering", 6th Multicolour Edition, New Age International Pvt. Ltd., New Delhi, 2018.
2. Lodish. H., Berk A., Zipurursky S.L., Matsudaria P., Baltimore D. and Darnell J., "Molecular Cell Biology", 4th Edition, Freeman Press, 2000.


**REFERENCES:**


1. Palanisamy P.N., Manikandan P., Geetha A., Manjula Rani K., Kowshalya V.N., "Environmental Science", Pearson Education, New Delhi, Revised Edition 2019.
2. Satyanarayan U.,& Chakrapani U., "Textbook of Biochemistry",1999 Ed. June 2017.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | illustrate the various natural resources and role of individual for its conservation | Understanding (K2) |
| CO2 | elaborate the features of ecosystem and biodiversity to find the need for conservation. | Understanding (K2) |
| CO3 | manipulate the sources, effects and control methods of various environmental pollution. | Applying (K3) |
| CO4 | make use of the knowledge of EIA and environmental legislation laws towards sustainability | Applying (K3) |
| CO5 | explain the functions of carbohydrates, lipids, proteins, nucleic acids, Cells and its organelles | Understanding (K2) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | | | | | 3 | | | | | | | |
| CO2 | 2 | 1 | | | | | 3 | | | | | | | |
| CO3 | 3 | 2 | 1 | | | | 3 | | | | | | | |
| CO4 | 3 | 2 | 1 | | | | 3 | | | | | | | |
| CO5 | 3 | 1 | | | | | | | | | | | | |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 25 | 40 | 35 | | | | 100 |
| CAT2 | 25 | 40 | 35 | | | | 100 |
| CAT3 | NA | | | | | | 100 |
| ESE | NA | | | | | | 100 |

***±3% may be varied (CAT 1, 2 – 50 marks)**

**20CDT51 - COMPUTER NETWORKS AND IOT**

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 5 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Preamble** | This course is to provide an overview of the basics of data communications and networking. This course also provides the Internet of Things architecture, protocols and application design using Raspberry Pi. The course presents the bottom-up approach of layers and It presents the functionalities and protocols of different layers such as physical layer, data link layer, network layer, transport layer and application layer. | |
| **Unit - I** | **Network Models and Physical Layer:** | **9** |
| Data Communications – Networks – Networks Types – Internet – Standards - TCP/IP Protocol Suite – The OSI Model – Data and Signals – Periodic Analog Signals – Digital Signals: Bit Rate – Bit Length – Data Rate Limits – Performance – Transmission Modes – Transmission Media. | | |
| **Unit – II** | **Data Link Layer and Network Layer:** | **9** |
| Link Layer Addressing – CRC – Checksum Concept – DLC Services – Stop-and-wait – Piggybacking – PPP – RandomAccess Protocols – Standard Ethernet – NetworkLayer Services – Packet Switching – IPv4 Addresses – Forwarding of IP Packets – Internet Protocol (IP). | | |
| **Unit – III** | **Transport Layer and Application Layer:** | **9** |
| Transport Layer Services – Connectionless and Connection Oriented Services – Go-back-N – Selective Repeat – UDP – TCP: TCP Services – TCP Features – TCP Segment – TCP Connection – HTTP – FTP – E-Mail – Telnet – SSH – DNS. | | |
| **Unit - IV** | **Internet of Things Architecture and Protocols:** | **9** |
| Introduction to Internet of Things – Definition and Characteristics of IoT – PhysicalDesign of IoT–IoTProtocols –IoTCommunication Models –IoTCommunication APIs –IoT Enabled Technologies –IoTLevels and Templates. | | |
| **Unit – V** | **IoT Design Methodology:** | **9** |
| M2M - Difference between M2M and IoT – IoT Platform Design Methodologies – Domain Specific IoT: Home automation – Smart Agriculture – IoT Physical Device: Introduction Raspberry Pi – Interfaces – Interfacing External Gadgets Using Raspberry Pi. | | |

**Total:45**

**TEXT BOOK:**


1. Behrouz A. Forouzan, “Data Communications and Networking”, McGraw-Hill, 5th Edition, 2015. For unit I to III)
2. ArshdeepBahga and Vijay Madisetti, “ Internet of Things: A Hands-on Approach, Universities Press, Orient Blackswan Private Limited - New Delhi; First Edition, 2015 for unit IV and V)


**REFERENCES:**


1. Kurose James F. and Ross Keith W., “Computer Networking: A Top-Down Approach”, 6th Edition, Pearson Education, New Delhi, 2017.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Explain the fundamentals of data communication and transmission media. | Applying (K3) |
| CO2 | Make use of the knowledge of error detection methods and protocols at data link layer and different addressing schemes at network layer. | Applying (K3) |
| CO3 | Identify different transport and application layer protocols and their services and develop applications. | Applying (K3) |
| CO4 | Explain the architecture and various protocols of Internet of Things paradigm. | Applying (K3) |
| CO5 | Develop Internet of Things applications using Raspberry Pi device. | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 30 | 45 | 25 | - | - | - | 100 |
| CAT2 | 10 | 45 | 45 | - | - | - | 100 |
| CAT3 | 25 | 45 | 30 | - | - | - | 100 |
| ESE | 20 | 45 | 35 | - | - | - | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDT52 - USER INTERFACE DESIGN

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 5 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course enables the students to learn how to design and prototype user interfaces to address the users and tasks identified in user research. | |
| **Unit - I** | **Basic Design Components** | **9** |
| Material Design: Introduction, Principles. Material Environment: Surfaces. Elevation. Light and Shadows. Basic Components: App bars Bottom and Top, Bottom Navigation, Buttons, Cards, Text Fields, Navigation Drawer.Human Interface Guidelines | | |
| **Unit - II** | **Advanced *Design Components*** | **9** |
| Advanced Components: Backdrop, Checkboxes, Chips, Date Pickers, Dialogs, Dividers, Image List, Lists, Menus, Progress Indicators, Radio Buttons, Sheets – Bottom and Side, Sliders, Snackbars, Switches, Tabs, Tool Tips, Time Pickers.Fluent Design System | | |
| **Unit - III** | **Navigation and Layout** | **9** |
| Getting Around: Navigation, Signposts, and Wayfinding: Signposts- Wayfinding- Navigation Types – Design Considerations – Navigational Models – Patterns. Layout of Screen Elements: Basics of Layout – Patterns. | | |
| **Unit - IV** | **Visual Style and Mobile Interfaces** | **9** |
| Visual Style and Aesthetics: Basics of Visual Design – Visual Design for Enterprise Applications – Range of Visual Styles. Mobile Interfaces: Challenges and Opportunities of Mobile Design – Approach to Mobile Design - Patterns | | |
| **Unit - V** | **Actions and Commands - Forms and Controls** | **9** |
| Actions and Commands:Tap, Swipe, and Pinch -Rotate and Shake -Buttons -Menu Bars - Menus – Toolbars - Links- Action Panels - Hover Tools - Keyboard Actions- Drag-and-Drop -Typed Commands-Affordance-Direct Manipulation. Forms and Controls: Basics of Form Design – Patterns. | | |

**Total: 45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Tidwell, J., Valencia, A., Brewer, C. (2019). Designing Interfaces: Patterns for Effective Interaction Design. Germany: O'Reilly Media. For unit III,IV and V |
| 2. | Material Design, https://material.io/components for unit I,II |
| 3 | Human Interface Guidelines, https://developer.apple.com/design/human-interface-guidelines/ for unit I |
| 4 | Fluent Design System, https://www.microsoft.com/design/fluent/#/ for unit II |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Apply the material design principles and its components used to create a user interface | Applying (K3) |
| CO2 | Make use of the advanced material components used to create a user interface | Applying (K3) |
| CO3 | Utilize the basic principles to design navigation and elements of layout | Applying (K3) |
| CO4 | Integrate the core elements of visual design in UI and discuss what makes a visual design aesthetically pleasing. | Applying (K3) |
| CO5 | Apply the guidelines for designing actions and commands and also for creating effective, usable forms and controls. | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 5 | 20 | 75 | - | - | - | 100 |
| CAT2 | 10 | 20 | 70 | - | - | - | 100 |
| CAT3 | 10 | 20 | 70 | - | - | - | 100 |
| ESE | 10 | 20 | 70 | - | - | - | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDT53 - Virtual Reality and Augmented Reality**

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 5 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course introduces the fundamentals of the Virtual Reality and Augmented Reality to efficiently incorporate user experience, identifying and resolving conflicts in real life. It aims to analyze the application of AR and VR in architecture, gaming, entertainment etc. | |
| **Unit - I** | **Introduction to Virtual Reality** | **9** |
| Introduction to Virtual Reality – Definition, Key Elements of Virtual Reality Experience, History of VR. VR: The Medium: Communicating through a Medium, A Medium's Content, Common Issues of Human Communication Media, Narrative, Form and Genre, Experience Versus Information. | | |
| **Unit - II** | **Virtual Reality Systems** | **9** |
| Interface to the Virtual World-Input: user Monitoring, World Monitoring. Interface to the Virtual World-Output: Visual Displays, Aural Displays, Haptic Displays. Rendering the Virtual World - Rendering systems - Interaction | | |
| **Unit - III** | **Introduction to Augmented Reality** | **9** |
| Augmented Reality - Definition and Scope, History, Examples. Displays - Multimodal Displays, Visual Perception, Requirements and Characteristics, Spatial Display Model, Visual Displays. Tracking - Tracking, Calibration, and Registration, Coordinate Systems, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion. | | |
| **Unit - IV** | **Vision, Interaction, Annotation and collaboration** | **9** |
| Computer Vision – Marker Tracking, Natural Feature tracking, Incremental tracking and Outdoor tracking. Interaction – Tangible interfaces, Virtual User Interfaces on Real Surfaces, Multi-view Interfaces, Haptic Interaction, Annotation, Collaboration – properties, Co-located Collaboration, Remote Collaboration. Case Study: VR in Healthcare and Education. | | |
| **Unit - V** | **Applications of VR and AR** | **9** |
| Applications – Gaming and Entertainment – Architecture and Construction – Science and Engineering – Health and Medicine – Aerospace and Defense – Education – Information and Big data visualization – Telerobotics and Telepresence. | | |

**Lecture:45, Practical:0, Total:45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Sherman William R, Craig Alan B., Understanding Virtual Reality: Interface, Application and Design, First Edition, Morgan Kaufmann Publishers, 2002. for unit I & II |
| 2. | Dieter Schmalstieg, Tobias Hollerer, Augmented Reality. Principles and Practice, Addison-Wesley Publishers, 2016. For unit III & IV) |
| 3. | Steve Aukstakalnis, Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability), 1st edition, Addison-Wesley, 2016. for unit V |

**REFERENCES:**

| | |
|---|---|
| 1. | Jason Jerald, The VR Book: Human Centric Design for Virtual Reality, Association for Computing Machinery and Morgan & Claypool Publishers, 2016. |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Compare the characteristics of virtual reality with other media for human communication and explore how VR is used to convey models of virtual worlds | Understand (K2) |
| CO2 | Explore the many levels at which the user interacts with a virtual world using the medium of virtual reality | Understand (K2) |
| CO3 | Understand the working principle of augmented reality and core technologies underlying augmented reality | Apply(K3) |
| CO4 | Provide detailed coverage of vision, Interaction, Annotation and collaboration concepts in augmented reality | Understand (K2) |
| CO5 | Demonstrate the various applications of Virtual Reality and Augmented Reality. | Understand (K2) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 25 | 65 | 10 | | | | 100 |
| CAT2 | 20 | 65 | 15 | | | | 100 |
| CAT3 | 20 | 65 | 15 | | | | 100 |
| ESE | 20 | 70 | 10 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDL51 - COMPUTER NETWORKS AND IOT LABORATORY**

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| **Prerequisites** | NIL | 5 | PC | 0 | 0 | 2 | 1 |
| **Preamble** | It provides an exposure to implement the various services offered by network layers and to measure the network performance and develop client/server applications using TCP and UDP. This lab also provides some fundamental IOT application developments using Raspberry Pi IOT Device. | | | | | | |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Write a C simple program to calculate various delays such as propagation delay, transmission delay, total delay and end-to-end delay. |
| 2. | Write a C program to implement bit stuffing and byte stuffing. |
| 3. | Write a C program to implement error detection techniques (parity check, checksum and CRC). |
| 4. | Write a C program to find the classes of an IP address. |
| 5. | Write a C program to implement ARP and RARP protocol. |
| 6. | Write a socket program to implement Go-Back-N (GBN) and Selective Repeat (SR) Protocol using TCP. |
| 7. | Write a socket program to implement chat application using UDP. |
| 8. | Write a socket program to implement DNS Protocol using UDP/TCP. |
| 9. | Develop an IOT application to control LED Lights using Raspberry Pi |
| 10. | Develop an IOT application to measure temperature, humidity, Lighting Level of a room using Raspberry Pi. |
| 11. | Develop an Motion detection IOT application using Raspberry Pi. |
| 12. | Develop an Smart Dustbin IOT application using Raspberry Pi. |

**Total: 30**

**REFERENCES / MANUALS / SOFTWARES:**

| | |
|---|---|
| 1. | Linux: C Compiler. |
| 2. | Raspberry Pi Device, Various IoT Sensors. |
| 3. | Python IDE. |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Make use of the performance parameters to measure the network performance andimplement the services offered by various layers of TCP/ IP Model. | Applying (K3), Precision(S3) |
| CO2 | Develop various UDP/TCP client-server applications using socket programming. | Applying (K3), Precision(S3) |
| CO3 | Develop various IoTapplications using Raspberry Pi Device. | Applying (K3), Precision(S3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 1 | 1 | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 2 | 1 | 1 | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 2 | 1 | 1 | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

## 20CDL52 -USER INTERFACE DESIGN LABORATORY

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 5 | PC | 0 | 0 | 2 | 1 |
| Preamble | This course enables the students to design modern mobile apps using fundamental design principles, process, and workflow of UI design using browser-based UI design tool, Figma, within the application. | | | | | | |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Explore Figma Interface in<br>• Various tools in toolbar<br>• Layers, Assets, Pages<br>• Design Panel |
| 2. | Apply design constraints to objects in your workflow |
| 3. | Create Frames and grids and add it in Figma |
| 4. | Apply Auto Layout to either frames or components in Figma |
| 5. | Create and use Figma components in Your Design |
| 6. | Create a style guide for your mobile and web application. |
| 7. | Create a mockup mobile UI screens for any mobile app. |
| 8. | Create a mockup web UI screens for any web application. |
| 9. | Create Prototyping in Figma<br>• Prototype Panel<br>• Inspect Panel |
| 10. | Create a Prototype for your mockup mobile and web application. |
| 11. | Create a micro interaction in Figma |
| 12. | Create a portfolio for your mockup mobile and web project. |

**Total: 30**

**REFERENCES / MANUALS / SOFTWARES:**

| | |
|---|---|
| 1. | Figma Software |
| 2. | Adobe Illustrator |
| 3. | Adobe After Effects |

| **COURSE OUTCOMES:**<br>On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Explore the basics of a modern design tool, Figma and its interface. | Applying (K3), Precision(S3) |
| CO2 | Learn to create and use reusable components | Applying (K3), Precision(S3) |
| CO3 | Create prototypes and portfolio for for your mockup mobile and web project. | Applying (K3), Precision(S3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 2 | 1 | | | | | | | | 3 | 2 |
| CO2 | 3 | 2 | 2 | 2 | 1 | | | | | | | | 3 | 2 |
| CO3 | 3 | 2 | 2 | 2 | 1 | | | | | | | | 3 | 2 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

## 20CDL53 - VIRTUAL REALITY AND AUGMENTED REALITY LABORATORY

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 5 | PC | 0 | 0 | 2 | 1 |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Import VR SDK and make a Test Scene Work with the given Headset |
| 2. | Design UI for VR Space |
| 3. | Create an Interactive VR Experience |
| 4. | Import AR SDK and make a Test Scene Work with Android Device |
| 5. | Design UI for AR space |
| 6. | Create an Interactive AR app |
| 7. | Import MR SDK and make a Test Scene Work with the given Headset |
| 8. | Design UI for MR Space |
| 9. | Create an Interactive MR Experience |
| 10. | Create VR Version of the Game Designed |

**Total:30**

**REFERENCES / MANUALS / SOFTWARES:**

| | |
|---|---|
| 1 | Visual Studio |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | understand how to use multiple AR and VR components with Unity | Applying (K3), Precision(S3) |
| CO2 | Design an user interface for AR and VR space | Applying (K3), Precision(S3) |
| CO3 | Create Virtual and Augmented Reality mobile apps with Unity | Applying (K3), Precision(S3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | 3 | 2 | | | | | | | | | 2 | 2 |
| CO2 | 3 | | 3 | 2 | | | | | | | | | 2 | 2 |
| CO3 | | | 3 | 2 | 1 | 1 | | | | | | 3 | | 3 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**20CDT61 - MACHINE LEARNING**

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Python programming and Frameworks | 6 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course focuses on finding patterns or making predictions from empirical data. The course also exploresthe techniques such as supervised, unsupervised learning algorithms and reinforcement learning. | |
| **Unit - I** | **Introduction** | **9** |
| Learning Problems – Designing a Learning System – Perspectives and Issues in Machine Learning – Concept Learning – task – search – finding maximally specific Hypotheses – version spaces and candidate elimination algorithm – inductive bias. | | |
| **Unit - II** | **Prediction** | **9** |
| Linear Regression – Non Linear Regression – Decision Tree Learning: Decision Tree Representation – Problems – basic decision tree learning algorithms – hypotheses search – Issues – Artificial Neural Networks: Introduction – Representations – Problems – Perceptrons – Multilayer networks and Back Propagation Algorithm – example. | | |
| **Unit - III** | **Supervised Learning** | **9** |
| Bayesian Learning: Bayes Theorem – Concept Learning – Maximum Likelihood and Least-Squared Error Hypothesis – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Example– Support Vector Machine. Instance Based Learning: Introduction – k-Nearest Neighbour Learning – Locally Weighted Regression – Radial Basis Functions – Case-Based Reasoning. | | |
| **Unit - IV** | **Unsupervised Learning and GA** | **9** |
| K – Means – K Medoids – Genetic Algorithms: Introduction – Example – Hypothesis Space Search – Genetic Programming– Models of Evolution and Learning – Parallelizing Genetic Algorithms. | | |
| **Unit - V** | **Learning sets of rules and Reinforcement Learning** | **9** |
| Learning sets of rules: Introduction – sequential covering algorithms – First order rules – FOIL – Induction as Inverted deduction – inverting resolution – Reinforcement Learning: Introduction – Markov Decision Processes – Values – SARSA vs Q-Learning. | | |

**Total:45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Tom M. Mitchell, "Machine Learning", 1st Edition, McGraw-Hill Education, India, 2013. |

**REFERENCES:**

| | |
|---|---|
| 1. | Stephen Marsland, "Machine Learning – An Algorithmic Perspective", 2nd Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014. |
| 2. | Jiawei Han, MichelineKamber, "Data Mining Concepts and Techniques", 3rd Edition, Elsevier, 2012. |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | employ the perspectives of machine learning and formulate hypothesis | Applying (K3) |
| CO2 | apply regression, decision tree and artificial neural networks for real world problems | Applying (K3) |
| CO3 | utilize parametric and non–parametric algorithms for solving a given problem | Applying (K3) |
| CO4 | employ the principles of unsupervised learning and genetic algorithm for optimization | Applying (K3) |
| CO5 | make use of algorithms for learning rules and outline reinforcement learning | Applying (K3) |

| Mapping of COs with POs and PSOs | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| 1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy | | | | | | | | | | | | | | |

| ASSESSMENT PATTERN - THEORY | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | 20 | 30 | 50 | | | | 100 |
| CAT2 | 10 | 30 | 60 | | | | 100 |
| CAT3 | 20 | 30 | 50 | | | | 100 |
| ESE | 20 | 20 | 60 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDT62- GAME DESIGN, PROTOTYPING AND DEVELOPMENT**

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 6 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course helps the students to provide the basic knowledge and practical guide to develop mobile games without prior knowledge or skills that are required to understand its contents. | |
| **Unit - I** | **Introduction** | **9** |
| Realm of Login in Games. Mobile operating systems- Mobile Indie Team- Key roles- game artist – programmer - game tester - Skills of a professional player- game producer- sound designer | | |
| **Unit - II** | **Graphics and Audio** | **9** |
| Graphics: File Formats - Software to Create Game Graphics - Resolution Issues - 2D Graphic Assets-3D Graphic -Assets - Designing A Character For Mobile - Colors –HUD. Audio: Types of game sounds-Audio editing software - Designing audio for mobile games - Best practices. | | |
| **Unit - III** | **Game programming and Controls** | **9** |
| Game programming- Scripting languages-Structure of a game program. Mobile Game Controls – Touchscreens –Keypads-Touchscreen gestures-Input interfaces for mobile games-Built-in devices-Future technologies. Interface Design – Approaches - Designing - Best practices | | |
| **Unit - IV** | **Game Engines** | **9** |
| Mobile Game Engines:Game engines- Prototyping: Prototyping styles - Types of prototyping - Reason- Avoid-Tools. Balancing, Tuning, and Polishing Mobile Games: Tuning-Difficulty settings- Unity Tutorial | | |
| **Unit - V** | **Game Design** | **9** |
| Mobile Game Design: Dos and don'ts of game design- Designing mobile games-Mobile market- Mobile gamers-Business models. Pitching a Mobile Game:Game concept-Game mechanics-Lilypads pitch document-Character design-Game mechanics. | | |

**Total: 45**

**TEXT BOOK:**


| | |
|---|---|
| 1. | Scolastici, C., & Nolte, D. (2013). Mobile game design essentials. Packt Publishing Ltd. (Unit I to V) |
| 2. | Manning, J., & Buttfield-Addison, P. (2017). Mobile Game Development with Unity: Build Once, Deploy Anywhere. " O'Reilly Media, Inc.". |
| 3 | Van Benthem, J. (2014). Logic in games. MIT press. |


| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Describe the most important platforms, software and roles of Indie Team to develop game | Applying (K3) |
| CO2 | Discuss about the 2D and 3D graphics format and creation of audio for mobile games | Applying (K3) |
| CO3 | Focus on the basic structure of game program and its controls along with the UI creation | Applying (K3) |
| CO4 | Techniques used to prototype and achieve a perfectly balanced game | Applying (K3) |
| CO5 | Explain the design process of mobile game and creation of presentation documents. | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

| ASSESSMENT PATTERN - THEORY | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | 20 | 40 | 40 | - | - | - | 100 |
| CAT2 | 10 | 50 | 40 | - | - | - | 100 |
| CAT3 | 15 | 45 | 40 | - | - | - | 100 |
| ESE | 10 | 50 | 40 | - | - | - | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDT63 - Mobile Interactive Design**

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 6 | ES | 3 | 1 | 0 | 4 |

| | | |
|---|---|---|
| Preamble | This course enables the students to provide an introduction and general overview of interaction design for all mobilecomputing platforms, with a particular emphasis on Google's Android and Apple's iOSplatforms. | |
| **Unit - I** | **Introduction** | **9** |
| Field of Interface Design - Dawn of the App-Mobile Device-Industry's Key Players-Interaction Design – Goals-Dynamic Differences in Mobile Design-Understanding the Role of Mobile-Mobile-Possible and not possible Interactions-Universal Appeal. | | |
| **Unit - II** | **Workflow and Design Flow** | **9** |
| First Sketches of an App: Tools - Planning for a Specific Platform - Starting with a Workflow - Creating Pixel-Perfect Digital Mockups. Finding the Right Design Flow: App Types- Native, Web and Hybrid Apps- App Navigation Methods-Picking an Interaction Type-Minimizing Interface Friction- Connectivity Failure. | | |
| **Unit - III** | **Designing and Developing** | **9** |
| Designing for Visual Appeal: Skeuomorphic and Flat Design. Creating an App Icon-Unique Look-Matching Art-Building Art. Working with Programmers: Understanding Your Programmer-Describing Your Design-Communicating During Development-Comprehending the Source Code. | | |
| **Unit - IV** | **Designing for Usability and Simplicity** | **9** |
| Making Apps Usable by All: Sandboxing - Interactions for the Mass Market-Building Multilingual Interaction Designs-Designing for Users with Disabilities. Designing for Simplicity: Sophistication-Simple Design Goals-Interfaces-Creating Simple Interactions-Simplicity through Familiarity-Testing Simplicity. | | |
| **Unit - V** | **Gaining and Refreshing Feedback Design** | **9** |
| Gaining Valuable Feedback: Beta-Test Strategy-Analyzing Valuable Test Data-Beta to Positive Changes. Refreshing a Design: Improving as a Designer -Judging Who Is Worth Listening To-Turning Requests into Changes-Preparing Users for Design Changes-Resubmission Process. | | |

**Total: 45**

**TEXT BOOK:**


1. Banga, C., &Weinhold, J. (2014). *Essential mobile interaction design: Perfecting interface design in mobile apps*. Pearson Education. (Unit I to V)
2. Cooper, A., Reimann, R., Cronin, D., &Noessel, C. (2014). About face: the essentials of interaction design. John Wiley & Sons.
3. Hoober, S., &Berkman, E. (2011). Designing mobile interfaces: Patterns for interaction design. " O'Reilly Media, Inc.".

| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|---|---|---|
| CO1 | Have in-depth understanding of what interaction design is and its importance | Applying (K3) |
| CO2 | Find a general strategic outlay for planning the design of a mobile application | Applying (K3) |
| CO3 | Work with programmers in develop, manipulate and edit code for an application's design | Applying (K3) |
| CO4 | Gain knowledge to design for usability and simplicity of interaction design | Applying (K3) |
| CO5 | Get the valuable feedback and update it to release a new version of your app | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 20 | 45 | 35 | - | - | - | 100 |
| CAT2 | 20 | 30 | 50 | - | - | - | 100 |
| CAT3 | 20 | 30 | 50 | - | - | - | 100 |
| ESE | 10 | 40 | 50 | - | - | - | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDL61 - MACHINE LEARNING LABORATORY

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Python Programming and Frameworks | 6 | PC | 0 | 0 | 2 | 1 |
| Preamble | This course focuses on providing hands-on experience in designing and implementing Machine Learning Algorithms for providing solutions to the real world problems. | | | | | | |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Exploration of UCI repository datasets and tools like WEKA, Rapid Miner, etc., |
| 2. | Perform data manipulation using NumPy and pandas and, data visualization using matplotlib. |
| 3. | Implement linear models to approximate the given data. |
| 4. | Find the attribute with maximum information gain and gain ratio for the given data. |
| 5. | Implement multi-layer perceptron algorithm and enhance it to other variations. |
| 6. | Implement Naive Bayesian classification and predict the class label for the given data. |
| 7. | Implement k-NN algorithm for the specified data. |
| 8. | Implement k-means clustering algorithm for the given data and visualize and interpret the result. |
| 9. | Write a python program to implement Genetic operators. |
| 10. | Write a python program to implement Q-Learning algorithm for the given data. |
| 11. | Build a classification modelusing appropriate dataset in cloud framework. |
| 12. | Build a clustering model using appropriate dataset in cloud framework. |

**Total:30**

**REFERENCES/MANUAL/SOFTWARE:**

| | |
|---|---|
| 1. | Laboratory Manual |
| 2. | Weka / Rapid Miner / Python / cloud framework |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | apply information theoretic approach for computing maximum information gain and gain ratio for the given data | Applying (K3), Precision (S3) |
| CO2 | implement supervised and unsupervised learning algorithms in Machine Learning | Applying (K3), Precision (S3) |
| CO3 | model the solutions for the given problem using Genetic Algorithms and reinforcement learning | Applying (K3), Precision (S3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | 1 | 1 | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | 1 | 1 | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

## 20CDL62- GAME DESIGN, PROTOTYPING AND DEVELOPMENT LABORATORY

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 6 | PC | 0 | 0 | 2 | 1 |
| Preamble | This course enables the students to create games and experiences in both 2D and 3D | | | | | | |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Plan development based on GDD written using Mind Mapping Tools (Mind Manager) |
| 2. | Basics of Unity Game Engine (Set up 3D Scene) |
| 3. | Creating Game Objects and Components |
| 4. | C# Code to Move, Scale and Rotate 3D object |
| 5. | Learning to get Input from Canvas |
| 6. | Learning to use Raycast |
| 7. | Code Core Loop based on Game Design Document |
| 8. | Create HUD and Scoring |
| 9. | Create End Report for the Game |
| 10. | Run Profiler and list the Top 4 Computation Hungry Scripts |

**Practical: 30, Total: 30**

**REFERENCES / MANUALS / SOFTWARES:**

| | |
|---|---|
| 1. | Unity Software |
| 2. | Adobe Illustrator |
| 3. | Adobe After Effects |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Learn about the Unity 3D Game Engine and basic elements of Unity 3D | Applying (K3), Precision(S3) |
| CO2 | Learn how to program in C# and how to use that C# knowledge to program Unity games | Applying (K3), Precision(S3) |
| CO3 | Learn how to create a complete game from start-to-finish | Applying (K3), Precision(S3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 2 | 1 | | | | | | | | 3 | 2 |
| CO2 | 3 | 2 | 2 | 2 | 1 | | | | | | | | 3 | 2 |
| CO3 | 3 | 2 | 2 | 2 | 1 | | | | | | | | 3 | 2 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**20CDL63 - OPEN SOURCE SOFTWARE LABORATORY**

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Computer Organization and Operating System | 6 | PC | 0 | 0 | 2 | 1 |
| Preamble | This course explores to FOSS environment and also the working of various open source packages in open source platform. | | | | | | |

**List of Exercises / Experiments :**

| | |
|---|---|
| 1. | **Kernel configuration, compilation and installation :**Download / access thelatest kernel source code from kernel.org,compile the kernel and install it in thelocal system. |
| 2. | Working with Linux commands for<br>• directory operations, displaying directory structure in tree format.<br>• operations such as redirection, pipes, filters, job control, changing ownership/permissions of files/links/directory. |
| 3. | Working withadvanced Linux commands curl, wget, ftp, ssh, grep and more. |
| 4. | Write shell script to show various system configuration like<br>• Currently logged user and login name<br>• Current shell<br>• Home directory<br>• Operating system type<br>• Current path setting<br>• Current working directory<br>• Number of users currently logged in |
| 5. | Write shell script to show various system configurations such as<br>• OS and version, release number, kernel version<br>• all available shells<br>• computer CPU information like processor type, speed etc<br>• memory information<br>• hard disk information like size of hard-disk, cache memory, model etc<br>• File system (Mounted) |
| 6. | Perform simple text processing using Perl, AWK. |
| 7. | Version Control System setup and usage using GIT. Working with the following features.<br>• Creating a repository<br>• Checking out a repository<br>• Adding content to the repository<br>• Committing the data to a repository<br>• Updating the local copy<br>• Comparing different revisions<br>• Revert<br>• Conflicts and a conflict Resolution |
| 8. | Working with the following remote repository operations in GitHub<br>• Fork and clone<br>• Pull request<br>• Fetch<br>• Rebase<br>• Patches and Hooks |
| 9. | Install Virtualbox/VMware Workstation with different flavors of Linux or Windows OS on top of Windows OS and communicate between virtual OS and Host OS. |
| 10. | Write a procedure to transfer the files from one virtual machine to another virtual machine. |
| 11. | Install a C compiler tools in the virtual machine created using virtual box and execute simple Programs. |
| 12. | Working with SSH, Telnet, Xterm |

**Total:30**

**REFERENCES/MANUAL/SOFTWARE:**

| | |
|---|---|
| 1. | Operating System : Windows and Linux |
| 2. | Software : GIT BASH, ORACLE VIRTUALBOX |
| 3. | Laboratory Manual |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Identify and apply various Linux commands and tools | Applying (K3), Precision (S3) |
| CO2 | Implement different operations in GIT | Applying (K3), Precision (S3) |
| CO3 | Demonstrate the usage of Virtualization | Applying (K3), Precision (S3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 2 | 2 | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | 2 | 2 | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | 2 | 2 | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**20GET71 - ENGINEERING ECONOMICS AND MANAGEMENT**

(Common to All Engineering And Technology Branches except Chemical Engineering)

| Programme & Branch | B.E. & Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 7 | HS | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | The aim of the course is to create fundamental knowledge on management by introducing concepts like economics, national income, marketing, operations management, accounting principles etc. | |
| **Unit - I** | **Micro Economics:** | **9** |
| Economics – Basics Concepts and Principles – Demand and Supply – Law of demand and Supply – Determinants – Market Equilibrium – Circular Flow of Economic activities and Income. | | |
| **Unit - II** | **Macro Economics, Business Ownership and Management concepts:** | **9** |
| National Income and its measurement techniques. Inflation - Causes of Inflation – Controlling Inflation – Business Cycle. Forms of business – Ownership types. Management concepts: Taylor and Fayol's Principles – Functions of Management - Managerial Skills - Levels of Management - Roles of manager. | | |
| **Unit - III** | **Marketing Management:** | **9** |
| Marketing - Core Concepts of Marketing - Four P's of Marketing - New product development – Intellectual Property rights (IPR), Product Life Cycle - Pricing Strategies and Decisions. | | |
| **Unit - IV** | **Operations Management:** | **9** |
| Operations Management - Resources - Types of Production system - Site selection, Plant Layout, Steps in Production Planning and Control - Inventory - EOQ Determination. | | |
| **Unit - V** | **Financial Management:** | **9** |
| Accounting Principles – Financial Statements and its uses – Depreciation: Straight Line and Diminishing Balance Method – Break Even Analysis – Capital Budgeting: Significance –Traditional and discounted cash flow methods. | | |

**Total:45**

**TEXT BOOK:**


1. Compiled by Department of Management Studies, Kongu Engineering College, "Economics and Management for Engineers", 1st Edition, McGraw Hill Education, Noida, 2013.


**REFERENCES:**


1. Geetika, Piyali Ghosh and Purba Roy Choudhury, "Managerial Economics", 3rd Edition, McGraw-Hill, New Delhi, 2018.
2. William J. Stevenson, "Operations Management", 14th Edition, McGraw-Hill Education, 2021.
3. William G. Nickels, James M. McHugh, Susan M. McHugh, "Understanding Business", 12th Edition, McGraw-Hill Education, New York, 2019.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | identify market equilibrium and interpret national income calculations and inflation issues | Applying (K3) |
| CO2 | choose a suitable business ownership for their enterprise and illustrate managerial functions | Applying (K3) |
| CO3 | infer marketing management decisions | Understanding (K2) |
| CO4 | apply appropriate operation management concept in business situations | Applying (K3) |
| CO5 | interpret financial and accounting statements and evaluate new proposals | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | 2 | | | 3 | | 2 | 2 | 2 | 3 | 2 | 1 | 2 |
| CO2 | | 1 | 2 | | | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 |
| CO3 | 1 | 2 | 1 | | | 2 | | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| CO4 | 1 | 2 | 1 | | | 2 | | 2 | 2 | 2 | 3 | 2 | 1 | 2 |
| CO5 | 2 | 2 | | | | 2 | | 2 | 2 | 2 | 3 | 2 | 2 | 2 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 20 | 40 | 40 | | | | 100 |
| CAT2 | 20 | 40 | 40 | | | | 100 |
| CAT3 | 20 | 40 | 40 | | | | 100 |
| ESE | 20 | 40 | 40 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

# 20CDC71 - CLOUD COMPUTING

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Computer Networks and IoT, Computer Organization and Operating System | 7 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides cloud computing evolution and its services, along with design and development. It also focuses on key challenges and issues in cloud computing. | |
| **Unit - I** | **Distributed System Models** | **6** |
| Scalable computing – Network Based Systems – System Models – Software Environment for Distributed and Cloud computing – Performance – Security – Energy Efficiency. | | |
| **Unit - II** | **Virtualization** | **6** |
| Implementation levels of Virtualization – Virtualization Structures – Tools and Mechanisms – CPU, Memory, I/O devices Virtualization – Virtual Clusters and Resource Management – Virtualization for Data-Center Automation. | | |
| **Unit - III** | **Cloud Platform Architecture over Virtualized Data Centers** | **6** |
| Cloud computing Service models – Data-Center Design and Interconnection Networks – Architectural Design of Compute and Storage Clouds – Public Cloud Platforms: Google App Engine – AWS – Azure – Inter-cloud Resource Management – Cloud Security – Trust Management. | | |
| **Unit - IV** | **Cloud Programming and Software Environments** | **6** |
| Cloud and Grid Platforms – Parallel and Distributed Programming Paradigms – Programming Support : Google App Engine – Amazon AWS – Microsoft Azure – Cloud Frameworks: Eucalyptus – Nimbus – OpenNebula – Sector – Sphere – OpenStack – Manjrasoft Aneka Cloud and Appliances. | | |
| **Unit - V** | **Ubiquitous Clouds and the Internet of Things** | **6** |
| Cloud Trends in supporting Ubiquitous Computing – Performance of Distributed Systems and the Cloud – Enabling technologies for the Internet of Things – Innovative Applications of the Internet of Things – Online Social and Professional Networking. | | |

**Total:60**

**TEXT BOOK:**

1. Kai Hwang, Geoffrey C Fox & Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", 1st Edition, (Reprint) Morgan Kauffmann, 2017.

| | **COURSE OUTCOMES:** On completion of the course, the students will be able to | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | explain the concepts, characteristics and benefits of Distributed System Models and apply the same for internet computing | Applying (K3) |
| CO2 | describe the importance of virtualization along with their technologies and apply in virtual resource management | Applying (K3) |
| CO3 | use and examine different cloud computing services | Applying (K3) |
| CO4 | analyze the components of Cloud Programming and Software Environments | Applying (K3) |
| CO5 | develop strategies for Ubiquitous Clouds and the Internet of Things | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO6 | 3 | 2 | 1 | 1 | 1 | | | | | | | | 3 | 2 |
| CO7 | 3 | 2 | 1 | 1 | 1 | | | | | | | | 3 | 2 |
| CO8 | 3 | 2 | 1 | 1 | 1 | | | | | | | | 3 | 2 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 10 | 60 | 30 | | | | 100 |
| CAT2 | 10 | 60 | 30 | | | | 100 |
| CAT3 | 10 | 60 | 30 | | | | 100 |
| ESE | 10 | 50 | 40 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

# 20CDE01 - COMPILER DESIGN

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 5 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides insight into the compiler construction process as well as the design techniques for the given programming language. | |
| **Unit - I** | **Lexical Analysis** | **9** |
| Introduction – Language Processors – The structure of a compiler – Lexical Analysis – The Role of the Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of Tokens – The Lexical-Analyzer Generator – Lex – Finite Automata – From Regular Expressions to Automata. | | |
| **Unit - II** | **Syntax Analysis** | **9** |
| Introduction – Context-Free Grammars – Writing a Grammar – Top-Down Parsing – Bottom-Up parsing – Operator Precedence Parser – Introduction to LR Parsing: Simple LR – More Powerful LR Parsers – Parser Generators. | | |
| **Unit - III** | **Syntax - Directed Translation and Intermediate Code Generation** | **9** |
| Syntax-Directed Translation – Evaluation orders for SDDs – Intermediate Code Generation – Variants of syntax trees – Three Address Code – Types and Declarations – Translation of Expressions – Control Flow – Backpatching – Switch Statements – Procedure calls. | | |
| **Unit - IV** | **Machine Independent Optimizations** | **9** |
| Basic Blocks and Flow Graphs – Optimization of Basic Blocks– Peephole Optimization – The Principal Sources of Optimization – Introduction to Data-Flow Analysis – loops and flow graphs. | | |
| **Unit - V** | **Code Generation and Storage Management** | **9** |
| Issues in the design of a code generation – The target Language – Addresses in the Target code – A simple code Generator – Run-Time Environments: Storage organization – Stack allocation of space – Heap Management – Introduction to garbage collection. | | |

**Total:45**

**TEXT BOOK:**


1. Aho Alfred, Sethi Ravi and Ullman Jeffrey D., “Compilers: Principles, Techniques and Tools”, 2nd Edition, Pearson India Education Pvt. Ltd., 2014.


**REFERENCES:**


1. Srikant Y.N. and Priti Shankar, “The Compiler Design Handbook: Optimizations and Machine Code Generation”, 2nd Edition, CRC Press, 2008.

| | **COURSE OUTCOMES:**<br>On completion of the course, the students will be able to | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | make use of regular expression to perform lexical analysis of the source program | Applying (K3) |
| CO2 | design a syntax-analysis tool for the given grammar | Applying (K3) |
| CO3 | develop intermediate code for the source program | Applying (K3) |
| CO4 | employ optimization techniques for the given intermediate code | Applying (K3) |
| CO5 | identify and use suitable storage allocation technique to generate the target code | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 10 | 30 | 60 | | | | 100 |
| CAT2 | 10 | 20 | 70 | | | | 100 |
| CAT3 | 40 | 40 | 20 | | | | 100 |
| ESE | 20 | 30 | 50 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDE02 - DATA SCIENCE**

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 5 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course introduces data science and essentials of applied statistics, applied probability and computer science required in the context of data science and its applications. | |
| **Unit - I** | **Introduction** | **9** |
| Introduction– Data Science – Data Science Relate to Other Fields - The Relationship between Data Science and Information Science – Computational Thinking – Issues of Ethics, Bias, and Privacy in Data Science – Data Types – Data Collections – Data Pre-processing. Techniques:Data Analysis and Data Analytics – Descriptive Analysis – Diagnostic Analytics – Predictive Analytics Prescriptive Analytics – Exploratory Analysis – Mechanistic Analysis | | |
| **Unit - II** | **Applications, Evaluations, and Methods** | **9** |
| Solving Data Problems:Collecting and Analyzing social media data. Data Collection Methods – Picking Data Collection and Analysis Method: Quantitative Methods – Qualitative Methods – Evaluation: Comparing Models – Cross-Validation. | | |
| **Unit - III** | **Probability** | **9** |
| Probability Concepts – Axioms of Probability – Conditional Probability and Independence – Bayes Theorem –Random Variables – Mean and Variance of a Discrete and Continuous Random Variable – Common Distributions: Binomial - Poisson – Uniform – Normal - Exponential - Gamma -Chi-Square - Weibull– Beta. | | |
| **Unit - IV** | **Statistics** | **9** |
| Role to Statistics -Estimation of Parameter and Sampling Distribution: Point Estimation – Sampling Distributions and the Central Limit Theorem. Statistical Intervals for a Single Sample: Confidence Interval on Mean – variance and Standard Deviation – Population Proportion – Guidelines – Bootstrap – Tolerance and Prediction Intervals. | | |
| **Unit - V** | **Testing** | **9** |
| Hypothesis Testing –Tests on the Mean, Variance and Standard – Tests on a Population Proportion – Summary –Testing for Goodness of Fit – Contingency Table Tests – Nonparametric Procedures – Equivalence Testing – Combining P -Values. A/B testing concepts – T-test and p-value – Measuring t-statistics and p-values | | |

**Lecture:45, Total:45**

**TEXT BOOK:**


| | |
|---|---|
| 1. | Chirag Shah, "A Hands-On Introduction to Data Science", 1st Edition, Cambridge Univ. Press, 2020. for units I, II |
| 2. | Douglas C. Montgomery, George C. Runger, Applied Statistics and Probability for Engineers, 6th Edition, Wiley, 2013. For units III, IV and V |
| 3. | Joel Grus, "Data Science from the Scratch", O'Reilly, 1st Edition, 2015. For unit V |

| | **COURSE OUTCOMES:** On completion of the course, the students will be able to | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | apply pre-processing techniques to clean, and prepare data and visualize | Applying (K3) |
| CO2 | utilize the data analysis techniques for applications handling large data | Applying (K3) |
| CO3 | determine the probability density function of randomvariables | Applying (K3) |
| CO4 | makeuse ofthe statistical foundations and analyze the degree of certainty ofpredictions using statistical test and models | Applying (K3) |
| CO5 | apply the concept of testing of hypothesis of various parameters, goodness of fit tests and nonparametric tests to engineering problems | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 20 | 40 | 40 | | | | 100 |
| CAT2 | 10 | 50 | 40 | | | | 100 |
| CAT3 | 15 | 45 | 40 | | | | 100 |
| ESE | 10 | 50 | 40 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDE03 - ARTIFICIAL INTELLIGENCE**

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 5 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course focuses on search methods, game playing, planning, constraint satisfaction and knowledge representation in artificial intelligence. | |
| **Unit - I** | **Intelligent Agents and Blind search** | **9** |
| Definition – History – Agents and Environments – Good behaviour and the concepts of rationality – Nature of environments – Structure of intelligent agents. State space search: Generate and Test – Simple search – Depth First Search (DFS) – Breadth First Search (BFS) – Comparison of DFS and BFS – Depth Bounded DFS | | |
| **Unit - II** | **Informed Search Methods** | **9** |
| **Informed Search Methods**: Heuristic Search: Heuristic functions – Best First Search – Hill Climbing – Local maxima – Solution state space – Variable neighbourhood descent – Beam search – Taboo search. Peak to Peak Methods. Brute force – Branch and Bound – Refinement search | | |
| **Unit - III** | **A* and Randomized Search Methods** | **9** |
| Algorithm A* - Admissibility of A*– Recursive Best First Search. Escaping local maxima: Iterated hill climbing – Simulated annealing – Genetic algorithms (GA) – Travelling Salesman Problem (TSP) –GA based methods for TSP | | |
| **Unit - IV** | **Game playing,Planning and Constraint Satisfaction** | **9** |
| Board games – Game playing algorithms: Algorithm Minimax– Algorithm AlphaBeta– B* Search –Limitations of search. The STRIPS domain – Forward state space planning – Backward state space planning – Goal stack planning – Plan space planning– Introduction to Constraint satisfaction Problem-N-Queens | | |
| **Unit - V** | **Prepositional Logic, First Order Logic and Inferencing** | **9** |
| Formal logic **–** Propositional logic **–** Resolution in propositional logic – First Order Logic (FOL) – Incompleteness of forward chaining – Resolution refutation in FOL – Horn clauses and SLD resolution – Backward chaining | | |

**Total:45**

**TEXTBOOK:**


1. Khemani D., “A First Course in Artificial Intelligence”, 1st Edition, 9th reprint, McGraw Hill Education (India) Private Limited, 2019.( 2nd half of 1stUnit, for unit II-V
2. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition, Pearson Education, 2013. (First half of 1stUnit)

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1: | paraphrase Artificial Intelligence, intelligent agents, and apply blind search to solve problems. | Applying (K3) |
| CO2: | demonstrate the effectiveness of heuristics in informed search methods. | Applying (K3) |
| CO3: | determineoptimal solutions using A* and randomized search methods. | Applying (K3) |
| CO4: | apply game playing and planning in problem solving. | Applying (K3) |
| CO5: | make use of propositional logic and first order logic in knowledge-based reasoning. | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 20 | 40 | 40 | | | | 100 |
| CAT2 | 20 | 30 | 50 | | | | 100 |
| CAT3 | 20 | 30 | 50 | | | | 100 |
| ESE | 20 | 30 | 50 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDE04 - ADVANCED JAVA PROGRAMMING**

| Programme& Branch | B.E. – Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 5 | PC | 2 | 0 | 2 | 3 |

| | | |
|---|---|---|
| Preamble | This course enables the students to develop, test, and deploy applications ready for production and how to establish them as cloud-based applications using Spring Boot. | |
| **Unit - I** | **Spring Boot** | **9** |
| Introduction – Features - Advantages, Microservices, System Requirements, Setting up the environment, 12-factor app, Spring Initializr, Build Tools – Maven and Gradle, pom.xml and build.gradle, Building application using Maven and Gradle, entry point class, Bootstrap Application Context , Spring Boot Starter Dependencies - Auto-Configuration | | |
| **Unit - II** | **Spring Annotations and Data** | **9** |
| Spring Boot Annotations: Java annotations – Existence of Spring Annotations - Spring and Spring Boot Annotations. Working with Spring Data JPA and Caching: Accessing relational data using JdbcTemplate and Spring Data JPA with the in-memory database and MySQL - Query methods in Spring Data JPA - Caching. | | |
| **Unit - III** | **Learning RESTFul API** | **9** |
| Building RESTFul Microservices: Creating and Consuming RESTFul APIs- Spring Boot Actuators – Custom health check indicators – Exception handling -Service discovery – RestTemplate - Routing a request – Spring Cloud Gateway. Securing a Web Application: Authentication and Authorization concepts – Spring security filters – Enabling and Disabling security – Oauth security – Accessing REST secured APIs –REST services | | |
| **Unit - IV** | **Implementing Resilience4J and Swagger** | **9** |
| Building Resilient System: Client-side load balancing – Circuit breaker – Implementing Resilience4J. Logging: Logging Data – Logback – Spring Cloud Sleuth and Zipkin – ELK. Working with the Swagger API Management Tool: API documentation – Implementing Swagger - Swagger UI – Swagger documentation – Swagger Codegen. | | |
| **Unit - V** | **Testing and Deploying** | **9** |
| Testing a Spring Boot Application: Unit Testing and Integration Testing – JUnit and Mockito framework – Checking code coverage – Testing RESTFul web services – Cucumber automation testing. Deploying a Spring Boot Application – Docker and containerization - Setting up Docker- Heroku CLI and deployment. Case Study. | | |

**List of Exercises / Experiments :**

| | |
|---|---|
| 1. | Build a simple web application with Spring Boot and add some services to it. |
| 2. | Create your own Custom Starter with Spring Boot |
| 3. | Demonstration of starter and libraries for connecting an application with JDBC. |
| 4. | Create REST Service with Spring Boot |
| 5. | Implementation of Form Data Binding and Validation with Spring Boot. |
| 6. | Demonstration of REST API Validation and Globally Error Handling with Spring Boot. |
| 7. | Implementing Reactive Circuit Breaker Using Resilience4j |
| 8. | Build out your API documentation by integrating an OpenAPI specification document into Swagger UI. |
| 9. | Implementation of Unit Testing Rest Services with Spring Boot and JUnit. |
| 10. | Write an Integration Tests for Rest Services with Spring Boot. |

**Lecture:30, Practical:30, Total:60**

**TEXT BOOK:**


| | |
|---|---|
| 1. | Shagun Bakliwal, “Hands-on Application Development using Spring Boot: Building Modern Cloud Native Applications by Learning RESTFul API, Microservices, CRUD Operations, Unit Testing, and Deployment”, BPB Publications, 1st Edition, 2021. |
| 2. | Rajput, D. “Mastering Spring Boot 2.0: Build modern, cloud-native, and distributed systems using Spring Boot”, Packt Publishing Ltd, 2018. |
| 3 | Claudio and Greg, “Developing Java Applications with Spring and Spring Boot”, Packt Publishing Ltd, 2018. |

| | **COURSE OUTCOMES:** On completion of the course, the students will be able to | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Apply the Spring Boot and all its capabilities. | Applying (K3) |
| CO2 | Demonstrate the common annotations of the Spring Data and Spring Data JPA | Applying (K3) |
| CO3 | Build RESTFul Microservices and Secured Web Application | Applying (K3) |
| CO4 | Implement Resilience4J and Swagger API and host the apps on Cloud. | Applying (K3) |
| CO5 | Learn to demonstrate Testing and Deploying a Spring Boot Application | Applying (K3) |
| CO6 | Learn to build, containerize, and run Spring Boot web apps | Applying (K3), Precision (S3) |
| CO7 | Initialize a project using Spring Boot Starters | Applying (K3), Precision (S3) |
| CO8 | Build real-time enterprise-ready apps from development to deployment using Spring Boot. | Applying (K3), Precision (S3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO6 | 3 | 2 | 2 | 1 | | | | | | | | | 2 | 1 |
| CO7 | 3 | 2 | 2 | 1 | | | | | | | | | 2 | 1 |
| CO8 | 3 | 2 | 2 | 1 | | | | | | | | | 2 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 5 | 20 | 75 | - | - | - | 100 |
| CAT2 | 10 | 20 | 70 | - | - | - | 100 |
| CAT3 | 10 | 20 | 70 | - | - | - | 100 |
| ESE | 10 | 20 | 70 | - | - | - | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDE05 - OPTIMIZATION TECHNIQUES

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 5 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides an insight modern optimization techniques used in various domains. It also introduces the meta-heuristic optimization methods as solutions to multi-objective problems. | |
| **Unit - I** | **Optimization Problem** | **9** |
| Statement of an optimization problem: design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of optimization problems classification based on the existence of constraints – nature of the design variables – physical structure of the problem – nature of the equations involved – permissible values of the design variables – deterministic nature of the variables – separability of the functions – number of objective functions – optimization techniques. Classical optimization techniques: single-variable optimization – multivariable optimization – convex programming problem. | | |
| **Unit - II** | **Linear Programming** | **9** |
| Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation of the simplex method – simplex algorithm. Integer linear programming: Graphical Representation – Gomory's cutting plane method. | | |
| **Unit - III** | **Nonlinear Programming** | **9** |
| Constrained optimization techniques– random search methods – complex method – sequential linear programming –transformation techniques – basic approach of the penalty function method – interior penalty function method – convex programming problem –exterior penalty function method – extrapolation techniques in the interior penalty function method – extended interior penalty function methods – penalty function method for problems with mixed equality and inequality constraints – penalty function method for parametric constraints – est problems: welded beam design – speed reducer (gear train) design. | | |
| **Unit - IV** | **Dynamic Programming** | **9** |
| Multistage decision processes – types of multistage decision problems – concept of sub optimization and principle of optimality – computational procedure in dynamic programming – illustrating the calculus method of solution – illustrating the tabular method of solution – conversion of a final value problem into an initial value problem – linear programming as a case of dynamic programming – continuous dynamic programming. | | |
| **Unit - V** | **Modern Methods of Optimization** | **9** |
| Genetic algorithms – simulated annealing – particle swarm optimization –solution of the constrained optimization problem – ant colony optimization – optimization of fuzzy systems neural-network-based optimization – metaheuristic optimization methods –multilevel and multiobjective optimization. | | |

**Total: 45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Singiresu S. Rao, "Engineering Optimization: Theory and Practice", John Wiley and Sons, 5th edition, 2019 |

**REFERENCES:**

| | |
|---|---|
| 1. | H.A. Taha, "Operations Research: An Introduction", 8th Edition, Pearson/Prentice Hall, 2007. |
| 2. | George Bernard Dantzig, MukundNarainThapa, "Linear programming", Springer series in operations research 3rd edition, 2003 |

| | **COURSE OUTCOMES:** On completion of the course, the students will be able to | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | investigate the optimization problem and the classical optimization techniques | Applying (K3) |
| CO2 | apply the linear programming model as a solution to various problems with linear functions | Applying (K3) |
| CO3 | make use of non-linear programming model to solve the constrained optimization problems | Applying (K3) |
| CO4 | develop optimal solutions for multistage decision problems using dynamic programming | Applying (K3) |
| CO5 | apply modern optimization techniques to solve decision problems | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 15 | 35 | 50 | | | | 100 |
| CAT2 | 15 | 35 | 50 | | | | 100 |
| CAT3 | 15 | 35 | 50 | | | | 100 |
| ESE | 10 | 40 | 50 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

# 20CDE06 - INFORMATION SECURITY

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Computer Networks | 5 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course focuses on wide spectrum of topics from legal and ethical issue, risk management, and implementation in the context of information security. | |
| **Unit - I** | **Information Security and The Need for Security** | **9** |
| The history of Information Security – CNSS Security model-Components of an Information System – Security in the system life cycle – Security professionals and the organization – Communities of interest – Information Security: Threat and Attacks – Compromises to intellectual property – Deviations in Quality of Service-Espionage – Force of nature – Human Error – Information Extortion – Sabotage-Software attacks – Technical hardware failures – Technical software failures | | |
| **Unit - II** | **Issues in Information Security and Planning for Security** | **9** |
| Law and ethics in information Security – Relevant U.S. Laws-International laws and legal bodies – Ethics and Information security – Codes of ethics of professional organizations – Key U.S. Federal agencies – Planning for Security: Information security policy, standards, and practices – The Information security blueprint – Security education, training, and awareness program | | |
| **Unit - III** | **Risk Management** | **9** |
| Risk Identification: Planning and organizing the process – Identifying, inventorying and categorizing assets- Classifying and prioritizing threats – Specifying asset vulnerabilities; Risk assessment : Planning and organizing risk assessment- Determining the loss frequency – Calculating risk – Assessing risk acceptability – The FAIR approach to risk assessment – Risk control-Quantitative versus qualitative risk management practices-Recommended risk control practices | | |
| **Unit - IV** | **Security Technology** | **9** |
| Access Control: Access control mechanisms – Biometrics – Access control architecture models – Firewalls: Firewall processing modes – Firewall architecture – Selecting the right firewalls – Configuring and managing firewalls – Content filters – Protecting remote connections – Intrusion detection and prevention systems –Honeypots, Honeynets, and padded cell systems – Scanning and analysis tools. | | |
| **Unit - V** | **Implementing Information Security and Security &Personnel** | **9** |
| Information security project management – Technical aspects of implementation-Nontechnical aspect of implementation-Information security certification and accreditation-Credentials for information security professionals-Employment policies and practices-Security considerations for temporary employees, consultants, and other workers-Internal control strategies – Privacy and the security of personnel data. | | |

**Total:45**

**TEXT BOOK:**


1. Michael E. Whitman and Herbert J. Mattord, “Principles of Information Security”, 6th Edition, Cengage Learning, India, 2018.


**REFERENCES:**


1. Charles P. Pfleeger and Shari Lawrence Pfleeger, “Security in Computing”, 5th Edition, Prentice Hall, 2018.
2. Micki Krause, Harold F. Tipton, “Handbook of Information Security Management”, Vol. 6, 6th Edition, CRC Press, 2012.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1: | explore the basic concepts in information security and determine the type of attacks in a security breach | Applying (K3) |
| CO2: | identify the legal, ethical, professional issues in information security and apply security policies, standards and practices | Applying (K3) |
| CO3: | identify the risks involved in information security and carry out risk assessment | Applying (K3) |
| CO4: | utilize security technologies for protecting information | Applying (K3) |
| CO5: | Make use of various aspects of implementing information security and, paraphrase the issues and concerns related to staffing the information security | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 20 | 60 | 20 | | | | 100 |
| CAT2 | 20 | 60 | 20 | | | | 100 |
| CAT3 | 20 | 60 | 20 | | | | 100 |
| ESE | 20 | 60 | 20 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDE07 - COMPUTER GRAPHICS**

| Programme & Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 7 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Preamble** | This course provides fundamentals of computer graphics algorithms that are used in interactive graphics systems and the techniques related to 2D transformations, Splines, illumination and color models. This course will benefit the students to apply these algorithms and techniques in upcoming real world scenarios. | |
| **Unit - I** | **Introduction to Graphics** | **9** |
| A survey of Computer Graphics – Computer aided design, Presentation Graphics, Computer Art, Entertainment, Education and Training, Visualization, Image Processing, Graphical User Interfaces. Overview of Graphics Systems – Video Display Devices, Raster-Scan Systems, Random-Scan Systems, Graphics Monitors and Workstations, Input Devices, Hard-Copy Devices, Graphics Software. | | |
| **Unit - II** | **Output Primitives** | **9** |
| Output Primitives – Points and Lines, Line Drawing Algorithms, Line functions, Circle Generating Algorithms, Ellipse Generating Algorithms, Polynomials and spline curves, Parallel curve algorithms, Curve function, Filled Area primitives and functions. Attributes – Line, Curve, Color and Grayscale levels, Area-fill, Character and Bundled attributes. | | |
| **Unit - III** | **Two Dimensional Transformations and Viewing** | **9** |
| 2D Transformations – Basic Transformations, Matrix Representations, Composite Transformations, Reflection, Shear. 2D Viewing – Viewing pipeline, Viewing Coordinate reference frame, Window-to-viewport Coordinate Transformation, Clipping Operations – point, Line, Polygon, Curve, Text. | | |
| **Unit - IV** | **Structural and Hierarchical modeling, GUI and Interactive Input Methods** | **9** |
| Structure Concepts, Editing Structures, Basic Modeling Concepts, Hierarchical Modeling. Graphical User interfaces and Interactive Input Methods - The User Dialogue, Input of Graphical Data, Input Functions, Initial Values for Input-Device Parameters, Interactive Picture-Construction Techniques, Virtual-Reality Environments. | | |
| **Unit - V** | **Visible Surface Detection, Illumination and Color Models** | **9** |
| Visible Surface Detection Methods – Illumination Models and Surface Rendering Methods – Light sources, Basic Illumination models, Displaying light intensities, Halftone patterns and Dithering Techniques, Polygon rendering methods, Ray-Tracing methods. Color Models and Color Applications. | | |

**Total:45**

**TEXT BOOK:**


1. Hearn Donald and Baker M. Pauline, —Computer Graphics C Versionǁ, 2nd Edition, Pearson Education, 2010


**REFERENCES:**


1. John F. Hughes, Andries Va nDam, Morgan McGuire, David F. Sklar, James D.Foley, Steven K.Feiner, Kurt A keley, Computer Graphics: Principles and Practiceǁ, 3rdEdition, Addison-Wesley Professional, 2013
2. Peter Shirley, Michael Ashikhmin and Steve Marschner, "Fundamentals of Computer Graphics", 3rd Edition, 2009, ISBN13: 9781568814698

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Outline the fundamental concepts of computer graphics and systems. | Understand (K2) |
| CO2 | Apply the output primitives, attributes and algorithms. | Apply (K3) |
| CO3 | Manipulate 2D objects by applying transformation, clipping, and viewing operations. | Apply (K3) |
| CO4 | Understand Structural and Hierarchical modeling and use various interactive input methods. | Apply (K3) |
| CO5 | Understand various visible surface detection algorithms and color models. | Understand (K2) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 15 | 60 | 25 | | | | 100 |
| CAT2 | 15 | 40 | 45 | | | | 100 |
| CAT3 | 15 | 40 | 45 | | | | 100 |
| ESE | 10 | 40 | 50 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDE08 - INTRODUCTION TO 3D DESIGN**

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 7 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides an introduction to designing for students working in 3D across related disciplines such as graphic objects and fundamentals of 3D object representations, transformations and viewing. This course will benefit the students to apply these algorithms and techniques in upcoming real world scenarios. | |
| **Unit - I** | **Introduction to 3D Design** | **9** |
| Introduction – Form Organization – Design definition – Looking: Attentive observation, comparison, connections – Touch: Tactile sensation – Context: Shaping force, site specific – Learning – Ideas and Approaches: Process – Tools – Transformation – variation and deformation – Conceptual strategies – Problem solving – Sketching, Model making and prototyping. | | |
| **Unit - II** | **Elements of 3D Design & Principles** | **9** |
| Form – Cube – Mass and Space – Line – Plane: 2D Element – Convention of 2D to 3D – Surface Qualities: Texture, Color – Chromatic Luminosity – Time and Motion. 3D Design Principles: Unity and Variety – Repetition: Visual and structural, Modularity – Pattern- Rhythm – Illusion of Motion – Balance - Symmetry and Asymmetry – Harmony – Proximity – Emphasis – Proportion - Scale. | | |
| **Unit - III** | **Structure, Functions, Forming and Fabrication of 3D Design** | **9** |
| Structure: Structural Principles – Structural Economy – Tension and Compression – Joinery – Transformers- Functions: Utility – Design and compared art – Form and Functions – Style: Signature and Typology. Basic forming: Additive, Subtractive, constructive – The Found Object: Readymade – Bridging Art and Life – Hybrid Form – Industrial Methods: The Machine Aesthetic – Replication Technologies. | | |
| **Unit - IV** | **Three Dimensional Concepts and Object Representations** | **9** |
| Three Dimensional Concepts - Three Dimensional Object Representations – Polygon Surfaces - Curved lines and surfaces, Quadric surfaces, Blobby objects, Spline Representations and Interpolation methods, Bezier and B-Spline curves and surfaces, Beta and Rational Splines, Conversion and Display. Sweep Representations - Constructive solid Geometry methods - Fractal Geometry methods. | | |
| **Unit - V** | **Three Dimensional Transformations and Viewing** | **9** |
| Three Dimensional Geometric Transformations – Translation, Rotation, Scaling, Reflection, Shear, Composite Transformations, Transformation functions, Coordinate Transformations. Three Dimensional Viewing – pipeline, coordinates, projections, volumes and projection transformations, Clipping, Viewing Functions. | | |

**Total:45**

**TEXT BOOK:**


1. Stephen Pentak, Richard Roth, “Design Basics 3D”, Cengage Learning, 8th Edition, 2013. For units – I to III
2. Hearn Donald and Baker M. Pauline, —Computer Graphics C Versionll, 2nd Edition, Pearson Education, 2010 for units IV & V


**REFERENCES:**


1. Samit Bhattacharya, "Computer Graphics, 2015. Oxford University Press, ISBN13:978-0-19-809619-1

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Describe the fundamentals of 3D design | Understand (K2) |
| CO2 | Understand the elements and principles of 3D design | Understand (K2) |
| CO3 | Make use of the structures, functions, forming and fabrications of 3D design | Apply (K3) |
| CO4 | Understand various 3D object representations and methods | Understand (K2) |
| CO5 | Manipulate 3D objects by applying transformation, clipping, and viewing operations. | Apply (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 25 | 50 | 25 | | | | 100 |
| CAT2 | 20 | 55 | 25 | | | | 100 |
| CAT3 | 20 | 50 | 30 | | | | 100 |
| ESE | 20 | 40 | 40 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDE09 - ANIMATION BASICS**

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 7 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course helps the students to learn the basics of computer animation programming and computer animators who want to better understand the underlying computational issues of animation software. It also surveys algorithms and programming techniques for specifying and generating motion for graphical objects. | |
| **Unit - I** | **Introduction and Background:** | **9** |
| Introduction: Perception - Heritage of Animation - Animation Production - History of Computer Animation. Background: Spaces and Transformations - Orientation Representation - Fixed Angle Representation, Euler Angle Representation, Angle and Axis, Quaternions, Exponential Map. | | |
| **Unit – II** | **Interpolation-Based Animation** | **9** |
| **Interpolation**: Appropriate Function - Controlling the Motion Along a Curve- Interpolation of orientations- Working with paths- Interpolation-Based Animation: Key-frame systems - Animation languages - Deforming objects - Three-dimensional shape interpolation - Morphing | | |
| **Unit - III** | **Motion Capture Techniques** | **9** |
| Kinematic Linkages: Hierarchical modeling-Forward kinematics-Inverse kinematics. Motion Capture: Motion capture technologies - Processing the images - Camera calibration - Three-dimensional position reconstruction -Fitting to the skeleton - Output from motion capture systems - Manipulating motion capture data. | | |
| **Unit - IV** | **Physically Based Animation** | **9** |
| **Physically Based Animation**: Basic physics -Spring animation examples - Particle systems -Rigid body –simulation – Cloth - Enforcing soft and hard constraints - Fluids: Liquids and Gases - Specific fluid models - Computational fluid dynamics. | | |
| **Unit - V** | **Modeling and Animating Human Figures** | **9** |
| Modeling and Animating Human Figures: Overview of virtual human representation - Reaching and grasping – Walking-Coverings. Facial Animation: The human face - Facial models - Animating the face - Lip-sync animation. Behavioral Animation: Primitive and Modeling intelligent behaviors - Knowledge of the environment - Crowds. | | |

**Total: 45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Rick Parent., "Computer Animation Algorithms and Techniques", 3rd edition, Morgan Kaufmann, 2012. |

**REFERENCES:**

| | |
|---|---|
| 1. | Theoharis, T., Papaioannou, G., Platis, N., & Patrikalakis, N. M. (2008). Graphics and visualization: principles & algorithms. CrC Press. |
| 2. | Parent, R., Ebert, D. S., Gould, D., Gross, M., Kazmier, C., Lumsden, C. J. & Worley, S. (2009). Computer animation complete: all-in-one: learn motion capture, characteristic, point-based, and Maya winning techniques. Morgan Kaufmann. |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Surveys the technical background of computer graphics relevant to computer animation | Applying (K3) |
| CO2 | Cover various computer animation algorithms and techniques | Applying (K3) |
| CO3 | Apply how the images are processed to reconstruct articulated figure kinematics | Applying (K3) |
| CO4 | Understand physics-based animation and modeling of fluids | Applying (K3) |
| CO5 | Cover Human figure animation, facial animation and behavioral animation | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 20 | 40 | 40 | - | - | - | 100 |
| CAT2 | 10 | 50 | 40 | - | - | - | 100 |
| CAT3 | 15 | 45 | 40 | - | - | - | 100 |
| ESE | 10 | 50 | 40 | - | - | - | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDE10 - INFORMATION DESIGN

| Programme & Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 7 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides an insights about information design and how to organize an information, about colour coding. | |
| **Unit - I** | **Inception of Information Design** | **9** |
| Introduction–Definition–History of Information Design–Need of Information Design – Types–Identifying audience – Defining the audience and their needs– Inclusivity –Visual impairment– Case study. | | |
| **Unit - II** | **Organizing Information** | **9** |
| Hierarchy of information – Dynamic composition and gesture – Sequence of information – Organizing information – Using a grid – Setting up the grid – Structure of grid – Hierarchy of grid. | | |
| **Unit - III** | **Legibility and Readability** | **9** |
| Readability: Colour – Tint and Tone – Legibility, readability and contrast – Weight, Size and Scale – Typographic elements – Graphic elements – Imagery – Visibility and contrast – Colour-coding – Choice of typeface, weight and scale – Case study : Illustration and Graphics in information design. | | |
| **Unit - IV** | **Experimentation and Inspiration for the design process** | **9** |
| Importance of experimentation and inspiration – Lateral thinking – Inspiration for design – Editing data for inspiration – Inspiration from world – Visual mapping – case study. | | |
| **Unit - V** | **Design through media** | **9** |
| Choosing appropriate media – compare print and digital – Designing digital platforms – computer data visualization – Inspiration design in practice: Design outcomes – Routes for print-based, interactive and environmental information design – case study. | | |

**Total:45**

**TEXT BOOK:**

1. Andy Ellison, Kathryn Coates, "An Introduction to Information Design", Orion Publishing Co, 2014

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Identify the audience and their requirements about information design | Applying (K3) |
| CO2 | Organize an information in sequence using grid | Applying (K3) |
| CO3 | make use of colour and graphic elements in design | Applying (K3) |
| CO4 | Experiment with lateral thinking and inspiration of design | Applying (K3) |
| CO5 | integrate the concepts of digital design through media | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | 3 | | | | | | | | | | 2 | 3 |
| CO2 | 2 | 1 | 3 | | | | | | | | | | 2 | 3 |
| CO3 | 2 | 1 | 3 | | | | | | | | | | 2 | 3 |
| CO4 | 2 | 1 | 3 | | | | | | | | | | 2 | 3 |
| CO5 | 2 | 1 | 3 | | | | | | | | | | 2 | 3 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 15 | 25 | 60 | | | | 100 |
| CAT2 | 15 | 20 | 65 | | | | 100 |
| CAT3 | 15 | 20 | 65 | | | | 100 |
| ESE | 10 | 20 | 70 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDE11 - CREATIVE THINKING

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 7 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course focuses on learners to enrich creative thinking and use in various applications for making better decisions | |
| **Unit - I** | **Idea of Critical & Creative Thinking** | **9** |
| Critical and Creative Thought Are Inseparable - Thinking That Grasps the Logic of Things - Whenever We Are Reasoning Something Through, We Are Engaged in Creative Thinking - Is Creative Genius an Exception? - The Narrow-minded Genius. | | |
| **Unit - II** | **Creative Thinking Motivation** | **9** |
| The Interplay Among Inborn Gifts, Environment, and Self Motivation - The Questioning Mind in Newton, Darwin, and Einstein - Creativity Need Not Be Mystified - The Elements of Thought - Intellectual Standards - Critical Thinking Applies to the Arts | | |
| **Unit - III** | **Creative Thinking & the Foundations of Meaningfulness** | **9** |
| Figuring Out the Logic of Things - Concepts and Language - Human Thinking - Academic Disciplines – Questioning - Reading, Writing, Speaking, and Listening | | |
| **Unit - IV** | **Creative Thinker** | **9** |
| Be committed to commitment - Be the medium of your medium - Don't be someone else - Be a generator - . Be positive about negatives - Don't think about what others think about - Doubt everything all the time - Feel inadequate - Be practically useless - Be perceptive about perception - Be naturally inspired - Don't be an expert on yourself - Be Stubborn about compromise - Be a weapon of mass creation - Get into what you're into - Challenge the challenging. | | |
| **Unit - V** | **Ways To Creative Think** | **9** |
| Mine your mind - Look forward to disappointment - Think with your feelings - Bring chaos to order - Take what you need - Remake, then remake the remake -Be curious about curiosity - Become anonymous - Achieve the perfect work-life balance - Make what you say unforgettable - Don't experiment, BE an experiment - Stop missing opportunities - Contradict yourself more often - Box your way out of boxes. | | |

**Total:45**

**TEXT BOOK:**


1. Richard Paul and Linda Elder, "The Nature and Functions of Critical & Creative Thinking", Thinker's Guide Library, 2012. for unit I - III
2. Rod Judkins, "The Art Of Creative Thinking", Hachette Book Publishing, 2015. for unit IV -V

| **COURSE OUTCOMES:**<br>On completion of the course, the students will be able to | **BT Mapped (Highest Level)** |
|---|---|
| demonstrate the idea of creative thinking | Applying (K3) |
| motivate the creative thinking | Applying (K3) |
| design the need of creative thinking | Applying (K3) |
| apply to be a creative thinker | Applying (K3) |
| Carryout ways to be a creative thinker | Applying (K3) |

| **Mapping of COs with POs and PSOs** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| 1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy | | | | | | | | | | | | | | |

| **ASSESSMENT PATTERN - THEORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | 15 | 45 | 40 | | | | 100 |
| CAT2 | 15 | 40 | 45 | | | | 100 |
| CAT3 | 15 | 40 | 45 | | | | 100 |
| ESE | 10 | 45 | 45 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDE12 - SPECIAL EFFECTS**

| Programme & Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 7 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | . | |
| **Unit - I** | **Interactive Design – Words, Visuals, Space** | **9** |
| Introduction – Interactive imperative – Fundamentals of Language in IxD – User Conversations - Visual Direction in Interaction Design – Affordances – Size & Distance – Embracing Space. | | |
| **Unit - II** | **Interactive Design – Time, Responsiveness, Behavior** | **9** |
| Introduction – Time - Interaction Design for Decisionmaking - Delightfully Tricking Users With Animation - Designing for User Behavior - Reducing Friction for a Smooth Experience - Designing Delightful Interactions. | | |
| **Unit - III** | **Animation Basics** | **9** |
| Animation: Most common uses of animation: Cartoons, simulations, scientific visualization – analysis – understanding - teaching - The Past: Cave Paintings - Egyptian murals - the magiclanterns - flipbooks - History of animation: Victorian parlor toys, Techniques of animation, otheranimation styles, Analyzing Animated Cartoons and their Evolution: History - Silent era - Feature films - commercial animation | | |
| **Unit - IV** | **Computer Animation** | **9** |
| Editorial cartoons: History and origin, Computer animation: Its history and animation methods - Computer animation in Film and TV, Limited animation - History and techniques – Motioncapture - Advantages and disadvantages - Introduction to Multimedia and Animation -Introduction to Computer graphics and animation | | |
| **Unit - V** | **Evaluation** | **9** |
| Introduction to Motion Picture - Origins of Visual Effects - In-Camera effects – VFX Cues – Tech and Digital Realm – VFX Concepts. | | |

**Total:45**

**TEXT BOOK:**


| | |
|---|---|
| 1. | Interaction Design Best Practices", UXPin. for unit I , II |
| 2. | Interaction Design Best Practices – Mastering Time, Responsiveness and Behavior, UXPin. For unit III, IV |
| 3. | Visual Effects and Compositing, “Jon Gress”, New Riders, 2014. For unit V |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | explain the basic concepts of interactive design in Words, Visuals, Space | Applying (K3) |
| CO2 | explain the basics concepts of Interactive Design in Time, Responsiveness, Behavior | Applying (K3) |
| CO3 | explore basic animation | Applying (K3) |
| CO4 | Illustrate computer animation | Applying (K3) |
| CO5 | Carry out evaluation | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 15 | 35 | 50 | | | | 100 |
| CAT2 | 15 | 35 | 50 | | | | 100 |
| CAT3 | 15 | 35 | 50 | | | | 100 |
| ESE | 10 | 40 | 50 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDE13- USABILITY STUDIES AND EVALUATION

| Programme & Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 7 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | . This course provides the insight of interactive system. The evaluation methods can be explored. | |
| **Unit - I** | **Usability of Interactive Systems and Universal Usability** | **9** |
| Introduction – Usability Goals and Measures – Usability Motivations – Universal Usability: Diverse cognitive and perceptual abilities – Personality differences – Cultural and international diversity – Users with disabilities – Accommodating hardware and software diversity – Goals –Guidelines – Golden rules of Interface design – Principles – Theories. | | |
| **Unit - II** | **Social Interaction and Emotional Interaction** | **9** |
| Introduction – Being Social – Face – to – Face – Remote Conversation – Tele presence – Co-presence - Emotions and the User Experience - Expressive Interfaces - Annoying Interfaces - Detecting Emotions and Emotional Technology - Persuasive Technologies and Behavioral Change - Anthropomorphism and Zoomorphism | | |
| **Unit - III** | **Data Gathering** | **9** |
| Introduction - Five Key Issues - Data Recording – Interviews – Questionnaires – Observation - Choosing and Combining Techniques. | | |
| **Unit - IV** | **Development Processes** | **9** |
| Managing design processes – Organizational Design to Support Usability – Four Pillars of Design – Development Methodologies – Scenario Development – Social Impact Statement for Early Design Review. | | |
| **Unit - V** | **Evaluation** | **9** |
| Evaluating Interface Designs: Expert Reviews – Usability Testing and Laboratories – Elements - Types –Survey Instruments – Acceptance Tests – Evaluation during Active Use – Controlled Psychologically Oriented Experiments - inspections, analytics, and models : Inspections: Heuristic Evaluation and Walkthroughs – Analytics - Predictive Models. | | |

**Total:45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Ben Shneiderman, Catherine Plaisant, Maxine S. Cohen & Steven M. Jacobs, "Designing the User Interface: Strategies for Effective Human-Computer Interaction", 5th Edition, Addison Wesley, 2010. For unit I - IV |
| 2. | Helen Sharpand Yvonne Rogress, "Interaction Design beyond Human Computer Interaction", 4thEdition, John Wiley, 2015 for unit V |

**REFERENCES:**

| | |
|---|---|
| 1. | www.nngroup.com/articles/usability-testing-101/ |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | describe User Interface Design and Usability | Applying (K3) |
| CO2 | demonstrate emotional interaction | Applying (K3) |
| CO3 | apply data gathering techniques | Applying (K3) |
| CO4 | explore design process | Applying (K3) |
| CO5 | explore different evaluation techniques | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 20 | 20 | 60 | | | | 100 |
| CAT2 | 20 | 20 | 60 | | | | 100 |
| CAT3 | 10 | 20 | 70 | | | | 100 |
| ESE | 15 | 25 | 60 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDE14 - RESPONSIVE WEB DESIGN

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 7 | OE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course helps the students to provide the basic knowledge and helps to develop responsive web based design using wireframes and mockups. | |
| **Unit - I** | **Introduction to Responsive Design** | **9** |
| Static mockup – Specialist invasion – Iterative work flow approach – Micro structure vs Modular structure – Enhancement as Design principle – Creating content inventory. | | |
| **Unit - II** | **Wireframe** | **9** |
| Low-fi web based wireframes – Steps to create low-fi web based wireframes – Setting up base mockup – Setting up base style – Adjusting wireframe – Adding navigation – creating variants – Myths about wireframe. | | |
| **Unit - III** | **Text and Linear Design** | **9** |
| Text design: Design with plain text – Marking up plain text – converting plain text to HTML. Linear Design: Developing a design Language – Introducing templates – Projects – Think and Sketch – Type and color. | | |
| **Unit - IV** | **Breakpoints** | **9** |
| Breakpoint Graph: Documentation – Creating breakpoint graph – Major and Minor breakpoints – Designing breakpoints: Sketching – Content in sketch: Text – Navigation – Tables. | | |
| **Unit - V** | **Web-Based Design Mockup** | **9** |
| Hurdles in creating web-based mockups – Static page to Static site generator : Templating – Choosing an SSG – Introducing Dexy – Installing Dexy – Including Style sheets – Adding and Sectioning content – Presenting interactive mockups – Design Guidelines – Creating design documentation. | | |

**Total: 45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Stephen Hay, “Responsive Design Workflow”, 1st Edition, New Riders Publishers, 2013 |

| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|---|---|---|
| CO1 | describe the design principles in responsive design | Applying (K3) |
| CO2 | built low-fidelity web based wireframes | Applying (K3) |
| CO3 | focus on the basic elements to handle text design and linear design | Applying (K3) |
| CO4 | Develop breakpoint graph using sketch and its content | Applying (K3) |
| CO5 | focus on creating web-based design mockups | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | | | | | | | | | | 3 | 3 |
| CO2 | 3 | 2 | 3 | | | | | | | | | | 3 | 3 |
| CO3 | 3 | 2 | 3 | | | | | | | | | | 3 | 3 |
| CO4 | 3 | 2 | 3 | | | | | | | | | | 3 | 3 |
| CO5 | 3 | 2 | 3 | | | | | | | | | | 3 | 3 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 15 | 25 | 60 | | | | 100 |
| CAT2 | 10 | 35 | 55 | | | | 100 |
| CAT3 | 15 | 25 | 60 | | | | 100 |
| ESE | 20 | 25 | 55 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDE15 - VISUAL DESIGN AND COMMUNICATION

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Human Computer Interaction | 7 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides the origins of visual phenomena and principles for the arrangement of form and goal of design is to create supportive conditions for user experience. This course delivers the designer's intent to narrow the range of possible interpretations and to satisfy the user. | |
| **Unit - I** | **Introduction: An Evolving Context for Design** | **9** |
| Designing for experience:Making sense of experience–Experience and Time–Experience and Media–Denotation and Connotation–The vocabulary of visual messages: Elements - Composition– Code –Style. | | |
| **Unit - II** | **Getting attention** | **9** |
| Introduction – Contrast - Figure-Ground – Camouflage – Color - Size constancy – Scale – Proportion – Proximity – Focus – Layering - Symmetry/Asymmetry – Closure – Continuity - Series and Sequences – Pattern - Rhythm and Pacing – Motion. | | |
| **Unit - III** | **Orienting for use and interpretive behavior** | **9** |
| Introduction – Affordances – Channel - Medium and Format – Feedback – Way finding – Mapping – Hierarchy - Reading Pattern – Grouping - Edge Relationships – Direction - Point of View. | | |
| **Unit - IV** | **Interpreting, interacting, and experiencing** | **9** |
| Introduction - Legibility and Readability - Denotation and Connotation – Framing – Abstraction - Icon, Index, and Symbol – Materiality – Substitution – Metaphor - Parallel Form – Appropriation – Ambiguity - Cognitive Dissonance. | | |
| **Unit - V** | **Extending and retaining meaning** | **9** |
| Introduction - Schemas and Stereotypes – Narrative – Archetypes – Mnemonics – Chunking – Redundancy - Graphic Identity - Branding. | | |

**Total:45**

**TEXT BOOK:**


1. Meredith Davis, Jamer Hunt, " Visual Communication Design An Introduction to Design Concepts in Everyday Experience", 1st Edition, Bloomsbury Publishing, 2017.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | apply the concepts of visual elements in design | Applying (K3) |
| CO2 | develop an attributes of design with visual elements | Applying (K3) |
| CO3 | make use of channels, grouping and patterns | Applying (K3) |
| CO4 | build a interpretation, interaction of visual design | Applying (K3) |
| CO5 | integrate the elements to make graphical identity | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | 3 | | | | | | | 2 | | | 2 | 3 |
| CO2 | 2 | | 3 | | | | | | | 2 | | | 2 | 3 |
| CO3 | 2 | | 3 | | | | | | | 2 | | | 2 | 3 |
| CO4 | 2 | | 3 | | | | | | | 2 | | | 2 | 3 |
| CO5 | 2 | | 3 | | | | | | | 2 | | | 2 | 3 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 15 | 25 | 60 | | | | 100 |
| CAT2 | 15 | 20 | 65 | | | | 100 |
| CAT3 | 15 | 20 | 65 | | | | 100 |
| ESE | 10 | 20 | 70 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDE16- ENVIRONMENTAL INFORMATION DESIGN

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 7 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides aa relatively new hybrid of the design field, filled that knowledge gap by putting forth the first formal methodology and which can be defined as the graphic communication of information in the built environment. | |
| **Unit - I** | **Environmental Graphic Design** | **9** |
| Introduction – The Spectrum of Environmental Graphic Design - The importance of Environmental Graphic Design –Digital Information Systems and Environmental Graphic Design - Signage Pyramid's Component Systems - Signage Pyramid and Resource Allocation. | | |
| **Unit - II** | **The Design Process** | **9** |
| The Client Is Part of the Process – The Design Process Applied to Environmental Graphic Design- Data Collection and Analysis – Schematic Design – Design Development – Documentation – Bidding – Fabrication/ Installation Observation – Post-installation Evaluation. | | |
| **Unit - III** | **The Information Content System** | **9** |
| Kinds of Sign Information Content – Hierarchy of Content – Developing the Sign Information Content System - Navigation: Message Hierarchy and Proximity – Other Factors Affecting the Sign Information Content System – Pictorial Information Content – Signage Master Plans. | | |
| **Unit - IV** | **The Graphic System** | **9** |
| Typography Overview - Choosing a Typeface - Typographic Treatment – Typographic Considerations in Signage for People Who Read by Touch – Symbols and Arrows - Diagrams – Other Graphic Elements – Color – Layout - Overview of Sign Graphic Application Processes. | | |
| **Unit - V** | **The Hardware System** | **9** |
| Shape - Connotations of Form – Sign Mounting Considerations – Sign Size Considerations – Basic Sign Materials – Electronic Digital Display Units – Stock Sign Hardware Systems - Sign Materials and Codes - Overview of Sign Coatings and Finishes. | | |

**Total:45**

**TEXT BOOK:**

1. Chris Calori, David Vanden-Eynden, " Signage and Wayfinding Design: A Complete Guide to Creating Environmental Graphic Design Systems", 2nd Edition, Wiley, 2015.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | apply the concepts of Digital Information Systems and Environmental Graphic Design | Applying (K3) |
| CO2 | Analyze the design process and development | Analyzing (K4) |
| CO3 | make use of Factors Affecting the Sign Information Content System | Applying (K3) |
| CO4 | Choose graphic elements of the graphical system | Applying (K3) |
| CO5 | integrate the elements of the hardware system | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | 3 | | 1 | | 3 | | | | | | 2 | 3 |
| CO2 | 3 | | 3 | | 1 | | 3 | | | | | | 2 | 3 |
| CO3 | 3 | | 3 | | 1 | | 3 | | | | | | 2 | 3 |
| CO4 | 3 | | 3 | | 1 | | 3 | | | | | | 2 | 3 |
| CO5 | 3 | | 3 | | 1 | | 3 | | | | | | 2 | 3 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 15 | 25 | 60 | | | | 100 |
| CAT2 | 15 | 20 | 65 | | | | 100 |
| CAT3 | 15 | 20 | 65 | | | | 100 |
| ESE | 10 | 20 | 70 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

# 20CDE17 - MANAGING DESIGN PROCESS

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 7 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides knowledge of the how to manage the design process, concept development and implementing the design. This course will benefit the students to apply these design concepts and techniques in upcoming real world scenarios. | |
| **Unit - I** | **Concept Development – Applied Creativity and Design Centric Research** | **9** |
| Introduction - Managing the design process - Applied Creativity - Big Goals - Design Centric Research – importance of research for design – Research aligns and focuses design – Design Research is about better design thinking –Research tactics – Defining the audience– Defining the medium. | | |
| **Unit - II** | **Concept Development – Strategic Thinking and Informed Risk Taking** | **9** |
| Strategic Thinking – Design and Strategy – Design strategy – Design as a business tool – Developing a Design Strategy – Managing Aesthetic Strategy – Evaluating design strategy – Articulating Design Strategy – Common mistakes in Design Strategy - Informed Risk Taking – Creative Briefs. | | |
| **Unit - III** | **Concept Development – Aesthetic Considerations and Managing Expectations** | **9** |
| Aesthetic in Design – Components – Mapping Aesthetics – Aesthetic Dynamics in Design – Evaluating Aesthetic Choices – Design Critique – Approving Aesthetic Ideas. Managing Expectations - Managing Client Expectations – Best Practices – Communication and Design Management. | | |
| **Unit - IV** | **Implementing Design – Project Management and Setup, Planning , Budgeting** | **9** |
| Introduction – Designer – Client Collaborative process. Project Management – Overview – Design Project Management Cycle – Project management enhances creativity – Traits for success in Project Management. Project Setup – Planning – Budgeting. | | |
| **Unit - V** | **Implementing Design – Assembling the team, Managing Creatives and clients, Profitability** | **9** |
| Assembling the team – Teamwork basics – Creative mix – teamwork responsibilities – Characteristics of successful design teams – Virtual Teamwork – Screening creatives. Managing Creatives – Managing Clients –Profitability – Profitability in Graphic design – Increasing Profitability – importance of ongoing design management. | | |

**Total:45**

**TEXT BOOKS:**


1. Terry Lee Stone, “Managing the Design Process – Concept Development”, An Essential Manual for the working Designer, 1st Edition, Rockport Publications, 2010. For unit – I - III
2. Terry Lee Stone, “Managing the Design Process – Implementing Design”, An Essential Manual for the working Designer, 1st Edition , Rockport Publications, 2010. For unit IV & V


**REFERENCES:**


1. Gavin Tunstall, “Managing the Building Design Process”, 2nd Edition**,** Routledge Publications, 2006.
2. Kathryn Best, “Design Management – Managing Design Strategy, Process and Implementation” 2nd edition, Fairchild Books, 2015.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Understand and make use of creativity and perform design centric research | Apply (K3) |
| CO2 | Apply strategic thinking and understand informed risk taking | Apply (K3) |
| CO3 | Make use of aesthetic considerations and manage the design expectations | Apply (K3) |
| CO4 | Describe project management and setup and apply the concepts of planning and budgeting | Apply (K3) |
| CO5 | Assemble the team and manage the creatives and clients. | Apply (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 1 | | | | | | | | | 2 | 1 |
| CO2 | 3 | 2 | 2 | 1 | | | | | | | | | 2 | 1 |
| CO3 | 3 | 2 | 2 | 1 | | | | | | | | | 2 | 1 |
| CO4 | 3 | 2 | 2 | 1 | | | | | | | | | 2 | 1 |
| CO5 | 3 | 2 | 2 | 1 | | | | | | | | | 2 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 25 | 60 | 15 | | | | 100 |
| CAT2 | 20 | 65 | 15 | | | | 100 |
| CAT3 | 20 | 65 | 15 | | | | 100 |
| ESE | 20 | 70 | 10 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDE18 - MULTIMEDIA TOOLS AND APPLICATIONS

| Programme & Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 7 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Preamble** | This course provides the fundamentals of multimedia and the stages of multimedia projects and heir applications. This course will benefit the students to apply these multimedia techniques in upcoming real world scenarios. | |
| **Unit - I** | **Introduction to Multimedia** | **9** |
| Introduction - Multimedia - Definitions - Where to Use Multimedia - Multimedia in Business, Schools, Home, Public Places - Virtual Reality - Delivering Multimedia - CD-ROM, DVD, Flash Drives - The Broadband Internet. Cover Text - The Power of Meaning - Fonts and Faces - Using Text in Multimedia - Computers and Text - Font Editing and Design Tools - Hypermedia and Hypertext. Images. | | |
| **Unit - II** | **Sound, Animation and Video** | **9** |
| Sound - The Power of Sound - Digital Audio - MIDI Audio - MIDI vs. Digital Audio - Multimedia System Sounds - Audio File Formats - Vaughan's Law of Multimedia Minimums - Adding Sound to Your Multimedia Project. Animation - The Power of Motion - Principles of Animation -Animation by Computer - Making Animations That Work. Video - Using Video - How Video Works and Is Displayed - Digital Video Containers - Obtaining Video Clips - Shooting and Editing Video. | | |
| **Unit - III** | **Making Multimedia** | **9** |
| The Stages of a Multimedia Project - The Intangibles - Multimedia Skills – Hardware – Software – Authoring Systems - The Process of Making Multimedia – Scheduling – Estimating - RFPs and Bid Proposals - Designing – Producing. | | |
| **Unit - IV** | **Internet and Multimedia** | **9** |
| Internet History – internetworking - Multimedia on the Web - Developing for the Web - Text for the Web - Images for the Web - Sound for the Web - Animation for the Web - Video for the Web. Mobile Multimedia - Digital Revolution Worldwide - Mobile Hardware – Connections - Mobile Operating Systems - Case Study: A Simple Stock Control Application. | | |
| **Unit - V** | **Applications** | **9** |
| Multimedia in the real world - Multimedia and the Single user - Multimedia on networks - Training and education - Multimedia for Information and sales - Point-of-information Systems - Point-of-sale Systems - Image processing – Project Management. | | |

**Total:45**

**TEXT BOOK:**


1. Tay Vaughan, Multimedia: Making It Work, 9th Edition, McGraw-Hill Publications,2014
2. Judith Jeffcoate, Multimedia In Practice: Technology And Applications, 1st Edition, CRC Press, 2019
3. Ashok Banerji and Ananda Mohan Ghosh, Multimedia Technologies, 1st Edition, Tata McGraw Hill, 2010

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Understand the fundamentals of multimedia. | Understand (K2) |
| CO2 | Apply the concept of sound, animation and video | Apply (K3) |
| CO3 | Demonstrate the stages and needs of multimedia project and apply for real time projects | Apply (K3) |
| CO4 | Understand how to use multimedia with internet | Understand (K2) |
| CO5 | Demonstrate and identify the areas to use multimedia applications. | Understand (K2) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 15 | 60 | 25 | | | | 100 |
| CAT2 | 15 | 65 | 20 | | | | 100 |
| CAT3 | 15 | 65 | 20 | | | | 100 |
| ESE | 10 | 70 | 20 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

# 20CDE19 - MOTION GRAPHICS

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Design Thinking | 7 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course enables the students to provide a wide understanding of the key concepts and techniques for thorough analysis of motion graphics designed for websites, desktop and mobile touchscreen applications and games. | |
| **Unit - I** | **Introduction to Tools, Image, Space and Time Concepts** | **9** |
| Introduction: Motion Graphics – Difference between Motion Graphics with Animation and Visual Effects . Tools: Camera – Video and still Image Formats – Video Compression- Image Creation and Manipulation. Image: Pixel – Design Elements – Tone – Color – Rasters and Vectors – Text – Design Principles.Space: Aspect Ratio – 2D Motion – 2.5 Dimensions – 3D CGI – Stereoscopic 3D. Time: Frame-Frame-rate – Animation – Tweening – Time Slice – Motion.Case Study. | | |
| **Unit – II** | **Recording, Recreating, Planning and Production** | **9** |
| Compositing – Transparency-Mattes – Keying – Blending Modes – Color Adjustments – Sound. Recording and Recreating Motion: Rotoscoping – Motion Tracking – Match Moving – Motion or Performance Capture. Process – Planning: Message and Audience – Sketchbooks – Collecting Inspiration – Design Process – Production Pipeline. Process – Production- Shooting Video – Media Management – Prototyping. Case Study | | |
| **Unit - III** | **History and Application of Motion Graphics** | **9** |
| History Motion Graphics. Application - Motion Graphics in Film, Motion Graphics in Television, Motion Graphics in Interactive Media: Game Design, Informational Kiosks, Mobile Touchscreens, Desktop Applications, DVD-Video Menus- Motion Graphics in Public Spaces: Interior Spaces – Exhibit Design – Performance – Exterior Spaces. | | |
| **Unit - IV** | **Typography and Conceptualization** | **9** |
| Motion Literacy: Language of Motion – Primary and Secondary Motion. Kinetic Images and Typography – Properties and Style. Pictorial Composition: Principles – Grid Systems – Breaking Spatial Conventions. Sequential Composition: Forms of Continuity and Discontinuity- Montage. Conceptualization: Assessment – Formulation – Cultivation – Storyboards – Animatics. Animation Processes. | | |
| **Unit - V** | **Compositing and Sequencing** | **9** |
| Motion Graphics Compositing: Blend Operations – Keying – Alpha Channels – Mattes – Spline Mask – Nesting – Color Correction. Motion Graphics Sequencing: Cut and Transition – Mobile Framing – Establishing Pace and Rhythm –Birth , Life and Death. | | |

**Total: 45**

**TEXT BOOK:**


1. Crook, Ian, and Peter Beare. Motion graphics: Principles and practices from the ground up. Bloomsbury Publishing, 2017. For unit I and II)
2. Krasner, Jon. Motion graphic design: applied history and aesthetics. Routledge, 2013. For unit III, IV and V

| | **COURSE OUTCOMES:** On completion of the course, the students will be able to | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Explain the core principles, concepts and terminology of motion graphics. | Applying (K3) |
| CO2 | Plan and develop creative motion graphics through interactive exercises. | Applying (K3) |
| CO3 | Illustrate the application of Motion Graphics in Film Television, Interactive Media and Public Spaces | Applying (K3) |
| CO4 | Explore the concept of Typography and Conceptualization in Motion Graphics | Applying (K3) |
| CO5 | Demonstrate various compositing and Sequencing techniques to create animated visual effects in Motion graphics | Applying (K3) |

**Mapping of COs with POs and PSOs**

| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
|---|---|---|---|---|---|---|---|
| CAT1 | 25 | 33 | 42 | - | - | - | 100 |
| CAT2 | 25 | 33 | 42 | - | - | - | 100 |
| CAT3 | 25 | 33 | 42 | - | - | - | 100 |
| ESE | 22 | 39 | 39 | - | - | - | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

# 20CDE20 - INTERACTIVE VISUAL DATA ANALYSIS FOR DESIGNER

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Design Thinking | 7 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course enables the students to apply essential strategies to create more effective data visualizations for nonprogrammers. | |
| **Unit - I** | **Principles Of Data Visualization** | **9** |
| Visual Processing and Perceptual Rankings: Anscombe's Quartet - Gestalt Principles Of Visual Perception - Preattentive Processing. Five Guidelines for Better Data Visualizations- Show the Data - Reduce the Clutter - Integrate the Graphics and Text - Avoid the Spaghetti Chart - Start with Gray - Form And Function. | | |
| **Unit – II** | **Basic Chart Types** | **9** |
| Comparing Categories: Charts: Bar, Marimekko and Mosaic, Unit, Isotype, and Waffle, Gauge and Bullet, Waterfall - Paired Bar - Stacked Bar- Diverging Bar - Sankey Diagram -Time: Chart - Line ,Circular Line ,Slope, Bump, Cycle, Area,Stacked Area, Horizon, Gantt – Sparklines -Streamgraph - Flow Charts and Timelines - Connected Scatterplot. Distribution: Histogram - Chart: Pyramid, Candlestick, Violin - Plot: Box-and-Whisker, Ridgeline, Stem-and-Leaf. | | |
| **Unit - III** | **Advanced Chart Types** | **9** |
| Geospatial: Choropleth Map – Cartogram - Proportional Symbol and Dot Density Maps - Flow Map – Relationship: Scatterplot- Parallel Coordinates Plot - Radar Charts - Chord Diagram - Arc Chart -Correlation Matrix-Network Diagrams -Tree Diagrams - Part-To-Whole: Pie Charts – Treemap -Sunburst Diagram - Nightingale Chart -Voronoi Diagram – Qualitative: Icons - Word - Quotes - Phrases - Matrices and Lists - Tables: Guidelines – Demonstration. | | |
| **Unit - IV** | **Designing and Redesigning Your Visual** | **9** |
| Developing: Anatomy - Color Palettes - Defining Fonts - Guidance - Exporting Images - Accessibility, Diversity, and Inclusion. Redesigns: Paired Bar Chart,Stacked Bar Chart, Line Chart, Choropleth Map, Dot Plot, Line Chart, Table- Data Visualization Tools. | | |
| **Unit - V** | **D3 Basics** | **9** |
| Introduction: Origins and Context – Alternatives – Setup – Data: Generating Page Elements - Binding Data - Drawing with Data: Drawing divs and SVGs - Making a Bar Chart and Scatterplot - Scales – Axes- Updates, Transitions, and Motion – Interactivity – Paths : Line and Area Charts– Selections – Layouts: Pie, Stack and Force Layout. | | |

**Lecture:45, Tutorial :-, Total: 45**

**TEXT BOOK:**


1. Schwabish, Jonathan. Better data visualizations: A guide for scholars, researchers, and Wonks. Columbia University Press, 2021. For unit I to IV
2. Murray, Scott. Interactive data visualization for the web: an introduction to designing with D3. " O'Reilly Media, Inc.", 2017. For unit V

| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|---|---|---|
| CO1 | Explain the princples of visual perception and data visualization best practices | Applying (K3) |
| CO2 | Explore the basic chart types used for Comparing Categories, Time and Distribution. | Applying (K3) |
| CO3 | Illustrate the chart types for Geospatial, Relationship, Part-To-Whole, Qualitative and Tables. | Applying (K3) |
| CO4 | Apply the steps involved in designing and redesigning of Data Visualization | Applying (K3) |
| CO5 | Demonstrate how to perform data Visualization using D3 tool | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 25 | 40 | 35 | - | - | - | 100 |
| CAT2 | 25 | 40 | 35 | - | - | - | 100 |
| CAT3 | 25 | 40 | 35 | - | - | - | 100 |
| ESE | 20 | 40 | 40 | - | - | - | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

# 20CDE21 - DESIGNING HUMAN CENTERED SYSTEMS

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 7 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Preamble** | The objective of this course is to understand the principles of effective design and the Human Centered Design (HCD) process for product development. this course will focus on is: how can we design human-centered systems that people find useful and usable? This course is an introduction to designing, prototyping, and evaluating user interfaces. | |
| **Unit - I** | **Psychopathology and Psychology of Everyday Things and Actions** | **9** |
| The Complexity of Modern Devices - Human-Centered Design - Fundamental Principles of Interaction - The System Image - The Paradox of Technology – The Design Challenge – How People Do Things: The Gulfs of Execution and Evaluation - The Seven Stages of Action - Human Thought: Mostly Subconscious - Human Cognition and Emotion - The Seven Stages of Action and the Three Levels of Processing - People as Storytellers - Blaming the Wrong Things - Falsely Blaming Yourself - The Seven Stages of Action: Seven Fundamental Design Principles. | | |
| **Unit – II** | **Knowledge in the Head and in the World** | **9** |
| Precise Behavior from Imprecise Knowledge - Memory Is Knowledge in the Head - The Structure of Memory - Approximate Models: Memory in the Real World - Knowledge in the Head - The Tradeoff Between Knowledge in the World and in the Head - Memory in Multiple Heads, Multiple Devices - Natural Mapping - Culture and Design: Natural Mappings Can Vary with Culture. | | |
| **Unit – III** | **Constraints, Discoverability, and Feedback** | **9** |
| Four Kinds of Constraints: Physical, Cultural, Semantic, and Logical – Applying Affordances, Signifiers, and Constraints to Everyday Objects - Constraints That Force the Desired Behavior - Conventions, Constraints, and Affordances - The Faucet: A Case History of Design – Using Sound as Signifiers | | |
| **Unit - IV** | **Classification of Errors, Slips and Mistakes** | **9** |
| Understanding Why There Is Error – Deliberate Violations - Two Types of Errors: Slips and Mistakes – The Classification of Slips – The Classification of Mistakes – Social and Institutional Pressures - Reporting Error – Detecting Error – Designing for Error – When Good Design Isn't Enough - Resilience Engineering – The Paradox of Automation – Design Principles for Dealing with Error | | |
| **Unit – V** | **Views of Human Centered Design** | **9** |
| Solving the Correct Problem - The Double-Diamond Model of Design - The Human-Centered Design Process – What I Just Told You? It Doesn't Really Work That Way – The Design Challenge - Complexity Is Good; It Is Confusion That Is Bad – Standardization and Technology - Deliberately Making Things Difficult - Design: Developing Technology for People - Competitive Forces - New Technologies Force Change - How Long Does It Take to Introduce a New Product? - Two Forms of Innovation: Incremental and Radical - The Design of Everyday Things - The Future of Books - The Moral Obligations of Design | | |

**Total:45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Don Norman, "The Design of Everyday Things: Revised and Expanded Edition", 2nd Edition, Basic Books Publication, ISBN: 978-0465050659, 2013. (UNIT 1 to 5) |

**REFERENCES:**

| | |
|---|---|
| 1. | Bill Buxton, "Sketching User Experiences: Getting the Design Right and the Right Design", Illustrated Edition, Morgan Kaufmann Publication, ISBN: 978-0123740373, 2007. |
| 2. | Jon Yablonski, "Laws of UX: Using Psychology to Design Better Products & Services", 1st Edition, Shroff/O'Reilly Publication, ISBN: 978-9352139989, 2020. |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Understand the psychological matters of everyday things and actions in addition to that emotional design. | Applying (K3) |
| CO2 | Explain the design knowledge in developing products and also understand the natural mappings and culture views.. | Applying (K3) |
| CO3 | Illustrate how change can be extremely disconcerting, even to professionals, even if the change is for the better. | Applying (K3) |
| CO4 | Make use of the approaches deal with design to eliminate or minimize the human errors. | Applying (K3) |
| CO5 | Summarize the general design guidelines based on the views on human centered design. | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | 1 | | | 3 | 2 | | 1 | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | 1 | | | 3 | 2 | | 1 | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | 1 | | | 3 | 2 | | 1 | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | 1 | | | 3 | 2 | | 1 | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | 1 | | | 3 | 2 | | 1 | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 25 | 20 | 55 | | | | 100 |
| CAT2 | 25 | 25 | 50 | | | | 100 |
| CAT3 | 25 | 30 | 45 | | | | 100 |
| ESE | 25 | 25 | 50 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

# 20CDE22 - DESIGN OF INTERACTIVE SYSTEMS

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 7 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Preamble** | The objective of this course is to learn all the aspects of design and development of interactive systems, which are now an important part of our lives. The design and usability of these systems leave an effect on the quality of people's relationship to technology. Web applications, social media applications, multimedia applications, embedded devices, etc., are all a part of this system, which has become an integral part of our lives. By the end of the course, the students will be familiar with the goals, problems and structure of interactive system design process. Moreover, the students will be exposed to the core techniques for task analysis and user analysis. Furthermore, students will be able to understand the innovative features of interactive system and be able to improve existing interfaces by considering these features. | |
| **Unit - I** | **Essentials of Designing Interactive Systems** | **9** |
| **Designing Interactive Systems:** A Fusion of Skills – **PACT:** A Framework for Designing Interactive Systems – The Process of Human-Centred Interactive Systems Design – Usability – Experience Design – **The Home Information Centre (HIC):** A Case Study in Designing Interactive Systems. | | |
| **Unit – II** | **Techniques for Designing Interactive Systems** | **9** |
| **Techniques:** Understanding – Envisionment – Design – Evaluation – Task Analysis – **Visual Interface Design:** GUI – Interface Design Guidelines – Psychological Principles and Interface Design Information Design – Visualization – **Multimodal Interface Design:** Interacting in Mixed Reality – Using Sound at the Interface – Tangible Interaction – Gestural Interaction and Surface Computing. | | |
| **Unit – III** | **Contexts for Designing Interactive Systems – I** | **9** |
| **Designing Websites**: Website Development – The Information Architecture of Websites – Navigation Design for Websites - **Social Media**: Background ideas – Social Networking – Sharing with Others – The Developing Web – **Collaborative Environments:** Issues for Cooperative Working – Technologies to Support Cooperative Working – Collaborative Virtual Environments – **Agents and Avatars:** Agents – Adaptive Systems – An Architecture for Agents – Applications of Agent-Based Interaction – Avatars and Conversational Agents. | | |
| **Unit - IV** | **Contexts for Designing Interactive Systems – II** | **9** |
| **Ubiquitous Computing** - Information Spaces – Blended Spaces - Home Environments - Navigating in Wireless Sensor Networks – **Mobile Computing**: Context Awareness – Understanding in Mobile Computing – Designing for Mobiles - Evaluation for Mobile Computing – **Wearable Computing:** Smart Materials – Material Design - From Materials to Implants. | | |
| **Unit – V** | **Foundations of Designing Interactive Systems** | **9** |
| **Memory and Attention:** Memory – Attention – Human Error – Affect – Cognition and Action – **Social Interaction**: Human Communication – People in Groups – Presence – Culture and Identity – Visual Perception – Non-visual Perception - Navigation. | | |

**Total:45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | David Benyon, "Designing Interactive Systems: A comprehensive guide to HCI, UX and interaction design", 3rd Edition, Pearson Publication, ISBN: 978-1447920113, 2013. (UNIT 1 to 5) |

**REFERENCES**:

| | |
|---|---|
| 1. | Jef Raskin, "The Humane Interface: New Directions for Designing Interactive Systems",Addison Wesley Publication, ISBN: 978-0201379372, 2000. |
| 2. | Michael G. Lamming, William M. Newman, "Interactive System Design", 1st Edition, Addison Wesley Publication, ISBN: 978-0201631623, 1995. |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Explain the issues of designing interactive systems and apply the guidelines on different systems. | Applying (K3) |
| CO2 | Understand the requirements of interactive systems, probing people for ideas, getting people to participate in the design process, card sorting to develop information architectures and investigating similar systems for ideas. | Applying (K3) |
| CO3 | Explain interaction and experience design in the different contexts like website design, social media, agents and avatars. | Applying (K3) |
| CO4 | Illustrate interaction and experience design on mobile, ubiquitous and wearable computing. | Applying (K3) |
| CO5 | Summarize the psychological foundations of HCI, ID and UX. | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 25 | 20 | 55 | | | | 100 |
| CAT2 | 20 | 30 | 50 | | | | 100 |
| CAT3 | 20 | 25 | 55 | | | | 100 |
| ESE | 20 | 25 | 55 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDE23 - MOBILE APPLICATION DESIGN SYSTEM

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 7 | OE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course helps the students to provide the basic knowledge and practical guide to design better mobile application with the help of elements of design system. | |
| **Unit - I** | **Mobile App** | **9** |
| Introduction – App vs Mobile Website – App Design and Development process – Types of Application – App categories– Resources– Design Constraints – user research | | |
| **Unit - II** | **Interaction and Patterns** | **9** |
| Principles of User Experience – Interaction and ways of handling mobile device – Incidence in device orientation- Patterns of interaction: Navigation – Tabs- Lists-Image Gallery- Drawer Menu. | | |
| **Unit - III** | **Actions and Gestures** | **9** |
| Actions: Action bar – Action overflow – Shortcuts – Sharing – Search – List editing – Dialogue box – In-App notifications – Data Input – Gestures: Tap – Drag – Slide – Long press – Double tap – Pinch and Spread – Rotate. | | |
| **Unit - IV** | **Visual Design** | **9** |
| Interface styles – Native and Custom interfaces – Visual identity – icons – Grid – Typography – Color – Text – Interactive elements- Language – Visual details – Animating the App | | |
| **Unit - V** | **Testing and Launching the App** | **9** |
| Testing: Usability test – Mobile Testing – Technology differences – Preparing design files – Image Slicing – Communication – Launching the App: Publishing the App – Promotional image and elements – After Launch: User comments – User Analytics – Promotion. | | |

**Total: 45**

**TEXT BOOK:**

1. Javier Cuello & Jose Vittone, “Designing Mobile Apps”, 1st Edition, CreateSpace Independent Publishing Platform, 2013

| | **COURSE OUTCOMES:**<br>On completion of the course, the students will be able to | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | describe the most important mobile applications | Applying (K3) |
| CO2 | built user interface design for mobile apps | Applying (K3) |
| CO3 | focus on the basic elements to handle actions and gestures | Applying (K3) |
| CO4 | Develop and design interactive elements for better visual design | Applying (K3) |
| CO5 | focus on testing the applications and to launch. | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | | | | | | | | | | 3 | 2 |
| CO2 | 3 | 2 | 3 | | | | | | | | | | 3 | 2 |
| CO3 | 3 | 2 | 3 | | | | | | | | | | 3 | 2 |
| CO4 | 3 | 2 | 3 | | | | | | | | | | 3 | 2 |
| CO5 | 3 | 2 | 3 | | | | | | | | | | 3 | 2 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 15 | 25 | 60 | | | | 100 |
| CAT2 | 10 | 35 | 55 | | | | 100 |
| CAT3 | 15 | 25 | 60 | | | | 100 |
| ESE | 20 | 25 | 55 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDE24 - AESTHETICS OF VIDEO EDITING

| Programme & Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 7 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | . This course aims to deal with aesthetics in video editing which is the major part of designing. | |
| **Unit - I** | **Introduction** | **9** |
| Bird's-eye view of the modern editing process and modern editing terminology Principles of Video Editing: Various principles of Editing like Contrast, Parallelism, Symbolism, Simultaneity Continuity, Making an edit invisible, Motivation for every edit, Delivering a message, Bearing audio in mind, editingis creating, Control of Overuse technique or Visual effects. | | |
| **Unit - II** | **Editing Basics** | **9** |
| Editing setup:-efficient editing habit, factory standard systems to support the editing process Non -Linear Editing (NLE) Concept. The Three -PointEdit: Understanding Three-Point Editing, Overview of the Three-Point Editing Process, Different Ways toDo Three-Point Editing. Working in the Timeline / Transitions / Key framing / Applying Filters / NLECompositing / Color Correction & Color Grading / Titling / Final Review &Project. | | |
| **Unit - III** | **Animation Edit** | **9** |
| Stabilizing a Shot , Controlling shakey video, Cropping the borders efficiently, Analysing and Tracking aPoint in the footage, The Tracker Panel & Motion Tracker Options, Corner Pin Tracking, Exporting Track data, Introduction to Masks, Animating Masks, Working with Mask Interpolation, Basics of Rotoscopy,Analysing the shot for Rotoscopy, Using Masks for Position Key frames, Creating a Simple RotoscopicAnimation. | | |
| **Unit - IV** | **Animation Tuning** | **9** |
| Introduction to Particle Playground, Filters, Plugins, Understanding the Gravity, Mass, Vortex,Turbalance, Color, Fields etc. Animating the Emitter, Key frame animation, Path Animation, Basicexpressions, BASIC COMPOSITING, Applying Layer Blending Modes, Creating a Track Matte, Keying& Key light, Compound Effects: Gradient Wipe Displacement Map, Wave World & Caustics,Precomposing & Nesting | | |
| **Unit - V** | **Footage** | **9** |
| Footage pre-processing, Stabilization, Undistortion, Shutterfix, Tracking Basics, Camera properties,Filmback, Focal length, Resolution, Using trackers, Import/Export tracking data, Merge/Split tracks,Hide, remove, disable etc,. Tracking multiple footages, Auto track. | | |

**Total:45**

**TEXT BOOK:**


1. Gary H. Anderson, "Video Editing and Post – Production: A Professional Guide", Focal Press Publications, 4th Illustrated Edition, 1999. For unit I - III
2. Declan McGrath, "Editing and Post Production", Focal Press Publications, Illustrated Edition, 2001 for unit IV-V


## REFERENCES:


1. Eve Light Honthaner, "The Complete film Production Handbook, Volume 1", RoutledgePublications, 4th Edition, 2013
2. Adele Droblas and Seth Greenbeg, "Adobe Pre 2001,miere Pro 2 Bible (W/ Cd)", Wiley – India Publications, 2007.
3. www.nngroup.com/articles/usability-testing-101/

| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|---|---|---|
| CO1 | describe basic aesthetics in editing | Applying (K3) |
| CO2 | demonstrate basics of video editing | Applying (K3) |
| CO3 | apply animation editing | Applying (K3) |
| CO4 | explore animation | Applying (K3) |
| CO5 | explore video footage editing techniques | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 20 | 20 | 60 | | | | 100 |
| CAT2 | 20 | 20 | 60 | | | | 100 |
| CAT3 | 10 | 20 | 70 | | | | 100 |
| ESE | 15 | 25 | 60 | | | | 100 |

*** ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)**

# 20CDE25 - DEEP LEARNING

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 7 | PE | 2 | 0 | 2 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides an overview of machine learning, neural networks, and Deep learning techniques for solving real world problems. | |
| | | |
| **Unit - I** | **Introduction** | **6** |
| Learning Algorithms – Capacity, Overfitting and Underfitting – Hyper parameters and Validation Sets – Estimators, Bias and Variance – Maximum Likelihood Estimation – Bayesian Statistics – Linear Regression – Supervised Learning Algorithms – Unsupervised Learning Algorithms – Building a Machine Learning Algorithm – Challenges Motivating Deep Learning | | |
| **Unit - II** | **Deep Feed forward Networks** | **6** |
| Example: Learning XOR – Gradient-Based Learning – Stochastic Gradient Descent - Hidden Units – Architecture Design – Back-Propagation and Other Differentiation Algorithms | | |
| **Unit - III** | **Regularization for Deep Learning** | **6** |
| Parameter Norm Penalties – Dataset Augmentation – Noise Robustness – Semi-Supervised Learning – Multi-Task Learning – Early Stopping – Parameter Tying and Parameter Sharing – Bagging and Other Ensemble Methods – Dropout – Adversarial Training. | | |
| **Unit - IV** | **Convolutional Networks** | **6** |
| The Convolution Operation – Motivation – Pooling – Variants of the Basic Convolution Function – Structured Outputs Efficient Convolution Algorithms – Transfer Learning - Applications: Computer Vision. | | |
| **Unit - V** | **Sequence Modeling: Recurrent and Recursive Nets** | **6** |
| Recurrent Neural Networks – Bidirectional RNNs – Encoder-Decoder Sequence-to-Sequence Architectures – Deep Recurrent Networks – Recursive Neural Networks – The Long Short-Term Memory and other Gated RNN – Transformers. Applications: Natural Language Processing. | | |

**Lecture:30, Practical:30, Total:60**

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Program to test the performance of multi-layer neural network with various activation and loss functions |
| 2. | Tuning the neural network performance with hyper parameters |
| 3. | Train a Deep learning model to classify a given image using pre trained model |
| 4. | Implement Object detection using Convolution Neural Network |
| 5. | Develop Recommendation system from sales data using Deep Learning |
| 6. | Develop Deep learning model by tuning hyper parameters |

**TEXT BOOK:**


| | |
|---|---|
| 1. | Ian Goodfellow, YoshuaBengio, and Aaron Courvill, “Deep Learning”, MIT Press, 1st Edition, 2016. |


**REFERENCES:**


| | |
|---|---|
| 1. | Josh Patterson and Adam Gibson, “Deep Learning – A Practitioner’s Approach”, 1st Edition, O’Reilly Series, 2017 |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | apply the concepts of machine learning algorithms to solve simple problems | Applying (K3) |
| CO2 | solve simple problems using the concepts of deep neural networks | Applying (K3) |
| CO3 | make use of different regularization methods for Deep learning | Applying (K3) |
| CO4 | exemplify the concepts of CNN models and apply it for solving computer vision related problems | Applying (K3) |
| CO5 | explain the concepts of RNN models and apply it for solving Natural Language problems | Applying (K3) |
| CO6 | develop deep learning model to classify a given image using pre trained model | Applying (K3), Precision(S3) |
| CO6 | implement CNN to identify object and RNN to perform sentiment analysis | Applying (K3), Precision(S3) |
| CO8 | implement image generation using GAN | Applying (K3), Precision(S3) |

| **Mapping of Cos with Pos and PSOs** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cos/Pos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO6 | 3 | 2 | 1 | 1 | 1 | | | | | | | | 3 | 1 |
| CO7 | 3 | 2 | 1 | 1 | 1 | | | | | | | | 3 | 1 |
| CO8 | 3 | 2 | 1 | 1 | 1 | | | | | | | | 3 | 1 |
| 1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy | | | | | | | | | | | | | | |

| **ASSESSMENT PATTERN - THEORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | 20 | 40 | 40 | | | | 100 |
| CAT2 | 20 | 40 | 40 | | | | 100 |
| CAT3 | 15 | 50 | 35 | | | | 100 |
| ESE | 20 | 40 | 40 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

# 20CDE26 - BUSINESS INTELLIGENCE AND ITS APPLICATIONS

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 7 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course focuses on learners to apply the BI concepts and techniques to various applications for making better decisions | |
| **Unit - I** | **Business View of Information Technology Applications** | **9** |
| Core Business Processes – Baldrige Business Excellence Framework – Purpose of using IT in Business – Characteristics of Internet-ready IT Applications – Enterprise Applications – Information users and their requirements. Case Study: GoodLife HealthCare Group, Good Food Restaurants Inc, Ten To Ten Retail Stores. Types of Digital Data: Introduction – Structured Data – Unstructured Data – Semi-Structured Data – Difference between semi-structured and structured data. | | |
| **Unit - II** | **Business Intelligence and Data Integration** | **9** |
| Business Intelligence: Definition – Evolution – Need for BI – BI Value Chain – Business Analytics –BI Framework – BI Users – BI Applications – BI Roles and Responsibilities – Data Integration : Need for Data Warehouse – Definition of Data Warehouse – Data mart – Ralph Kimbal's Approach vs. W.H.Inmon's Approach – Goals of Data Warehouse –ETL Process – Data Integration Technologies – Data Quality – Data Profiling. | | |
| **Unit - III** | **OLTP, OLAP and Multidimensional Data Modeling** | **9** |
| OLTP – OLAP – OLAP Architectures – Data Models – Role of OLAP Tools in BI –OLAP Operations –Basics of Data Modeling – Types of Data Model – Data Modeling Techniques –Fact Table –Dimension Table –Dimensional Models –Dimensional Modeling Life Cycle –Designing the Dimensional Model. | | |
| **Unit - IV** | **Performance Management and Enterprise Reporting** | **9** |
| Understanding Measures and Performance – Measurement System – Role of metrics –KPIs – Enterprise Reporting: Reporting Perspectives – Report Standardization and Presentation Practices – Enterprise Reporting Characteristics – Balanced Scorecard – Dashboards –Creating Dashboards – Scorecards vs. Dashboards – Analysis. | | |
| **Unit - V** | **Role of Statistics in Analytics and BI Applications** | **9** |
| Role of Statistics in Analytics –Data Description and Summarization – Statistical Test – Application of Analysis in Industries. BI Applications: Understanding Business Intelligence and Mobility – Business Intelligence and Cloud Computing –Business Intelligence for ERP systems – Social CRM and Business Intelligence. | | |

**Lecture:45Total:45**

**TEXT BOOK:**

1. Prasad R.N. and SeemaAcharya, "Fundamentals of Business Analytics", 2nd Edition, Wiley-India Publication, 2016. (Units 1-5)

**REFERENCES:**

1. Ramesh Sharda, DursunDelen and Efraim Turban, "Business Intelligence, Analytics, and Data Science: A Managerial Perspective", 4th Edition, Pearson Education, 2017.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | demonstrate the enterprise view of IT applications and identify the different types of digital data | Applying (K3) |
| CO2 | make use of BI concepts and techniques to experiment ETL process | Applying (K3) |
| CO3 | compare OLTP with OLAP systems and design dimensional model | Applying (K3) |
| CO4 | apply different software design techniques for a given problem | Applying (K3) |
| CO5 | apply BI to mobile, cloud, ERP and social CRM systems | Applying (K3) |

| **Mapping of COs with POs and PSOs** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| 1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy | | | | | | | | | | | | | | |

| **ASSESSMENT PATTERN - THEORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | 15 | 45 | 40 | | | | 100 |
| CAT2 | 15 | 40 | 45 | | | | 100 |
| CAT3 | 15 | 40 | 45 | | | | 100 |
| ESE | 10 | 45 | 45 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDE27 - WEB MINING

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 7 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides knowledge about web searching, indexing, query processing and web content mining. | |
| **UNIT – I** | **Information Retrieval and Web Search** | **9** |
| Basic Concepts – Information Retrieval Models – Relevance Feedback – Evaluation Measures – Text and Web Page Pre-processing – Inverted Index and its compression – Latent Sematic Indexing – Web Search – Meta-Searching and Combining Multiple Rankings – Web Spamming | | |
| **UNIT – II** | **Web Crawling** | **9** |
| Basic Crawler Algorithm – Implementation Issues – Universal Crawlers – Focused Crawlers – Topical Crawlers – Evaluation – Crawler Ethics and Conflicts | | |
| **UNIT – III** | **Wrapper Generation** | **9** |
| Preliminaries –Wrapper Induction-Instance-Based Wrapper Learning –Automatic Wrapper Generation: Problems –String Matching and Tree Matching – Multiple Alignment – Building DOM Trees –Extraction Based on a Single List Page and Multiple pages –Introduction to Schema Matching –Pre-Processing for Schema Matching-Schema – Level Match –Domain and Instance-Level Matching –Combining similarities | | |
| **UNIT – IV** | **Web Usage Mining** | **9** |
| Web Usage Mining – Clickstream Analysis – Log Files – Data Collection and Pre-Processing – Data Modeling for Web Usage Mining – The BIRCH Clustering Algorithm –Affinity Analysis and the A Priori Algorithm – Discretizing the Numerical Variable: Binning –Applying the A Priori Algorithm to CCSU Web Log Data– Discovery and Analysis of Web Usage Patterns –Recommender Systems and Collaborative Filtering | | |
| **UNIT – V** | **Opinion Mining** | **9** |
| The Problem of Opinion Mining – Document Sentiment Classification – Sentence Subjectivity and Sentiment Classification – Opinion Lexicon Expansion – Aspect-Based Opinion Mining – Mining Comparative Opinions Search and Retrieval – Opinion Spam Detection | | |

**Total:45**

**TEXT BOOK:**


1. Bing Liu, " Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data Centric Systems and Applications)", Springer; 2nd Edition 2011 for units I,II,III,IV(part 1), V
2. Zdravko Markov, Daniel T. Larose, "Data Mining the Web: Uncovering Patterns in Web Content, Structure, and Usage", John Wiley & Sons, Inc., 2010 for unit IV (half)

| | **COURSE OUTCOMES:** On completion of the course, the students will be able to | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | determine information retrieval models and methods related to Web search | Applying (K3) |
| CO2 | apply algorithms for Web crawling applications | Applying (K3) |
| CO3 | make use of wrapper to extract structured data | Applying (K3) |
| CO4 | analyze, capture and model the behavioural patterns and profiles of users interacting with a Web site | Analyzing (K4) |
| CO5 | apply opinion mining techniques to classify opinions | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | 1 | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | 1 | | | | | | | | 3 | 1 |
| CO4 | 3 | 3 | 2 | | | | | | | | | | 3 | 2 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 20 | 50 | 30 | | | | 100 |
| CAT2 | 20 | 50 | 30 | | | | 100 |
| CAT3 | 20 | 40 | 30 | 10 | | | 100 |
| ESE | 20 | 30 | 40 | 10 | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDE28 - BIG DATA ANALYTICS**

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 7 | PE | 2 | 0 | 2 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides knowledge about Big data and its framework, storage and stream processing with SPARK and KAFKA | |
| **Unit - I** | **Big data** | **6** |
| Introduction – Types of Digital Data – characteristics – evolution – definition – challenges – Big Data – Big Data Analytics – importance – data science – terminologies used in Big Data environments – Analytics Tools. | | |
| **Unit - II** | **Hadoop** | **6** |
| Hadoop Introduction – RDBMS VsHadoop – Distributed computing challenges – Hadoop Overview – HDFS – Processing data with Hadoop – Interacting with Hadoop Ecosystem. Introduction to MapReduce Programming- Mapper– Reducer– Combiner – Partitioner– Searching - Sorting - Compression. | | |
| **Unit - III** | **MongoDB and Cassandra** | **6** |
| Introduction to MongoDB – Terms used in MongoDB– Data types in MongoDB – MongoDB Query Language. Introduction to Cassandra – Features of Cassandra – CQL Data types – CQLSH– CRUD operations – Collections – Altercommands – Import and Export – Querying System tables. | | |
| **Unit - IV** | **HIVE and PIG** | **6** |
| Introduction to Hive – Architecture – Data types – File format – Hive Query Language – RCFile implementation. Introduction to Pig – Pig on Hadoop – Data types – Running Pig – Execution modes of Pig – HDFS commands – Relational Operators – Eval function – Complex Data types. | | |
| **Unit - V** | **Apache SPARK and KAFKA** | **6** |
| Introduction – SPARK architecture – SPARK SQL – SPARK Streaming – SPARK Eco system – SPARK for Big Data Processing – SPARK applications – Apache KAFKA – KAFKA Architecture – Use cases. | | |

**List of Exercises / Experiments :**

| | |
|---|---|
| 1. | Install, configure and run Hadoop and HDFS. |
| 2. | Demonstrate File Management tasks in Hadoop. |
| 3. | Implement word count programs using MapReduce. |
| 4. | DevelopMapReduce code to find the maximum temperature of a city. |
| 5. | Implement Matrix Multiplication using MapReduce. |
| 6. | Develop a code that stores big data in MongoDB. |
| 7. | Develop a code that stores big data in Cassandra. |

**Lecture:30, Practical:30, Total:60**

**TEXT BOOK:**


| | |
|---|---|
| 1. | SeemaAcharya and SubhashiniChellappan, “Big Data and Analytics”, 2nd Edition, Wiley, 2019. |


**REFERENCES:**


| | |
|---|---|
| 1. | Dr.AnilMaheshwari, “Big Data”, 2nd Edition, McGraw Hill Education, 2019 |
| 2. | EMC Education Services, ”Data science and Big data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, John Wiley and Sons, 2015. |
| 3. | https://spark.apache.org/docs/latest/ |

| | **COURSE OUTCOMES:** On completion of the course, the students will be able to | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | describe the characteristics of big data and use it for identifying the types of digital data | Applying (K3) |
| CO2 | implement MapReduce programs in Hadoop framework | Applying (K3) |
| CO3 | utilize MongoDB and Cassandra to develop database applications | Applying (K3) |
| CO4 | develop solutions for big data problems using Hive and Pig | Applying (K3) |
| CO5 | determine the need for stream processing and use of Spark and Kafka | Applying (K3) |
| CO6 | demonstrate simple programs using MapReduce, Hadoop and HDFS | Applying (K3), Precision(S3) |
| CO7 | use MongoDB / Cassandra for storing big data in real world problems | Applying (K3), Precision(S3) |
| CO8 | implement programs for data streaming and text analysis using open source frameworks/ tools | Applying (K3), Precision(S3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | 1 | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | 1 | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | 1 | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | 1 | | | | | | | | 3 | 1 |
| CO6 | 3 | 2 | 1 | 1 | 1 | | | | | | | | 3 | 1 |
| CO7 | 3 | 2 | 1 | 1 | 1 | | | | | | | | 3 | 1 |
| CO8 | 3 | 2 | 1 | 1 | 1 | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT 1-50 marks | 25 | 50 | 25 | | | | 100 |
| CAT 2-50 marks | 20 | 40 | 40 | | | | 100 |
| CAT 3-50 marks | 25 | 50 | 25 | | | | 100 |
| ESE -100 marks | 25 | 30 | 45 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20GEE01 - FUNDAMENTALS OF RESEARCH

| Programme & Branch | B. E (Computer Science and Design) | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 7 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course familiarize the fundamental concepts/techniques adopted in research, problem formulation and also disseminate the process involved in collection, consolidation of published literature and rewriting them in a presentable form using latest tools. | |
| **Unit - I** | **Introduction to Research** | **9** |
| Introduction to Research: Types and Process of Research - Outcome of Research - Sources of Research Problem - Characteristics of a Good Research Problem - Errors in Selecting a Research Problem - Importance of Keywords. | | |
| **Unit - II** | **Literature Review** | **9** |
| Literature Review: Literature Collection - Methods - Analysis - Citation Study - Gap Analysis - Problem Formulation Techniques. | | |
| **Unit - III** | **Research Methodology** | **9** |
| Research Methodology: Appropriate Choice of Algorithms/Methodologies/Methods - Measurement and Result Analysis - Investigation of Solutions for Research Problem - Interpretation - Research Limitations. | | |
| **Unit - IV** | **Journals and Papers:** | **9** |
| Journals and Papers: Journals in Science/Engineering - Indexing and Impact factor of Journals. Plagiarism and Research Ethics. Types of Research Papers - Original Article/Review Paper/Short Communication/Case Study. | | |
| **Unit - V** | **Reports and Presentations** | **9** |
| Reports and Presentations: How to Write a Report - Language and Style - Format of Project Report - Title Page - Abstract - Table of Contents - Headings and Sub-Headings - Footnotes - Tables and Figures - Appendix - Bibliography etc - Different Reference Formats. Presentation using PPTs. Research Tools. | | |

**Total: 45**

**TEXT BOOK:**


| | |
|---|---|
| 1. | Walliman, Nicholas. “Research Methods: The basics”. Routledge, 2017. |


**REFERENCES:**


| | |
|---|---|
| 1. | Melville S, Goddard W. “Research Methodology: An Introduction For Science and Engineering Students”. Kenwyn: Juta & Co Ltd., 1996. |
| 2. | Kumar, Ranjit. “Research Methodology: A step-by-step guide for beginners”. SAGE Publications Limited, 2019. |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | list the various stages in research and categorize the quality of journals. | Analyzing (K4) |
| CO2 | formulate a research problem from published literature/journal papers | Evaluating K5) |
| CO3 | write, present a journal paper/ project report in proper format | Creating (K6) |
| CO4 | select suitable journal and submit a research paper. | Applying (K3) |
| CO5 | compile a research report and the presentation | Applying (K3) |

**Mapping of COs with POs and PSOs**

| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 1 | 1 | | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
|---|---|---|---|---|---|---|---|
| CAT1 | | 40 | 35 | 25 | | | 100 |
| CAT2 | | 30 | 40 | 30 | | | 100 |
| CAT3 | | | | 50 | 50 | | 100 |
| ESE | | 25 | 25 | 25 | 25 | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDE29 - SOFTWARE QUALITY AND TESTING

| Programme& Branch | B.E. & Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Software Engineering | 7 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course focuses on the implementation of appropriate functionality that satisfies the requirements/needs of its targeted client/users for the intended software system, product, or service correctly and efficiently. | |
| **Unit - I** | **Software Quality Assurance and Review Techniques** | **9** |
| Defining Quality – Importance of Quality –Quality Control Vs Quality assurance –Quality assurance at each phase of SDLC - Need for SQA group in an Organization. Structured walkthroughs –Inspections –Various roles and responsibilities involved in Inspections – Making review successful. | | |
| **Unit - II** | **Software Measurement and Metrics** | **9** |
| Product quality – Models for software product Quality – Process Quality Aspects. Measurement and Metrics: Introduction – Measurement during software life cycle context –Defect metrics – Metrics for software maintenance– Requirements related metrics – Measurements and process improvement – Measurement principles. | | |
| **Unit - III** | **Basics of Testing** | **9** |
| Introduction – Definition– Testing Approaches – Essentials – features and principles of software Testing. Testing Environment: Assessing Capabilities – Staff Competency and User Satisfaction – Creating an environment supportive of software testing – Building the software testing process: Testing Guidelines. | | |
| **Unit - IV** | **Software Testing process** | **9** |
| Overview of Software Testing Process – Organizing for testing: Workbench – Input – Procedure. Developing the test plan:Workbench – Input – Procedure.Verification testing: Workbench – Input – Procedure. Validation testing :Workbench – Input – Procedure. | | |
| **Unit - V** | **Analyzing and reporting** | **9** |
| Analyzing and reporting test results: Workbench – Input – Procedure. Testing software system security – Testing client/server systems – Testing web-based systems – Using Agile Methods to Improve Software Testing. | | |

**Total:45**

**TEXT BOOK:**


1. Nina S. Godbole, "Software Quality Assurance Principles and Practice", 2nd Edition, Narosa Publishing House, 2017 for units I,II
2. Perry William, "Effective Methods for Software Testing", 3rd Edition, Wiley, India, 2013 for units III, IV, V

| | **COURSE OUTCOMES:** On completion of the course, the students will be able to | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | apply quality assurance steps at each phase of SDLC and conduct reviews and inspections | Applying (K3) |
| CO2 | apply the concepts, metrics, and models in software quality assurance | Applying (K3) |
| CO3 | apply the step by step activities and set up environment for software testing | Applying (K3) |
| CO4 | develop procedures and workbenches for various testing process | Applying (K3) |
| CO5 | apply testing for client server, web based and software security systems and identify the agile methods for improving the testing process | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 30 | 50 | 20 | | | | 100 |
| CAT2 | 20 | 50 | 30 | | | | 100 |
| CAT3 | 20 | 50 | 30 | | | | 100 |
| ESE | 25 | 30 | 45 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDE30 - DATA VISUALIZATION TECHNIQUES

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 8 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides complex information in a way that is easier to interpret by turning information into visually engaging images and stories. | |
| **Unit - I** | **Introduction** | **9** |
| Visualization – visualization process – role of cognition – Pseudocode conventions – Scatter plot - Data foundation: Types of data - Structure within and between records - Data preprocessing – Human perceptions and information processing – Visualization foundations. | | |
| **Unit - II** | **Spatial and Geospatial, Time oriented data and Multivariate data** | **9** |
| One, two, three dimensional data – Dynamic data – Combining techniques - Visualization of spatial data - Visualization of point data - Visualization of line data - Visualization of area data - Issues in Geospatial data Visualization –Characterizing and visualizing Time oriented data- Point, Line ad region based techniques for multivariate data. | | |
| **Unit - III** | **Tree, Graph, Networks, Text and Document** | **9** |
| Displaying hierarchical structure – Displaying Arbitrary Graphs/Networks – Other issues. Visualization techniques for Tree- Graph and Networks - Levels of text representation – Vector space model – Single Document Visualization – Document collection visualization- Extended text visualization. | | |
| **Unit - IV** | **Designing Effective Visualization** | **9** |
| Steps in Designing Visualization – problems in Designing Effective Visualization – Comparing and evaluating visualization techniques – Visualization Systems. | | |
| **Unit - V** | **Information Dashboard Design** | **9** |
| Characteristics of dashboards – Key goals in visual design process – Dashboard display media – Designing dashboards for usability – Meaningful organization – Maintaining consistency – Aesthetics of dashboards – Testing for usability – Case Studies: Sales dashboard, Marketing analysis dashboard. | | |

**Total: 45**

**TEXT BOOK:**


1. Matthew O. Ward. , Georges Grinstein and Daniel Keim., “Interactive Data Visualization: Foundations, Techniques, and Applications”, 2nd Edition, CRC Press, 2015 for units I - IV
2. Stephen Few, "Information Dashboard Design: The Effective Visual Communication of Data", O'Reilly, 2nd Edition, 2013. For unit V

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | describe principles of visual perception and carryout preprocessing in real time data | Applying (K3) |
| CO2 | apply visualization techniques for various data analysis tasks | Applying (K3) |
| CO3 | apply visualization techniques for the applications using unstructured data | Applying (K3) |
| CO4 | make use of different visualization techniques for the given problems | Applying (K3) |
| CO5 | design information dashboard for Sales and marketing analysis | Applying (K3) |

| **Mapping of COs with POs and PSOs** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| 1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy | | | | | | | | | | | | | | |

| **ASSESSMENT PATTERN - THEORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | 25 | 55 | 20 | | | | 100 |
| CAT2 | 20 | 30 | 50 | | | | 100 |
| CAT3 | 20 | 40 | 40 | | | | 100 |
| ESE | 20 | 40 | 40 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDE31- TOTAL QUALITY MANAGEMENT

| Programme & Branch | B.E. – Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 8 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course deals with Quality concepts and TQM principles focusing on process quality to assure product quality to the customers. It also deals with the Basic and modern Quality management tools including ISO standards | |
| **Unit - I** | **Quality Concepts and Principles:** | **9** |
| Quality Concepts and Principles: Definition of Quality - Dimensions of Quality - Quality Planning - Quality costs - Basic concepts of Total Quality Management - Historical Review. Principles of TQM - Leadership –Concepts - Quality Council - Quality Statements - Strategic Planning - Deming Philosophy - Barriers to TQM Implementation | | |
| **Unit - II** | **Total Quality Management-Principles and Strategies:** | **9** |
| Total Quality Management-Principles and Strategies: Customer satisfaction –Customer Perception of Quality - Customer Complaints - Customer Retention - Employee Involvement –Motivation - Empowerment - Teams - Recognition and Reward - Performance Appraisal - Benefits. Continuous Process Improvement –Juran Trilogy - PDSA Cycle - 5S - Kaizen - Supplier Partnership –Partnering - sourcing - Supplier Selection - Supplier Rating - Relationship Development - Performance Measures | | |
| **Unit - III** | **Control Charts for Process Control:** | **9** |
| Control Charts for Process Control: The seven tools of quality - Statistical Fundamentals –Measures of central Tendency and Dispersion - Population and Sample - Normal Curve - Control Charts for variables and attributes - Process capability - Concept of six sigma. | | |
| **Unit - IV** | **TQM-Modern Tools:** | **9** |
| TQM-Modern Tools: The new seven tools of quality - Benchmarking-Need - Types and process; Quality Function Deployment-HOQ construction - case studies; Taguchi"s Robust design-Quality loss function - DOE; Total Productive Maintenance-uptime enhancement; Failure Mode and Effect Analysis-Risk Priority Number - Process - case studies. | | |
| **Unit - V** | **Quality Systems:** | **9** |
| Quality Systems: Need for ISO 9000 and Other Quality Systems - ISO 9000 : 2015 Quality System –Elements - Implementation of Quality System - Documentation - Quality Auditing - Introduction to TS 16949 - QS 9000 - ISO 14000 - ISO 18000 - ISO 20000 - ISO 22000. Process of implementing ISO - Barriers in TQM implementation. | | |

**Total: 45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Dale H. Besterfield, "Total Quality Management", 3rd Edition, Pearson Education, New Delhi, 2011. |

**REFERENCES:**

| | |
|---|---|
| 1. | Subburaj Ramasamy, "Total Quality Management", Tata McGraw Hill, New Delhi, 2008. |
| ‘2. | Feigenbaum A.V., "Total Quality Management", 4th Edition, Tata McGraw Hill , New Delhi, 2004. |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | demonstrate the need, history and principles of quality and TQM | Applying (K3) |
| CO2 | illustrate the principles and strategies of TQM | Applying (K3) |
| CO3 | make use of various tools and techniques of quality management | Analyzing (K4) |
| CO4 | apply various quality tools and techniques in both manufacturing and service industry | Applying (K3) |
| CO5 | explain the concepts of quality management system and ISO. | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | | | | 2 | 2 | 3 | 2 | 2 | 1 | 1 | | 3 |
| CO2 | 1 | 1 | | | | 3 | 2 | 3 | 3 | 3 | 1 | 1 | 2 | 3 |
| CO3 | 3 | 2 | 2 | 2 | 2 | 2 | | 1 | 2 | 2 | 1 | 1 | 1 | 3 |
| CO4 | 2 | 2 | 2 | 2 | 2 | 2 | | 1 | 2 | 2 | 1 | 1 | 2 | 3 |
| CO5 | | | | | | 3 | 3 | 2 | 3 | 2 | 1 | 1 | | 3 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 25 | 45 | 30 | | | | 100 |
| CAT2 | 20 | 30 | 30 | 20 | | | 100 |
| CAT3 | 25 | 45 | 30 | | | | 100 |
| ESE | 20 | 30 | 35 | 15 | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDE32 - CYBER FORENSICS

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 8 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course imparts fundamental principles and techniques for digital forensics investigation and security management. | |
| **Unit - I** | **Computer Forensics and Investigations** | **9** |
| Understanding computer forensics - Preparing Computer investigations – Taking a systematic approach –Assessing the case – Planning Investigation – Securing evidence– Procedures for Corporate High-Tech investigations – Conducting an Investigation – Completing the case. | | |
| **Unit - II** | **Data Acquisition** | **9** |
| Understanding storage formats for digital evidence – Determining the best acquisition method - Contingency planning for image acquisitions – Using Acquisition tools: Windows XP Write-protection with USB Devices – Validating Data Acquisitions: Windows Validation Methods – Performing RAID Data Acquisitions – Using Remote Network Acquisition tools – Using other Forensics Acquisition tools. | | |
| **Unit - III** | **Processing Crime and Incident Scenes** | **9** |
| Identifying Digital Evidence – Collecting Evidence in Private Sector Incident Scenes –Processing Law Enforcement Crime Scenes – Preparing for a Search –Securing a Computer Incident or Crime Scene –Seizing Digital Evidence at the Scene –Storing Digital Evidence –Obtaining a Digital Hash –Reviewing a Case. | | |
| **Unit - IV** | **Computer Forensics Tools, Analysis and Validation** | **9** |
| Evaluating Computer Forensics Tool Needs –Computer Forensics Software Tools – Computer Forensics Hardware Tools –Validating and Testing Forensic Software – Computer Forensics Analysis and Validation: Determining Data Collection and Analysis –Validating Forensic Data –Addressing Data-Hiding Techniques –Performing Remote Acquisitions. | | |
| **Unit - V** | **Recovering Graphics Files, Email Investigations** | **9** |
| Recognizing a Graphics File– Understanding Data Compression – Locating And Recovering Graphic Files- Identifying Unknown File Formats– Understanding Copyright Issues –Investigating Email Crimes And Violations- Understanding Email Servers– Using Specialized Email Forensics Tools. | | |

**Total:45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Nelson Bill, Phillips Amelia and Steuart Christopher, “Guide to Computer Forensics and Investigations”, 3rd Edition, Cengage Learning, 2017. |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | apply systematic approach for digital forensic investigation | Applying (K3) |
| CO2 | carry out acquisition of data using various tools | Applying (K3) |
| CO3 | determine the seizure of digital evidence in a crime scene | Applying (K3) |
| CO4 | make use of forensic tools in forensic examination | Applying (K3) |
| CO5 | carry out investigationusing E-mail and graphic files | Applying (K3) |

| **Mapping of COs with POs and PSOs** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 3 | 1 | | | | | | | | | | 3 | 1 |
| 1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy | | | | | | | | | | | | | | |

| **ASSESSMENT PATTERN - THEORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | 15 | 35 | 50 | | | | 100 |
| CAT2 | 15 | 35 | 50 | | | | 100 |
| CAT3 | 15 | 35 | 50 | | | | 100 |
| ESE | 10 | 40 | 50 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDE33 - BLOCKCHAIN TECHNOLOGIES**

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 8 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides a comprehensive introduction to the theoretical and practical aspects of blockchain technology. | |
| **Unit - I** | **Blockchain 101** | **9** |
| Distributed systems - The history of blockchain - Introduction to blockchain – definitions - elements - Features - Applications of blockchain technology - Tiers - Types of blockchain - Consensus in blockchain - CAP theorem - Benefits and limitations of blockchain. | | |
| **Unit - II** | **Decentralization and Cryptography Technical Foundations** | **9** |
| Decentralization using blockchain – Methods – Routes - Blockchain and full ecosystem decentralization - Smart contract - Decentralized applications – Platforms for decentralization. Cryptography and Technical Foundations– Introduction - Cryptography - Confidentiality - Integrity – Authentication - Cryptographic primitives - Asymmetric cryptography - Public and private keys – RSA - Discrete logarithm problem - Hash functions - Elliptic Curve Digital signature algorithm | | |
| **Unit - III** | **Bitcoins and Alternative Coins** | **9** |
| Bitcoin – Transactions – Blockchain - Bitcoin payments - Alternative Coins - Theoretical foundations - Bitcoin limitations – Namecoin - Litecoin – Primecoin – Zcash - Smart Contracts. | | |
| **Unit - IV** | **Ethereum 101** | **9** |
| Introduction – Ethereum blockchain - Elements of the Ethereum blockchain - Precompiled contracts – Accounts – Block – Ether – Messages – Mining - Clients and wallets - The Ethereum network - Ethereum Development. | | |
| **Unit - V** | **Hyperledger** | **9** |
| Projects – Protocol - Hyperledger Fabric – Sawtooth lake – Corda – Blockchains-Outside of Currencies: Internet of Things – Government – Health – Finance. | | |

**Total:45**

**TEXT BOOK:**


1. Imran Bashir, “Mastering Blockchain Distributed ledgers, decentralization and smart contracts Explained”, Packt Publishing, 1st Edition, 2017.


**REFERENCES:**


1. Brenn Hill, Samanyu Chopra, Paul Valencourt, “Blockchain Quick Reference: A guide to exploring decentralized blockchain application development”, Packt publishing, 1st Edition 2018.

| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|---|---|---|
| CO1 | determine the basics and various real time applications of blockchain | Applying (K3) |
| CO2 | apply decentralization and cryptography for blockchain applications | Applying (K3) |
| CO3 | make use of blockchain technology for bitcoin, alternative coins and develop smart contracts | Applying (K3) |
| CO4 | develop a distributed application using Ethereum | Applying (K3) |
| CO5 | deploy an application using Hyperledger | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | 1 | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | 1 | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 20 | 40 | 40 | | | | 100 |
| CAT2 | 20 | 40 | 40 | | | | 100 |
| CAT3 | 10 | 50 | 40 | | | | 100 |
| ESE | 20 | 50 | 30 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDE34 - DIGITAL MARKETING**

| Programme& Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 8 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides basics of digital marketing, its underlying technologies and frameworks, consumer behavior aspects including demand management and Integrated Marketing Communications for digital platform | |
| **Unit - I** | **Basics of Digital Marketing** | **9** |
| Evolution of Digital Marketing – Digital Marketing an Introduction – Internet Marketing: Underlying Technology and Frameworks – Digital Marketing Framework – Factors Impacting Digital Marketplace –Value Chain Digitization – The Consumer for Digital Marketing – Consumer Behavior on the Internet – Evolution of Consumer Behavior Models – Managing Consumer Demand – Integrated Marketing Communications. | | |
| **Unit - II** | **Digital Marketing Strategy Development** | **9** |
| Digital Marketing Assessment Phase: Elements of the Assessment Phase – Digital Marketing Internal Assessment – Digital Marketing Objectives Planning – Digital Marketing Strategy Definition: Digital Marketing Strategy Groundwork – Defining the Digital Marketing Mix – Digital Marketing Strategy Roadmap. | | |
| **Unit - III** | **Digital Marketing Planning and Setup** | **9** |
| Digital Marketing Communications and Channel Mix: Digital Marketing Planning Development – Designing the Communication Mix – Introduction to Digital Marketing Channels. Digital Marketing Operations Setup: Understanding Digital Marketing Conversion – Basics of Web Development and Management – User Experience, Usability, and Service Quality Elements. | | |
| **Unit - IV** | **Digital Marketing Execution** | **9** |
| Digital Marketing Campaign Management: Basic Elements of Digital Campaigns – Basic Elements of Digital Campaign Management – Implementing Intent – Based Campaigns (Search Execution) – Implementing Brand – Based Campaigns (Display Execution) – Campaign Execution for Emerging Marketing Models – Campaign Analytics and Marketing RoI. Digital Marketing Execution Elements – Managing Digital Marketing Revenue – Managing Service Delivery and Payment – Managing Digital Implementation Challenges | | |
| **Unit - V** | **Digital Business Present and Future** | **9** |
| Digital Marketing – Landscape and Emerging Areas: Digital Marketing – Global Landscape – Digital Marketing – The Indian View – Digital Marketing – Emerging Trends and Concepts. A Career in Digital Marketing: Emerging Opportunities for Digital Marketing Professionals – Building a Career in Digital Marketing– Top Digital Marketing Areas as Career Tracks –Approaching a Career in Digital Marketing. | | |

**Total:45**

**TEXT BOOK:**

1. Puneet Bhatia, “Fundamentals of Digital Marketing”, 1st Edition, Pearson Education, 2019.

| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|---|---|---|
| CO1 | explain the basic concepts of digital marketing and apply to solve the real world problems | Applying (K3) |
| CO2 | carry out the various digital marketing strategies | Applying (K3) |
| CO3 | explore digital marketing operation setup and apply for web development | Applying (K3) |
| CO4 | make use of the digital marketing campaign management | Applying (K3) |
| CO5 | determine the emerging areas of digital marketing | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 15 | 35 | 50 | | | | 100 |
| CAT2 | 15 | 35 | 50 | | | | 100 |
| CAT3 | 15 | 35 | 50 | | | | 100 |
| ESE | 10 | 40 | 50 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDE35 - SOFTWARE DEFINED NETWORKS

| Programme & Branch | BE - Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Computer Networks | 8 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides an insight on programmability protocols, interfaces, controllers and its applications in various environments like data centers and service provider networks. | |
| **Unit - I** | **Introduction to SDN** | **9** |
| Introduction: Basic packet switching terminology – The modern data center – Traditional switch architecture – Autonomous and dynamic forwarding table. Evolution of switches and control planes – Cost – Data center innovation – Data center needs. The Genesis of SDN: The evolution of networking technology – Forerunners of SDN – Getting started with mininet and experimenting with mininet. | | |
| **Unit - II** | **SDN and OpenFlow** | **9** |
| Fundamental characteristics of SDN – SDN operation – SDN devices – SDN controllers – Alternate SDN methods. The OpenFlow specification: OpenFlow overview – OpenFlow 1.0 and OpenFlow basics - OpenFlow 1.1 Additions - OpenFlow 1.2 Additions - OpenFlow 1.3 Additions – OpenFlow Limitations. NetApp Development: Simple forwarding in OpenDayLight controller. | | |
| **Unit - III** | **SDN Interfaces** | **9** |
| Alternative definitions of SDN: Potential drawbacks of open SDN – SDN via APIs- SDN via hypervisor based overlays – SDN via opening up the device – Network Functions virtualization – Alternatives overlap and ranking. SDN open source: Open source licensing issues – OpenFlow source code – Switch implementation – Controller implementations – Orchestration and Network virtualization – Simulation, Testing and Tools – OpenStack – Applying SDN open source | | |
| **Unit - IV** | **SDN in the Data center** | **9** |
| Data center definition – Data center demands – Tunneling technologies for the data center – Path technologies in the data center – SDN and shortest path complexity – Ethernet fabrics in the data center – SDN use cases in the data center – Open SDN versus Overlays in the data center – Real-world data center implementation. | | |
| **Unit - V** | **SDN environments and applications** | **9** |
| SDN in other environment – Wide area networks – Service provider and carrier networks – Campus networks – Hospitality networks – Mobile networks – In-Line network functions – Optical networks. SDN Applications: Reactive versus Proactive applications – A simple reactive Java application – Creating network virtualization tunnels – offloading flows in the data center – Access control for the campus – Traffic engineering for the service providers –NetApp Development: A simple Firewall. | | |

**Lecture:45, Total:45**

**TEXT BOOK:**


1. Paul Goransson and Chuck Black, "Software Defined Networks: A Comprehensive Approach", 1st Edition, Morgan Kaufmann, 2014.


**REFERENCES:**


1. SiamakAzodolmolky, "Software Defined Networking with OpenFlow", Packet Publishing, 1st Edition, 2013.
2. Thomas D. Nadeau and Ken Gray, "SDN: Software Defined Networks", O'Reilly Media, 1st Edition, 2013.

| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|---|---|---|
| CO1 | apply the programmability in the network using software defined network | Applying (K3) |
| CO2 | model a networking task using OpenFlow protocol | Applying (K3) |
| CO3 | demonstrate the networking application using software defined network interfaces and open source tools | Applying (K3) |
| CO4 | employ the software defined network architecture in the data centers | Applying (K3) |
| CO5 | design and develop various applications of SDN | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | 1 | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | 1 | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | 1 | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 10 | 30 | 60 | | | | 100 |
| CAT2 | 15 | 25 | 60 | | | | 100 |
| CAT3 | 15 | 25 | 60 | | | | 100 |
| ESE | 10 | 30 | 60 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDO01 - FUNDAMENTALS OF USER EXPERIENCE DESIGN

| Programme& Branch | B.E. – Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 4 | OE | 3 | 1 | 0 | 4 |

| | | |
|---|---|---|
| **Preamble** | This subject will teach how to create amazing user experiences for products from scratch, user personas and also understand the importance of a good UX design and the role of a UX designer. It deals different stages of designing a UX and the application of various principles of psychology in UX design. Also learn how to conduct user research and market research, which is crucial to creating a great UX. | |
| **Unit – I** | **UX Design Process:** | **9** |
| What is UX? – UX Design Vs UI Design – Why is UX so Important – Full Stack Design – UX Design Process – Discovery and Planning – The UX Strategy – UX Research: Discover – Explore – Test – Listen – UX Analysis – Design – Production. | | |
| **Unit – II** | **User Research:** | **9** |
| User Behavior Basics – The Gestalt Theory – Psychology in UX – User Research – Market Research Vs User Research – Benefits of User Research – Getting to Know Your Users – Grouping Customer Information – How to Conduct User Interviews?. | | |
| **Unit – III** | **User Personas and Affinity Diagram:** | **9** |
| User Personas: What are User Personas? – Creating a Persona – Four Different Perspectives on Personas – Benefits of Personas – Affinity Diagrams: Affinity Diagram – Work Activity Affinity Diagram – Capture, Grouping and Labeling. | | |
| **Unit – IV** | **Information Architecture and Visual Design Principles:** | **9** |
| Information Architecture: Navigation – Task Flow – Content Strategy – Site Map – Gestures – Basics of Visual Design – Lines – Shapes – Colors – Font/Typography – Textures – Forms – Design Principles – Alignment – Hierarchy – Contrast – Repetition – Proximity – Balance – Space – Visual Design Tools. | | |
| **Unit – V** | **Wireframes and Prototyping** | **9** |
| What is Wireframe? – How to Create Wireframes? – Types of Wireframes – Wireframing Tools: Sketch Wireframes – Stenciling and Paper cutouts – Wireframing Software – What is Prototyping – Prototyping Methods – Paper Prototypes – Digital Prototypes – Coding Prototypes – The process of Creating Prototypes – Prototyping Tools. | | |

**Lecture: 45**

**TEXT BOOK:**


1. Elvis Canziba “Hands-On UX Design for Developers: Design, Prototype, and Implement Compelling User Experiences from Scratch”, First Edition, Packet Publishing, 2018 for units I - V
2. Rex Hartson, Pardha S. Pyla, “The UX Book Process and Guidelines for Ensuring a Quality User Experience”, 1st Edition, Morgan Kaufmann Publisher, Elsevier, 2012 2018 for unit 2
3. https://www.netsolutions.com/insights/information-architecture/ 2018 for unit 3
4. https://boldist.co/design/gesture-based-interfaces/ for unit 3
5. https://www.usertesting.com/blog/affinity-mapping for unit 3

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Utilize the UX design process on product or service. | Applying (K3) |
| CO2 | Apply principles and procedures to conduct user research. | Applying (K3) |
| CO3 | Create user persona and construct affinity diagram for the product or service | Applying (K3) |
| CO4 | Design information architecture based on various visual design principles. | Applying (K3) |
| CO5 | Create wireframes and prototypes for the product or service by using various tools and software. | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 1 | | | | | 3 | 2 | 1 | | 3 | 1 |
| CO2 | 3 | 3 | 3 | 1 | | | | | 3 | 2 | 1 | | 3 | 1 |
| CO3 | 3 | 3 | 3 | 1 | | | | | 3 | 2 | 1 | | 3 | 1 |
| CO4 | 3 | 3 | 3 | 1 | | | | | 3 | 2 | 1 | | 3 | 1 |
| CO5 | 3 | 3 | 3 | 1 | | | | | 3 | 2 | 1 | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 20 | 20 | 60 | - | - | - | 100 |
| CAT2 | 10 | 20 | 70 | - | - | - | 100 |
| CAT3 | 15 | 20 | 65 | - | - | - | 100 |
| ESE | 15 | 20 | 65 | - | - | - | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDO02 - FUNDAMENTALS OF USER INTERACTIVE DESIGN

| Programme& Branch | B.E. – Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 5 | OE | 3 | 0 | 2 | 4 |

| | | |
|---|---|---|
| Preamble | This course gives perfect introduction to user interface design and explains how to design intuitive user interfaces by focusing on effective human communication. | |
| **Unit - I** | **Introduction** | **9+3** |
| UI Is Communication Concept - Communication Design Principles- UI Design Situation - Core Principles of UI Is Communication - Effective Communication - Intuitive UI- Necessary And Unnecessary Consistency - Unintuitive UI- Inductive UI- Deductive UI | | |
| **Unit - II** | **Interaction and Visual Design** | **9+3** |
| Interactions -Controls - Commands - Labels And Instructions – Feedback - Task Steps and Navigation - Surfaces - Errors And Notifications - Dynamic Elements - Importance of Visual Design - Graphic Designers – Layout -- Typography And Text – Color - Affordances - Icons And Glyphs- Animations And Transitions - Demanding Attention. | | |
| **Unit - III** | **Communication Design Process** | **9+3** |
| Communicating to People - Emotional Connection – Personality - Attributes - Good Tone -Motivating Users - Minimizing Effort - Forgiveness - Building Trustworthiness - Courageous Design - communication-driven design process- Basic design process – Mistakes - Planning phase - Design phase -Refinement phase. | | |
| **Unit - IV** | **Material Design and Components** | **9+3** |
| Material Design: Introduction, Principles. Material Environment: Surfaces. Elevation. Light and Shadows. Basic Components: App bars Bottom and Top, Bottom Navigation, Buttons, Cards, Text Fields, Navigation Drawer. | | |
| **Unit - V** | **Advanced Components** | **9+3** |
| Advanced Components: Backdrop, Checkboxes, Chips, Date Pickers, Dialogs, Dividers, Image List, Lists, Menus, Progress Indicators, Radio Buttons, Sheets – Bottom and Side, Sliders, Snackbars, Switches, Tabs, Tool Tips, Time Pickers. | | |

**Lecture:45, Tutorial :15, Total: 60**

**TEXT BOOK:**


1. McKay, Everett N. UI is communication: How to design intuitive, user centered interfaces by focusing on effective communication. Newnes, 2013.


**REFERENCES:**


1. https://material.io/components

| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|---|---|---|
| CO1 | Establish the baseline principles of UI design as a form of effective human communication | Applying (K3) |
| CO2 | Make use of practical communication-based guide to interaction and visual design | Applying (K3) |
| CO3 | Integrate the concepts of Communication-based design process from interaction to visual design | Applying (K3) |
| CO4 | Apply the material design principles and its components used to create a user interface | Applying (K3) |
| CO5 | Design a simple user interface by applying the advanced material components | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 5 | 20 | 75 | - | - | - | 100 |
| CAT2 | 10 | 20 | 70 | - | - | - | 100 |
| CAT3 | 10 | 20 | 70 | - | - | - | 100 |
| ESE | 10 | 20 | 70 | - | - | - | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**20CDO03 - INTRODUCTION TO MOBILE GAME DESIGN**

| Programme& Branch | B.E. – Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 6 | OE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course helps the students to provide the basic knowledge and practical guide to develop mobile games without prior knowledge or skills that are required to understand its contents. | |
| **Unit - I** | **Mobile Game Design Process** | **9** |
| Introduction – Mobile operating system – Mobile Indie Team: Roles – Basic Game Design Process – Do's and Don'ts of Game Design – Hardware Limitations – Design Constraints – Business models | | |
| **Unit - II** | **User Interface Design for Mobile Games** | **9** |
| Roles of UI – UI in video games – Designing the UI: Aesthetics, vectors and rasters, Designing icons – UI Design Practices: Screen Flow, Wireframes, Button Size, Main Screen, Screen rotation, challenges – Mobile Game Engines. | | |
| **Unit - III** | **Graphics and Audio for Mobile** | **9** |
| Graphics : Pixels and Vectors – Graphic file formats – 2D & 3D Graphic Assets – Character Designing – Colors for mobile – Audio: Digital Sound Technology – Recording and Playback – Types of Game sounds – Designing Audio – Practices for audio design. | | |
| **Unit - IV** | **Mobile Game Controls and Coding** | **9** |
| Mobile Game controls: Input Technology – Touchscreens – Keypads – Touchscreen Gestures – Input Interfaces – Built-in devices – Future technologies – Coding Games: Programming language features – Game programming: C++, Java, HTML5, Xcode – Structure of Game program. | | |
| **Unit - V** | **Prototyping** | **9** |
| Prototyping process: Defining – Building – Testing – Fixing – Styles: Horizontal and Vertical – Prototyping Types: Disposable code – Imagination – Pencil and Paper – Visual prototypes – Interactive prototypes – Tools for prototyping – Pitching a mobile game: Game Mechanics – Control scheme and Interface – Game Flow. | | |

**Total: 45**

**TEXT BOOK:**


| | |
|---|---|
| 1. | Dr. Claudio Scolastici, David Nolte, "Mobile Game Design Essentials", Packt Publishing Ltd, 2013 |
| 2. | Manning, J., & Buttfield-Addison, P. (2017). "Mobile Game Development with Unity: Build Once, Deploy Anywhere". O'Reilly Media, Inc. |

| COURSE OUTCOMES: On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|---|---|---|
| CO1 | describe the most important design process to develop game | Applying (K3) |
| CO2 | built user interface design for mobile games | Applying (K3) |
| CO3 | focus on the basic structure of game program and its controls along with the creation of user interface | Applying (K3) |
| CO4 | Develop and design controls in mobile games using game programming . | Applying (K3) |
| CO5 | model visual prototype for mobile gaming. | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | | | | | | | | | | 3 | 3 |
| CO2 | 3 | 2 | 3 | | | | | | | | | | 3 | 3 |
| CO3 | 3 | 2 | 3 | | | | | | | | | | 3 | 3 |
| CO4 | 3 | 2 | 3 | | | | | | | | | | 3 | 3 |
| CO5 | 3 | 2 | 3 | | | | | | | | | | 3 | 3 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 15 | 25 | 60 | | | | 100 |
| CAT2 | 10 | 35 | 55 | | | | 100 |
| CAT3 | 15 | 25 | 60 | | | | 100 |
| ESE | 20 | 25 | 55 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## 20CDO04 - INTRODUCTION TO GRAPHICS DESIGN

| Programme& Branch | B.E. – Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 8 | OE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Preamble** | This course provides knowledge of principles of design and how they apply to various graphic designs and provides in-depth knowledge of major design formats and disciplines such as typography, interactive design, motion graphics and package design. This course will benefit the students to apply these design concepts and techniques in upcoming real world scenarios. | |
| **Unit - I** | **Fundamentals of Graphic Design** | **9** |
| Introduction – Graphic design, discipline, career competencies and expectations, importance of design. Basics – Formal elements of design, typographic shapes, HAUS, Laws of perceptual organization. Typography – Elements, Type Classifications, Designing with Type, Spacing, Web Type basics, Expressive typography. Design Process – Design Thinking, Five phase model of design process, Craftsmanship. | | |
| **Unit - II** | **Concept Generation** | **9** |
| Concept Generation and Creativity – Design concept, concept generation process, Tools that stimulate creative thinking. Visualization, icons and color – Image classifications and depictions, signs and symbols, Icon design, Media, methods and visualization, Creating, selecting and manipulating images, Basics of visualizing form, drawing, using color. Composition. | | |
| **Unit - III** | **Proportional systems, Formats and Disciplines** | **9** |
| Proportional Systems, the grid and Brochure design – Mathematical ratios and proportional systems, Grid. Posters - Purpose of posters, Social Commentary. Book covers – purpose of cover design, designing a cover, designing for a series. | | |
| **Unit - IV** | **Branding and Advertising** | **9** |
| Branding and visual identity – Branding, purpose and process of branding, visual identity - purpose and designing, logo - purpose and designing, fundamentals of letterhead design. Advertising - .purpose, who creates advertising? , Role of storytelling and story building, designing ads, The Ad Campaign, Responsible advertising and being proactive. | | |
| **Unit - V** | **Web, Mobile, Motion Design and Package Design** | **9** |
| Web, Mobile and Motion design – expectations from interactive experiences, Websites, Website Development, Conceptual development and visual design, Engaging content, Mobile design, Motion design, and Visual basics for screen based media. Package Design – purpose, considerations, Audio CD package design. | | |

**Total:45**

**TEXT BOOK:**


1. Robin Landa, Graphic Design Solutions, 6th Edition, Cencage Learning,2019
2. Katherine A. Hughes, Graphic Design- Learn It, Do It, 1st Edition, CRC Press, 2019
3. Valerie Colston, Graphic Design: A Practical Guide for Librarians, 1st Edition, Rowman & Littlefield Publishers, 2019

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Understand the formal elements, design principles and process. | Understand (K2) |
| CO2 | Apply the concept generation process and creative thinking for real world design scenarios. | Apply (K3) |
| CO3 | Utilize the formats, disciplines and proportional systems. | Apply (K3) |
| CO4 | Apply branding and logos and identity to products and advertising. | Apply (K3) |
| CO5 | Develop visual language in various projects and media channels including web, mobile and motion design and understand package design. | Apply (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 15 | 60 | 25 | | | | 100 |
| CAT2 | 15 | 65 | 20 | | | | 100 |
| CAT3 | 15 | 65 | 20 | | | | 100 |
| ESE | 10 | 70 | 20 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**CURRICULUM For BACHELOR OF ENGINEERING DEGREE IN**

**COMPUTER SCIENCE AND DESIGN WITH HONORS IN**

**VIRTUAL AND AUGMENTED REALITY**

| S. No. | Course Name | Hours / Week | | | Credit |
|---|---|---|---|---|---|
| | | L | T | P | |
| 1 | Introduction to Immersive Design | 3 | 0 | 0 | 3 |
| 2 | Fundamentals of 3D Engines | 3 | 0 | 0 | 3 |
| 3 | 2D & 3D Character Animation | 3 | 0 | 0 | 3 |
| 4 | Modelling and Dynamics on Computer Graphics | 3 | 0 | 0 | 3 |
| 5 | Mixed Reality Theory | 3 | 1 | 0 | 4 |
| 6 | Virtual Reality in Game Development | 3 | 1 | 0 | 4 |
| **Total Credits** | | | | | **20** |

## INTRODUCTION TO IMMERSIVE DESIGN

| Programme& Branch | B.E. – Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 6 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Preamble** | This course opens a world of possibility to extend the physical spaces around us by enhancingthem with digital content. In Designing Immersive 3D Experiences, designers, and evendevelopers, will learn how to take their traditional 2D knowledge of design and expandit into three dimensions. Understandinghow to design in 3D and then transfer that knowledge into XR is essential for thedesigners of today and tomorrow. Also this course lays out a holistic approach to extended reality development thatconsiders factors from color palettes and lighting to sound stages and typography. | |
| **Unit - I** | **Introduction to Extended Reality** | 9 |
| Extended Reality: The tech behind the acronyms - You are already using extended reality - Prosthetic knowledge - Looking ahead – Technology Check: - Is any of this actually new? - The world in the palm of your hand - Projection mapping - Head-mounted displays - Spatial computing Reality check. | | |
| **Unit – II** | **Immersive Design for 3D** | 9 |
| The Immersive Experience: The world in 3D - Affordances - Multimodal experiences - Experience design – Ideation: Identify the why - Innovation and practicality - Outside influence - Keep it human - The answer to your questions - Creating The Prototype: Fake it 'til you make it - Sketch transparently - The power of prototypes - Use what you know - Process work. | | |
| **Unit – III** | **UX/UI for Immersive Design** | 9 |
| The UX of XR: Approachable design - Seamless user flow - Know thy audience - Making reality accessible - UX challenge - The UI of XR: The z-axis - 3D interface metaphors - Time and space – Microinteractions - Inspiration is all around you. | | |
| **Unit - IV** | **Human Factors and Background of Immersive Design** | 9 |
| Human Factors: Designing the whole experience - Theories of perception - Creating hierarchy in 3D - Human centered - The Uncontrollable Background: Expecting the unexpected - Figure-ground - Location, location, location - Getting emotional - Control is overrated. | | |
| **Unit – V** | **Extended Reality(XR) Development** | 9 |
| Augmented Typography: Legibility and readability - Creating visual contrast - Take control - Design with purpose - Color for XR: Color appearance models - Light interactions - Dynamic adaptation – Reflection - Sound Design: Hearing what you see - Spatial sound - Augmented audio - Voice experiences - Power of sound. | | |
| | | |

**Total:45**

**TEXT BOOK:**


1. Renee Colette Stevens, "Designing Immersive 3D Experiences: A Designer's Guide to Creating Realistic 3D Experiences for Extended Reality ", 1st Edition, New Riders, ASIN : B095BQT1VT, 2021.


**REFERENCES**:


1. Abhishek Kumar "Immersive3D Design Visualization with Autodesk Maya and Unreal Engine 4", 1st Edition, Apress, ISBN: 978-1484265963, 2020.
2. Cornel Hillmann"UX for XR: User Experience Design and Strategies for Immersive Technologies ", 1st Edition, Apress, ISBN: 978-1484270196, 2021.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Understand the fundamentals of immersive design / extended reality (XR). | Applying (K3) |
| CO2 | Outline the phases of immersive design for 3D such as immersive experience, ideation and prototype. | Applying (K3) |
| CO3 | Make use of user experience (UX) / user interface (UI) design concepts for immersive design. | Applying (K3) |
| CO4 | Identify the human factors and background involves in immersive design. | Applying (K3) |
| CO5 | Explain the extended reality (XR) development factors from color palettes and lighting to sound stages and typography. | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 1 | | | | | | | | | 3 | 1 |
| CO2 | 3 | 3 | 3 | 1 | | | | | | | | | 3 | 1 |
| CO3 | 3 | 3 | 3 | 1 | | | | | | | | | 3 | 1 |
| CO4 | 3 | 3 | 3 | 1 | | | | | | | | | 3 | 1 |
| CO5 | 3 | 3 | 3 | 1 | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 25 | 30 | 45 | | | | 100 |
| CAT2 | 20 | 30 | 50 | | | | 100 |
| CAT3 | 25 | 30 | 45 | | | | 100 |
| ESE | 25 | 30 | 45 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

**FUNDAMENTALS OF 3D ENGINES**

| Programme& Branch | B.E. – Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 5 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Preamble** | This course is introducing the fundamental principles of real-time 3D graphics engines. By using state-of-the-art game engines, students can understand interactive application production and master the solving problems the problems related to real-time games, simulations and other interactive applications | |
| **Unit - I** | **Introduction to 3D Engine** | **9** |
| **Introduction:**Rendering Challenges in Virtual Globes - OpenGlobe Architecture – **Math Foundations:** VirtualGlobe Coordinate Systems – EllipsoidBasics – CoordinateTransformations – Curveson an Ellipsoid. | | |
| **Unit – II** | **Rendering** | **9** |
| **Renderer Design:** The Need for a Renderer - Bird's-Eye View - State Management – Shaders -VertexData – Textures - Framebuffers Putting It All Together: Rendering a Triangle **Globe Rendering:**Tessellation – Shading – GPURay Casting. | | |
| **Unit – III** | **Precision** | **9** |
| **Vertex Transform Precision**: Jittering Explained – RenderingRelative to Center – Rendering Relative to Eye Using the CPU – Rendering Relative to Eye Using the GPU – Recommendations – **Depth Buffer Precision**: Causes of Depth Buffer Errors – BasicSolutions – Complementary Depth Buffering – Logarithmic Depth Buffer – Renderingwith Multiple Frustums - W-Buffer. | | |
| **Unit - IV** | **Vector Data** | **9** |
| **Vector Data and Polylines:**Sources of Vector Data – CombatingZ-Fighting – Polylines – **Polygons:**Render to Texture – TessellatingPolygons – Polygonson Terrain – **Billboards:** Basic Rendering - MinimizingTexture Switches – Originsand Offsets – Rendering Text. | | |
| **Unit – V** | **Terrain** | **9** |
| **Terrain Basics:** Terrain Representations – Rendering Height Maps – Computing Normals – Shading – **Massive-Terrain Rendering:** Level of Detail – Preprocessing – Out-of-Core Rendering – Culling – **Geometry Clip mapping:** The Clipmap Pyramid – Vertex Buffers - Vertex and Fragment Shaders – Blending – Clipmap Update – Shading - Geometry Clipmapping on a Globe. | | |

**Total:45**

**TEXT BOOK:**

1. Patrick Cozzi, "3D Engine Design for Virtual Globes", 1st Edition, A K Peters / CRC Press, ISBN: 978-1568817118, 2011.

**REFERENCES**:


1. David H. Eberly, "3D Game Engine Architecture: Engineering Real-Time Applications with Wild Magic", 1st Edition, CRC Press, ISBN: 978-0122290640, 2004.
2. Stefan Zerbst and Oliver Duvel, "3D Game Engine Programming", Pap/Cdr Edition, Premier Press, ISBN: 978-1592003518, 2004.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Understand the fundamental concepts of 3D engine design. | Applying (K3) |
| CO2 | Outline the various rendering methods for 3D engine design. | Applying (K3) |
| CO3 | Make use of various precision techniques for 3D engine design. | Applying (K3) |
| CO4 | Identify and explain the various sources of vector data and rendering option in polygons and billboards. | Applying (K3) |
| CO5 | Illustrate the basics of terrain and geometry clipmapping. | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 25 | 30 | 45 | | | | 100 |
| CAT2 | 20 | 30 | 50 | | | | 100 |
| CAT3 | 25 | 25 | 50 | | | | 100 |
| ESE | 25 | 30 | 50 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

# 2D AND 3D CHARACTER ANIMATION

| Programme& Branch | B.E. – Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 5 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Preamble** | This course provides fundamentals of 2D and 3D character design and character animation that includes actions with animated characters, animation of human characters and animal characters and lip-sync. This course will benefit the students to apply these techniques in upcoming real world scenarios. | |
| **Unit - I** | **Introduction to Character design and Animation** | **9** |
| Basics of Character Design – Modeling Characters – Surface types, Creating characters. Rigging Characters – Hierarchies, Facial Rigging, Mesh Deformation, Refining Rigs. Basics of Animation – Understanding Motion, Animation Interfaces, Language of movement, Secondary action. | | |
| **Unit - II** | **Character Construction** | **9** |
| Construction of Simple character – Basic human anatomy, Joints, Arcs, Designing a basic human character, Designing 3D character. Actions with Animated Character – Timing, Anticipation, Follow through, Overlapping Action, Vibration. | | |
| **Unit - III** | **Animation of Walks and Runs** | **9** |
| Animation of Human Walks and Runs – Walk cycles, Pace, Walking mechanics, Walk cycles displaying different moods, External Influences, Walking together, Running. Animation of Animation Walks and Runs – Four types of Animal locomotion, Construction of an animal, Animal leg and foot construction, Animal runs. | | |
| **Unit - IV** | **Animation of Acting** | **9** |
| Body Language – Acting, Consequence, Emotion, Laban movement theory, General body language, Basic body postures, Basic modes, Gestures, Rhythm in Animation, video footage, Rotoscoping, types of animation acting. Facial Expressions – Emotions, Eyes, Facial Expressions, Head Angle, Hand to face gestures, Close-ups, Animating a piece of facial acting. | | |
| **Unit - V** | **Animation of Acting and Lip-Sync** | **9** |
| Animation of Acting: Two or more characters – Two characters on screen together, Personal space, Mirroring, Characters looking at each other, Acting with each other while talking, Alternating from one shot to another, Large group of characters on screen. Lip-Sync – Recording and Breaking down a dialog track, How we speak, Acting with dialog, Mouth shapes, Animating with mouth shapes. | | |

**Total:45**

**TEXT BOOK:**


1. George Maestri, Digital Character Animation 3, 1st Edition, New Riders Publishers, 2006 for Unit – I
2. Steve Roberts, Character Animation Fundamentals: Developing Skills for 2D and 3D Character Animation, 1st Edition, Routledge Publishers, 2017. For Units – II to V


**REFERENCES:**


1. Steve Roberts, Character Animation: 2D Skills for Better 3D, 2nd edition, Focal Press, 2007.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Outline the fundamental concepts of Character design and Animation. | Understand (K2) |
| CO2 | Construct simple characters and perform actions with animated Character. | Apply (K3) |
| CO3 | Explore animation of human and animal walks and runs | Apply (K3) |
| CO4 | Understand Animation of Acting with body language and facial expressions. | Understand (K2) |
| CO5 | Understand Animation of Acting with multiple characters and lip-sync. | Understand (K2) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 15 | 60 | 25 | | | | 100 |
| CAT2 | 15 | 40 | 45 | | | | 100 |
| CAT3 | 15 | 50 | 35 | | | | 100 |
| ESE | 10 | 60 | 30 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

# MODELLING AND DYNAMICS FOR COMPUTER GRAPHICS

| Programme& Branch | B.E. – Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 5 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Preamble** | This course provides fundamentals of **Physically based Modeling**, prototype libraries and insight of simulating humans with respect to their behaviors and specifications. This course will benefit the students to apply these techniques in upcoming real world scenarios. | |
| **Unit - I** | **Introduction to Physically based Modeling** | **9** |
| Introduction – Overview -Overview of Physically Based Modeling. Structured Modeling - A Structured Analysis of Modeling - Structured Physically-Based Modeling - Structured Mathematical Modeling - Structured Mathematical Modeling. Mathematical Modules -. Structured Naming Strategies - Mathematical State Spaces - Identifiers (Ids) - Indexed Sets and Trees. | | |
| **Unit - II** | **Prototype Libraries** | **9** |
| Model Libraries – Coordinate frames model - Kinematic Rigid Bodies model -Dynamic Rigid-Bodies Model – Fancy forces model – Tennis ball Cannon – Extensions to Prototype Library – Rigid body collision - Rigid body contact – Finite state control – Mixed dynamic and kinematic motion – flexible bodies. | | |
| **Unit - III** | **Simulating Humans** | **9** |
| Introduction - Why Make Human Figure Models? - Historical Roots – current possibilities - Manipulation, Animation, and Simulation. Body Modeling - Geometric Body Modeling - Representing Articulated Figures - A Flexible Torso Model - Shoulder Complex - Clothing Models. Spatial Interaction - Direct Manipulation - Manipulation with Constraints - Inverse Kinematic Positioning - Reachable Spaces. | | |
| **Unit - IV** | **Behavioral control and simulation** | **9** |
| Behavioral Control - An Interactive System for Postural Control - Interactive Manipulation With Behaviors - The Animation Interface - Human Figure Motions - Virtual Human Control. Simulation with Societies of Behaviors - Forward Simulation with Behaviors – Locomotion - Strength Guided Motion - Collision-Free Path and Motion Planning - Posture Planning. | | |
| **Unit - V** | **Specifications and Epilogue** | **9** |
| Task-Level Specifications - Performing Simple Commands - Language Terms for Motion and Space - Task-Level Simulation - A Model for Instruction Understanding. Interactive human models - Reasonable Biomechanical Properties - Human-like Behaviors - Simulated Humans as Virtual Agents - Task Guidance through Instructions - Natural Manual Interfaces and Virtual Reality- Generating Text, Voice-over, and Spoken Explication for Animation - Coordinating Multiple Agents. | | |

**Total:45**

**TEXT BOOK:**


1. Ronen Barzel, Physically-Based Modeling for Computer Graphics: A Structured Approach, 1st Edition, Morgan Kaufmann Publishers, 1992 for Units I & II
2. Norman I. Badler,Cary B. Phillips, Bonnie Lynn Webber, Simulating Humans: Computer Graphics, Animation, and Control, 1st Edition, Oxford University Press, 1993. For units – III to V

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Outline the fundamental concepts of Physically based Modeling. | Understand (K2) |
| CO2 | Make use of the prototype libraries for graphic designing. | Apply (K3) |
| CO3 | Understand simulation of humans and explore the simulation models. | Understand (K2) |
| CO4 | Develop an interactive system based on human behaviors and motion. | Apply (K3) |
| CO5 | Understand and make use of the task level specifications and coordinating multiple agents. | Understand (K2) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 2 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 15 | 60 | 25 | | | | 100 |
| CAT2 | 15 | 40 | 45 | | | | 100 |
| CAT3 | 15 | 50 | 35 | | | | 100 |
| ESE | 10 | 60 | 30 | | | | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

# MIXED REALITY THEORY

| Programme& Branch | B.E. – Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | | PC | 3 | 1 | 0 | 4 |

| | | |
|---|---|---|
| Preamble | This course helps the students to provide broad range of mixed reality engineering issues in Interaction Design, Software Design and Implementation and Application. | |
| **Unit - I** | **Overview** | **9** |
| Definition of Mixed Reality –Centricity and Control issues associated with mixed reality – Global taxonomy of mixed reality display integration – Steps toward Seamless mixed reality | | |
| **Unit - II** | **Interaction Design** | **9** |
| Integrating Framework for mixed systems- Holistic Approach to Design and Evaluation of mixed reality systems – Embedded mixed reality environments –Semantic Environments Heuristics for a cross-context Human Information Interaction model. | | |
| **Unit - III** | **Design Issues** | **9** |
| Tangible Interaction in Mixed reality systems – Designing a Mixed reality Intergenerational entertainment system – Auditory-induced presence in Mixed reality Environments – Exploration of Exertion – Developing Mixed interactive Systems | | |
| **Unit - IV** | **Software Design and Implementation** | **9** |
| Designing Outdoor –Multimodal Excitatory interfaces with automatic content classification – Management of tracking – Authoring Immersive – Model-based approach – Software Engineering Method | | |
| **Unit - V** | **Applications** | **9** |
| Health Care Services with mixed reality systems - Experience induction machine –Mycoach - RoboCup mixed reality league – Mixed-reality prototypes to support early creative design | | |

**Total: 45**

**TEXT BOOK:**


| | |
|---|---|
| 1. | Tamura, H. (1998). Mixed reality: Merging real and virtual worlds. Journal of the Robotics Society of Japan, 16(6), 759-762. For unit I |
| 2. | Dubois, Emmanuel, Philip Gray, and Laurence Nigay, eds. The engineering of mixed reality systems. Springer Science & Business Media, 2009. For unit II-V |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Focus on the general concept of mixed reality | Applying (K3) |
| CO2 | Demonstrate the interaction design and development of mixed reality systems | Applying (K3) |
| CO3 | Have in-depth understanding about the design issues of mixed reality | Applying (K3) |
| CO4 | Address technical platforms and solutions for interaction techniques, development tools and a global view on software development process | Applying (K3) |
| CO5 | Highlights the application of mixed reality in a number of fields | Applying (K3) |

| **Mapping of COs with POs and PSOs** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| 1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy | | | | | | | | | | | | | | |

| **ASSESSMENT PATTERN - THEORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | 20 | 40 | 40 | - | - | - | 100 |
| CAT2 | 10 | 50 | 40 | - | - | - | 100 |
| CAT3 | 15 | 45 | 40 | - | - | - | 100 |
| ESE | 10 | 50 | 40 | - | - | - | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

# VIRTUAL REALITY IN GAME DEVELOPMENT

| Programme& Branch | B.E. – Computer Science and Design | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | | PC | 3 | 1 | 0 | 4 |

| | | |
|---|---|---|
| Preamble | This course helps the students to take a practical, project-based approach to teach the specifics of VR development using the Unity 3D game engine. | |
| **Unit - I** | **Introduction** | **9** |
| Virtual reality - Differences between virtual reality and augmented reality - Applications versus games - Types of VR experience - Types of HMD - Virtual reality works - Technical skills that are important to VR- Technical requirements - Installing Unity - Getting started with Unity - Creating a simple diorama - Using prefabs - Importing content. | | |
| **Unit – II** | **Building Project for VR** | **9** |
| Unity XR platform - VR platforms and toolkits- Enabling virtual reality -Building and running -Building for SteamVR, Oculus Rift, Immersive Windows MR, Oculus Quest and Google Cardboard. Gaze-Based Control - Interacting with Your Hands - Setting up the scene - Input Manager button - Controlling balloons with the input trigger - Unity events for input - Tracking your hands - Interacting with a balloon gun - Popping balloons | | |
| **Unit - III** | **User Interface for VR** | **9** |
| Canvasing the World Space UI : VR design principles- Reusable default canvas - HUD - In-game world space UI - Reticle cursor Interactive dashboard - Direct interaction - Wrist-based menu palette. Glide locomotion- XRI Locomotion System-Teleporting between locations-Locomotion and comfort in VR-Lighting, Rendering, Realism: Strategies - environment lighting - PBR materials and URP Shaders - Light objects and Emission surfaces-Light and Reflection Probes - Post-processing effects | | |
| **Unit - IV** | **Exploring Interactive Space** | **9** |
| Playing with Physics and Fire: Unity physics-Creating bouncy balls – Game Object life cycle – Build headshot game,Paddleball game and shooter ball game -Juicing - Exploring Interactive Spaces: ProBuilder and ProGrids -Art gallery building - Assembling the scene - Creating the artwork rig - Adding pictures - Managing art info data -Displaying the art info -Adjusting for image aspect ratio-Teleporting around the gallery | | |
| **Unit - V** | **Animation and Optimization** | **9** |
| Using All 360 Degrees : Exploring media- Photo globes -Viewing photos - Playing videos - Unity skyboxes -Capturing.Animation and VR: Composing - Audio tracks -Activate objects - Animation Track -Animation editor - Animation clips - Animator Controller. Optimizing for Performance and Comfort: Unity Profiler and Stats windows -Optimizeart, scene with static objects, rendering pipeline and code - Runtime performance and debugging. | | |

**Total: 45**

**TEXT BOOK:**


1. Linowes, Jonathan. Unity 2020 Virtual Reality Projects: Learn VR Development by Building Immersive Applications and Games with Unity 2019.4 and Later Versions. Packt Publishing Limited, 2020.
2. Murray, Jeff W. Building Virtual Reality with Unity and SteamVR. CRC Press, 2020.

| | **COURSE OUTCOMES:**<br>On completion of the course, the students will be able to | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | Introduction to the new technologies and opportunities in consumer VR in gamming applications | Applying (K3) |
| CO2 | Set up the project for VR using Unity Scripting | Applying (K3) |
| CO3 | Implement UI for VR using Unity world space canvas | Applying (K3) |
| CO4 | Explore the unity physics engine and teaches how to build an interactive art gallery | Applying (K3) |
| CO5 | Demonstrate how to build a complete VR and use the Unity profile in VR application | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 3 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 20 | 40 | 40 | - | - | - | 100 |
| CAT2 | 10 | 50 | 40 | - | - | - | 100 |
| CAT3 | 15 | 45 | 40 | - | - | - | 100 |
| ESE | 10 | 50 | 40 | - | - | - | 100 |

*** ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)**

## Specialization in Data Science

| S. No. | Course Name | L | T | P | Credit |
|---|---|---|---|---|---|
| 1 | Statistical Learning | 3 | 0 | 0 | 3 |
| 2 | Data preparation and Analysis | 3 | 0 | 0 | 3 |
| 3 | Content based video and image retrieval | 3 | 0 | 0 | 3 |
| 4 | Stochastic Modeling | 3 | 0 | 0 | 3 |
| 5 | Reinforcement Learning | 3 | 0 | 0 | 3 |
| 6 | Real-Time Analytics | 3 | 0 | 0 | 3 |

**DATA PREPARATION AND ANALYSIS**

| | Category | L | T | P | Credit | |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 | |

| | |
|---|---|
| Preamble | This course provides various techniques to prepare data for analysis, perform exploratory data analysis, and develop meaningful data visualizations. |
| Prerequisites | Nil |

**UNIT – I** **9**

**Data Gathering and Preparation:** Introduction: Sources of Data - Process for Making Sense of Data. Describing Data: Process for Making Sense of Data - Types of Variables - Central Tendency - Distribution of the Data Confidence Intervals - Hypothesis Tests. Data Loading, Storage and File formats: Reading and Writing Data in Text Format - Binary Data Formats - Interacting with Web APIs - Interacting with Databases.

**UNIT – II** **9**

**Data Cleaning:** Preparing Data Tables: Cleaning the Data - Removing Observations and Variables - Generating Consistent Scales Across Variables - New Frequency Distribution - Converting Text to Numbers - Converting Continuous Data to Categories Combining Variables - Generating Groups - Preparing Unstructured Data. Data Cleaning: Handling Missing Data - Data Transformation.

**UNIT – III** **9**

**Exploratory Analysis:** Understanding Relationships: Visualizing Relationships Between Variables -

Calculating Metrics About Relationships. Identifying and Understanding Groups: Clustering - Association Rules - Learning Decision Trees from Data.

**UNIT – IV** **9**

**Prediction and Data Wrangling:** Building Models from Data: Linear Regression - Logistic Regression - k- Nearest Neighbors - Classification and Regression Trees - Other Approaches. Data Wrangling: Hierarchical Indexing - Combining and Merging Datasets - Reshaping and Pivoting.

**UNIT – V** **9**

**Visualization and Data Aggregation:** A Brief matplotlib API Primer - Plotting with Pandas and Seaborn - Other Python Visualization Tools - Data Aggregation and Group Operations: Group By Mechanics - Data Aggregation – Apply: General split apply combine - Pivot Tables and Cross Tabulation.

**Lecture:45**

**TEXT BOOKS:**


1. Glenn J. Myatt, Wayne P. Johnson, "Making Sense of Data I: A practical Guide to Exploratory Data Analysis and Data Mining", 2nd Edition, Wiley Publication, 2014.
2. Wes McKinney, “Python for Data Analysis”, 2nd Edition, O'Reilly Media Publication, 2017.


**REFERENCES:**


1. Jake VanderPlas, "Python Data Science Handbook", O'Reilly Media Publication, 2016.
2. Ramesh Sharda, Dursun Delen, Efraim Turban, “Business Intelligence, Analytics, and Data Science: A Managerial Perspective” 4th Edition, Pearson Education, 2017.

## STATISTICAL LEARNING

| Programme & Branch | B.E. – Computer Science and Engineering | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | | | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | The course provides an overview of statistical learning with various modeling and prediction techniques and implement the techniques using R. | |
| **Unit - I** | **Introduction and Statistical Learning:** | **9** |
| Introduction: An Overview of Statistical Learning – History - Statistical Learning: Overview – Assessing Model Accuracy – Introduction to R and working with R. | | |
| **Unit - II** | **Linear Regression and Classification:** | **9** |
| Linear Regression: Simple Linear Regression - Multiple Linear Regression – Other Considerations – Working with Linear Regression using R– Classification: Overview – Logistic Regression – Linear Discriminant Analysis – Working with Logistic Regression using R. | | |
| **Unit - III** | **Resampling Methods and Linear Model Selection:** | **9** |
| Resampling Methods: Cross-Validation – Bootstrap - Working with Cross-Validation in R– Linear Model Selection: Subset Selection – Dimension Reduction Methods – Working with PCR in R. | | |
| **Unit - IV** | **Non-Linear Modeling and Tree-based Methods:** | **9** |
| Beyond Linearity: Polynomial Regression – Step Functions – Basis Functions – Regression Splines – Smoothing Splines – Working with Non-Linear Modeling in R – Tree-Based Methods – Basic Decision Trees – Bagging – Random Forests – Boosting – Working with Decision Trees in R | | |
| **Unit - V** | **Support Vector Machines and Unsupervised Learning:** | **9** |
| Support Vector Machines: Maximal Margin Classifier – Support Vector Classifier – Support Vector Machine – Working with SVM in R – Unsupervised Learning: Clustering Methods – Working with Clustering in R | | |

**Total: 45**

**TEXT BOOK:**

| | | |
|---|---|---|
| 1. | James G, Witten D, Hastie T, Tibshirani R, "An Introduction to Statistical Learning with Applications in R", 1st edition, Springer, 2017-ebook-8th printing | I,II,III,IV,V |

**REFERENCES:**

| | |
|---|---|
| 1. | Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning”, 2nd edition, Springer 2009. |
| 2. | Douglas C, Montgomery and George C Runger, “Applied Statistics and Probability for Engineers”, 3rd Edition, John Wiley & Sons Inc., 2003. |

## CONTENT BASED VIDEO AND IMAGE RETRIEVAL

| Category | L | T | P | Credit |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |

| | |
|---|---|
| Preamble | Provides basic knowledge about image, Similarity Measures and various image retrieval techniques and prepares the students to retrieve information from video. |
| Prerequisites | **Nil** |

**UNIT – I** **9**

**Content Based Image Retrieval**: Introduction - Multimedia Information Retrieval-Image Retrieval- Low level features of an image – Spatial information - Visual Content Descriptor – Similarity Measures and Indexing Schemes – User Interaction - Region Based Image Retrieval: Introduction - Framework - System and User Designated ROI Approaches.

**UNIT – II** **9**

**Similarity Measures and Performance Evaluation**: Similarity Measures – Performance Evaluation - **MPEG-7: Multimedia Content Description Standard:** Introduction **-** MPEG-7 multimedia context and Applications – Constructs - Description definition language - Multimedia Description Schemes- Description Tools.

**UNIT – III** **9**

**Shape, Color and Texture Feature**: Introduction- One-Dimensional Function- Color Feature: Basics - CIE Chromaticity-Based Models- RGB Color Model - YIQ Color Space - HSI Family of Color Models - Texture Feature: Introduction - Perceptual Model of Texture- Models of Texture.

**UNIT – IV** **9**

**Relative Locations of Multiple Regions of Interest Using Selective Regions Matching:** Introduction- Related Work- Region Codes-Based Selective Region Matching- Experimental Results. **Location-Independent Regions of Interest:** Introduction- Related Work- Retrieval Technique- Experimental Evaluation.

**UNIT – V** **9**

**Content based Retrieval**: Introduction- Information Retrieval- Content Based Video Retrieval. Video Modeling- Spatio- Temporal Formalization of Video Events - Stochastic Modeling of Events.

**Lecture:45, Total: 45**

**REFERENCES/MANUAL/SOFTWARE:**


1. Vipin Tyagi, “Content Based Image Retrieval Ideas, Influences and Current Trends”, Springer, 2018
2. Milan Petkovic, William Jonker, “Content Based Video Retrieval A Database Perspective”, Springer, 2013

## STOCHASTIC MODELING

| Category | L | T | P | Credit |
|---|---|---|---|---|
| | 3 | 0 | 0 | 3 |

| | |
|---|---|
| **Preamble** | The purpose of this course is to equip students with theoretical knowledge and practical skills, which are necessary for the analysis of stochastic dynamical systems in engineering and other fields |
| **Prerequisites** | Probability and Statistics |

**UNIT – I** **9**

**Stochastic Processes**: Introduction – Probability – Random Variable – Expected Value – Stochastic Process- The Poisson Process: Interval and Waiting Time Distributions Conditional Distribution of Arrival Time – Non Homogeneous Poisson Process – Renewal Theory

**UNIT – II** **9**

**Markov Chains**: Definition, Chapman-Kolmogorov Equations – Limit Theorems – Branching Process – Applications of Markov Chain – Time Revisable Markov Chain – Semi Markov Process

**UNIT – III** **9**

**Continuous Time Markov Chain:** Introduction – Birth and Death Process - Kolmogorov Differential Equations – Limiting Probability – Time reversibility – Applications of Reversed Chain to Queuing Theory – Uniformization

**UNIT – IV** **9**

**Brownian Motion:** Introduction – Hitting Times, Maximum Variable, and Arc Sine Laws – Variations on Brownian Motion - Brownian Motion with Drift - Backward and Forward Diffusion Functions – Applications of Kolmogorov Equations – Markov Shot Noise Process – Stationary Process

**UNIT – V** **9**

**Stochastic Order Relations:** Stochastically Larger – Coupling – Hazard Rate Ordering and Applications to Counting Process – Likelihood Ration Ordering - Stochastically more Variable – Applications of Variability Orderings – Associated Random Variable

**Total: 45**

**TEXT BOOK:**


1. Sheldon M. Ross, “Stochastic Processes”, Wiley, Second Edition , 2008
2. Saeed Ghahramani, “Fundamentals of Probability with Stochastic Processes”, Prentice Hall, New Jersy, 2014.


**REFERENCES:**


1. Roy D.Yates and David J. Goodman, “Probability and Stochastic Processes – A friendly Introduction for Electrical and Computer Engineers”, John Wiley & Sons, 2015.
2. Medhi J, “Stochastic Processes”, New Age International Publishers ,New Delhi, 2014.

**REINFORCEMENT LEARNING**

| Programme & Branch | B.E. & Computer Science and Engineering | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Deep Learning | | | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course will provide a solid introduction to the field of reinforcement learning and explore the core challenges and approaches, including generalization and exploration with reinforcement learning algorithms. | |
| **Unit - I** | **Title:** | **9** |
| **Introduction :** Reinforcement Learning – Examples-Elements of Reinforcement Learning – Limitations and Scope – **Multi –armed Bandits :** A k-armed Bandit Problem - Action-value Methods - The 10-armed Testbed - Incremental Implementation - Tracking a Non-stationary Problem - Optimistic Initial Values - Gradient Bandit Algorithms | | |
| **Unit - II** | | **9** |
| **Finite Markov Decision processes :** The Agent – Environment Interface - Goals and Rewards - Returns and Episodes - Unified Notation for Episodic and Continuing Tasks - Policies and Value Functions - **Dynamic programming**: Policy Evaluation (Prediction) - Policy Improvement - Policy Iteration - Value Iteration -Asynchronous Dynamic Programming - Generalized Policy Iteration | | |
| **Unit - III** | | **9** |
| **Monte carlo methods :** Monte Carlo Prediction - Monte Carlo Estimation of Action Values - Monte Carlo Control - Monte Carlo Control without Exploring Starts - Off-policy Prediction via Importance Sampling -Incremental Implementation - Off-policy Monte Carlo Control - **Temporal Difference Learning:** TD Prediction - Advantages of TD Prediction Methods - Optimality of TD(0) - Sarsa: On-policy TD Control - Q-learning: Off-policy TD Control | | |
| **Unit - IV** | | **9** |
| **n-step Bootstrapping :** n-step Sarsa - n-step Off-policy Learning - n-step Tree Backup Algorithm - **Planning and Learning with Tabular Methods** : Models and Planning – Dyna - Integrated Planning, Acting, and Learning - Prioritized Sweeping - Expected vs. Sample Updates - Trajectory Sampling - Real-time Dynamic Programming - Planning at Decision Time - Heuristic Search - Rollout Algorithms - Monte Carlo Tree Search | | |
| **Unit - V** | | **9** |
| **On-policy Prediction with Approximation:** Value-function Approximation - The Prediction Objective (VE) - Stochastic-gradient and Semi-gradient Methods - Linear Methods - Feature Construction for Linear Methods -Selecting Step - Size Parameters Manually - **On-policy Control with Approximation:** Episodic Semi-gradient Control - Semi-gradient n-step Sarsa - Average Reward: A New Problem Setting for Continuing Tasks - Policy Gradient Methods | | |

**Lecture: 45, Total: 45**

**REFERENCES:**


| | |
|---|---|
| 1. | Sutton and Barto ,"Reinforcement Learning: An Introduction", The MIT Press, 2nd Edition,2018 |
| 2. | Marco Wiering and Martijn van Otterlo ,"Reinforcement Learning: State-of-the-Art(Adaptation, Learning, and Optimization )",Volume-12 ,Springer ,2012 |

**REAL-TIME ANALYTICS**

| Programme & Branch | B.E. – Computer Science and Engineering | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | | | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides a comprehensive knowledge about data analysis technologies to build an effective real-time analytics platform. | |
| **Unit - I** | **Streaming Data and analytics** | **9** |
| Introduction to Streaming Data: Sources – Why Streaming Data is Different – Infrastructures and Algorithms. Streaming Analytics Architecture: Real-Time Architecture Components – Feature of Real-Time Architecture – Languages for Real-Time programming – A Real-Time Architecture Checklist. | | |
| **Unit - II** | **Processing and Storing Streaming Data** | **9** |
| Processing Streaming Data: Distributed Streaming Data Processing – Processing Data with Storm: Components, Configuring of a Storm Cluster – Distributed Clusters – Local Clusters – Storm Topologies. Storing Streaming Data : Consistent Hashing – No SQL Storage Systems – Other Storage Technologies – Choosing a Technology – Warehousing. | | |
| **Unit - III** | **Visualization and Aggregation** | **9** |
| Visualization: Visualizing Data – Mobile Streaming Applications – Exact Aggregation and Delivery: Timed Counting and Summation – Multi –Resolution Time-Series Aggregation – Stochastic Optimization | | |
| **Unit - IV** | **Statistical Approximation of Streaming Data and Sketching** | **9** |
| Statistical Approximation of Streaming Data: Sampling from a streaming Population – Biased Streaming Sampling. Sketching : Registers and Hash Functions – Working with Sets – The Bloom Filter – Distinct Value Sketches – The Count-Min Sketch – Other Applications | | |
| **Unit - V** | **Real-Time Models, Monitoring and Forecasting** | **9** |
| Real-Time Models and Monitoring: Simple Time-Series Models – Linear Models – Logistic Regression – Neural Network Models – Forecasting: Exponential Smoothing Methods – Regression Methods - Neural Network Methods. Monitoring: Outlier Detection - Change Detection | | |

**Total: 45**

**TEXT BOOKS:**


1. Ellis, Byron. “Real-time analytics: Techniques to analyze and visualize streaming data”, John Wiley & Sons, 1st Edition, 2014


**REFERENCES:**


1. Goetz, P. Taylor, and Brian O'Neill, “Storm blueprints: patterns for distributed real-time computation”, Packt Publishing Ltd, 1st Edition, 2014.