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 AND OUTCOME BASED EDUCATION)

(For the students admitted from 2020 - 2021 and onwards)

BACHELOR OF ENGINEERING DEGREE
IN
COMPUTER SCIENCE AND ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

KONGU

Assuring the Best

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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 ENGINEERING

VISION

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

MISSION

Department of Computer Science Engineering is committed to:

MS1: Develop innovative, competent and ethically strong computer engineers 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 Engineering programme will:

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

PEO2: Analyze, design, develop and verify 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 Engineering 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 Engineering 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 systems using engineering skills, knowledge of software design process, 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/industrial 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 Training, Industrial Training, 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:

SNo	Specializations for Honours degree in emerging areas	To be offered as Honours, Only for the following branches mentioned against the specialization
1.	Construction Technology	BE – Civil Engineering
2.	Smart Cities	BE – Civil Engineering
3.	Smart Manufacturing *	BE – Mechanical Engineering
4.	Computational Product Design *	BE – Mechanical Engineering
5.	Intelligent Autonomous Systems *	BE – Mechatronics Engineering
6.	E-Mobility *	BE – Automobile Engineering
7.	Artificial Intelligence and Machine Learning	BE – Electronics and Communication Engineering
8.	System on Chip Design *	BE – Electronics and Communication Engineering
9.	Electric Vehicles	BE – Electrical and Electronics Engineering
10.	Microgrid Technologies	BE – Electrical and Electronics Engineering
11.	Intelligent Sensors Technology *	BE – Electronics and Instrumentation Engineering
12.	Smart Industrial Automation *	BE – Electronics and Instrumentation Engineering
13.	Data Science	BE – Computer Science and Engineering
14.	Cyber Security	BE – Computer Science and Engineering
15.	Data Science	BTech – Information Technology
16.	Cyber Security	BTech – Information Technology
17.	Petroleum and Petrochemical Engineering *	BTech – Chemical Engineering
18.	Waste Technology *	BTech – Chemical Engineering
19.	Food Processing and Management *	BTech – Food Technology
20.	Virtual and Augumented Reality	BE- Computer Science and Design
21.	Data Science	BE- Computer Science and Design
22.	Internet of Things (IoT)	BTech – Artificial Intelligence and Data Science
23.	Blockchain	BTech – Artificial Intelligence and Data Science
24.	Internet of Things (IoT)	BTech – Artificial Intelligence and Machine Learning
25.	Blockchain	BTech – Artificial Intelligence and Machine Learning

*Title by KEC

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/industrial training, comprehensive test & viva, internship and entrepreneurships/start ups during the programme to gain/exhibit the knowledge/skills.

4.3.1 Professional Skills Training/ Industrial 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 Phase-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 / II or Industrial Training-I/ II respectively. 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 project 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 the 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 - I / Industrial Training / Mandatory Course	100	---
4.	Project Work-II Phase-I / Project Work-II Phase-II / Internships	50	50
5.	Value Added Course	The distribution of marks shall be decided based on the credit weightage assigned	---
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:

<table>
<tr><th>Sl. No.</th><th>Type</th><th>Max. Marks</th><th>Remarks</th></tr>
<tr><td rowspan="3">1.</td><td>Test - I</td><td>30</td><td rowspan="3">Average of best two</td></tr>
<tr><td>Test - II</td><td>30</td></tr>
<tr><td>Test - III</td><td>30</td></tr>
<tr><td>2.</td><td>Tutorial</td><td>15</td><td>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)</td></tr>
<tr><td>3.</td><td>Assignment / Paper Presentation in Conference / Seminar / Comprehension / Activity based learning / Class notes</td><td>05</td><td>To be assessed by the Course Teacher based on any one type.</td></tr>
<tr><td colspan="2" align="right">Total</td><td>50</td><td>Rounded off to the one decimal place</td></tr>
</table>

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 4th semester vacation and during 5th semester. Phase-II training shall be conducted for minimum of 80 hours in 5th semester vacation and during 6th semester. The evaluation procedure shall be approved by Principal.

7.9 Comprehensive Test and 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 project through 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. 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.

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.

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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B.E. DEGREE IN COMPUTER SCIENCE AND ENGINEERING
CURRICULUM UNDER REGULATIONS 2020
(For the candidates admitted from academic year 2020-2021 onwards)

CURRICULUM BREAKDOWN STRUCTURE (for 2020-21 / 2021-22 batches of students)										
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	11	4	4					30	17.75
ES	4	4	4			7			19	11.24
PC	4	4	12	16	12	5	4		57	33.72
PE					3		12	3	18	10.65
OE				4	4	3		3	14	8.3
EC					2	6	6	4	18	10.65
MC										-
Semesterwise Total	22	23	23	24	21	21	25	10	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 semester wise curriculum)							
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 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 and 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.	20PHT23	Physics for Communication and Computer Science Engineering	3	0	0	3	II
7.	20CYT23	Chemistry of Electronic Materials	3	0	0	3	II
8.	20PHL27	Physical Sciences Laboratory - II	0	0	2	1	II
9.	20MAT34	Discrete Mathematical Structures	3	1	0	4	III
10.	20MAT42	Probability and Statistics	3	1	0	4	IV
Total Credits to be earned						**30**	

ENGINEERING SCIENCE (ES)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	20CSC11	Basics of Electrical and Electronics Engineering	3	0	2	4	I
2.	20MEC11	Engineering Drawing	2	0	2	3	I
3.	20MEL11	Engineering Practices Laboratory	0	0	2	1	II
4.	20CSC32	Digital Principles and Design	3	0	2	4	III
5.	20CST62	Internet of Things and Cloud	3	0	0	3	VI
6.	20CST63	Mobile Communication	3	0	0	3	VI
7.	20CSL62	Internet of Things and Cloud Laboratory	0	0	2	1	VI
Total Credits to be earned						**19**	

PROFESSIONAL CORE(PC)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	20CST11	Problem Solving and Programming	3	0	0	3	I
2.	20CSL11	Problem Solving and Programming Laboratory	0	0	2	1	I
3.	20CST21	Programming and Linear Data Structures	3	0	2	4	II
4.	20CST31	Data Structures	3	0	0	3	III
5.	20CST32	Object Oriented Programming	3	0	0	3	III
6.	20CST33	Computer Organization	3	1	0	4	III
7.	20CSL31	Data Structures Laboratory	0	0	2	1	III
8.	20CSL32	Object Oriented Programming Laboratory	0	0	2	1	III
9.	20CST41	Database Management Systems	3	0	0	3	IV
10.	20CST42	Python Programming and Frameworks	3	0	0	3	IV
11.	20CSC42	Design and Analysis of Algorithms	3	0	2	4	IV
12.	20CST43	Operating Systems	3	1	0	4	IV
13.	20CSL41	Database Management Systems Laboratory	0	0	2	1	IV
14.	20CSL42	Python Programming and Frameworks Laboratory	0	0	2	1	IV
15.	20CST51	Computer Networks	3	0	0	3	V
16.	20CST52	Machine Learning	3	0	0	3	V
17.	20CST53	Agile Methodologies	3	0	0	3	V
18.	20CSL51	Network Laboratory	0	0	2	1	V
19.	20CSL52	Machine Learning Laboratory	0	0	2	1	V
20.	20CSL53	Software Development Laboratory	0	0	2	1	V
21.	20CST61	Principles of Compiler Design	3	0	0	3	VI
22.	20CSL61	Compiler Design Laboratory	0	0	2	1	VI
23.	20CSL63	Open Source Systems Laboratory	0	0	2	1	VI
24.	20CST71	Deep Learning	3	0	2	4	VII
Total Credits to be earned						**57**	

PROFESSIONAL ELECTIVE (PE)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**	**Domain/ Stream**
		Elective 1						
1.	20CSE01	Theory of Computation	3	0	0	3	V	SD
2.	20CSE02	Data science	3	0	0	3	V	AI
3.	20CSE03	Building Enterprise Applications	3	0	0	3	V	SDE
4.	20CSE04	Artificial Intelligence	3	0	0	3	V	AI
5.	20CSE05	Multicore Architecture	3	0	0	3	V	SD
6.	20CSE06	Unix Internals	3	0	0	3	V	SD
7.	20CSE07	Graph theory	3	0	0	3	V	SD
		Elective 2						
8.	20CSE08	Game Theory and its Applications	3	0	0	3	VII	AI
9.	20CSE09	Wireless and Sensor Networks	3	0	0	3	VII	NS
10	20CSE10	Optimization Techniques	3	0	0	3	VII	SDE
11	20CSE11	Data Warehousing and Data Mining	3	0	0	3	VII	SDE
12	20CSE12	Distributed Systems	3	0	0	3	VII	SDE
13	20CSE13	Full Stack Development	3	0	0	3	VII	SD
14	20CSE14	Graphics and Multimedia	3	0	0	3	VII	SD
		Elective 3						
15.	20CSE15	Blockchain Technologies	3	0	0	3	VII	NS
16.	20CSE16	Total Quality Management	3	0	0	3	VII	GE
17.	20CSE17	Decision Support Systems	3	0	0	3	VII	AI
18.	20CSE18	Social Network Analysis	3	0	0	3	VII	SD
19.	20CSE19	Human Computer Interface	3	0	0	3	VII	SDE
20.	20CSE20	Business Intelligence and its Applications	3	0	0	3	VII	SDE
21.	20CSE21	Web Mining	3	0	0	3	VII	SDE
		Elective 4						
22.	20CSE22	Cryptography and Network Security	3	0	0	3	VII	NS
23.	20CSE23	Modeling and Simulation	3	0	0	3	VII	SD
24.	20CSE24	Parallel Computing Architecture and Programming	3	0	0	3	VII	SD
24.	20CSE25	Digital Marketing	3	0	0	3	VII	SDE

25.	20CSE26	Big Data Analytics	2	0	2	3	VII	SDE
26.	20CSE27	Cross platform application development	3	0	0	3	VII	SDE
28.	20CSE28	Approximation Algorithms	3	0	0	3	VII	AI
29.	20GEE01	Fundamental of Research	3	0	0	3	VII	GE
		Elective 5						
30.	20CSE29	Software Defined Networks	3	0	0	3	VII	NS
31	20CSE30	Information Security	3	0	0	3	VII	NS
32	20CSE31	Intelligent Systems	3	0	0	3	VII	AI
33	20CSE32	Software Project Management	3	0	0	3	VII	SDE
34	20CSE33	Data Visualization Techniques	3	0	0	3	VII	SDE
35	20CSE34	Information Retrieval	3	0	0	3	VII	SD
36	20CSE35	Computer Vision	3	0	0	3	VII	AI
		Elective 6						
37	20CSE36	Natural Language Processing	3	0	0	3	VIII	SD
38	20CSE37	Cyber Forensics	3	0	0	3	VIII	NS
39	20CSE38	Augmented and Virtual Reality	3	0	0	3	VIII	AI
40	20CSE39	Predictive Data Analytics	3	0	0	3	VIII	SDE
41	20CSE40	Software Quality and Testing	3	0	0	3	VIII	SDE
42	20CSE41	Randomized Algorithms	3	0	0	3	VIII	AI
		Total credits to be earned				**18**		

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	--	--	--	2	V	--
2.	20GEP61	Comprehensive Test / Viva	---	---	---	2	VI	--
3.	20GEL61/ 20GEI61	Professional Skills Training - II / Industrial Training - II	---	---	---	2	VI	--
4.	20CSP61	Project Work I	0	0	4	2	VI	--
5.	20CSP71	Project Work – II Phase - I	0	0	12	6	VII	--
6.	20CSP81	Project work - II Phase - II	---	---	8	4	VIII	--
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

OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	20CSO01	Fundamentals of Databases	3	0	2	4	4
2.	20CSO02	Python Programming and Frameworks	3	0	2	4	4
3.	20CSO03	Computational science for Engineers	3	1	0	4	5
4.	20CSO04	Formal Languages and Automata Theory	3	1	0	4	5
5.	20GEO03	Design Thinking for Engineers	3	1	0	4	5
6.	20CSO05	Java Programming	2	0	2	3	6
7.	20CSO06	Web Engineering	2	0	2	3	6
8.	20CSO07	Nature inspired optimization techniques	3	0	0	3	6
9.	20CSO08	Fundamentals of Internet of Things	3	0	0	3	8
10.	20CSO09	Machine Translation	3	0	0	3	8
11.	20CSO10	Fundamentals of Blockchain	3	0	0	3	8

OPEN ELECTIVE COURSES OFFERED BY OTHER DEPARTMENTS (OE)

S.No.	**Course Code**	**Course Title**	L	T	P	C	Offering Dept.
		SEMESTER - IV					
1	20CEO01	Remote Sensing and its Applications	3	0	2	4	CIVIL
2	20MEO01	Renewable Energy Sources	3	0	2	4	MECH
3	20MTO01	Design of Mechatronics Systems	3	1	0	4	MTS
4	20AUO01	Automotive Engineering	3	0	2	4	AUTO
5	20ECO01	Wearable Technology	3	1	0	4	ECE
6	20ECO02	Basics of Electronics in Automation Appliances	3	1	0	4	ECE
7	20ECO03	Principles of Quantum Computing	3	0	2	4	ECE
8	20EEO01	Solar and Wind Energy Systems	3	1	0	4	EEE
9	20EEO02	Electrical Wiring and Lighting	3	1	0	4	EEE
10	20EEO03	Electrical Safety	3	1	0	4	EEE
11	20EIO01	Digital Image Processing and Its Applications	3	1	0	4	EIE
14	20ITO01	Artificial Intelligence	3	1	0	4	IT
15	20ITO02	Web Technologies	3	1	0	4	IT
16	20ITO03	Introduction to Operating Systems	3	1	0	4	IT
17	20ITO04	Programming in Python	3	1	0	4	IT
18	20CHO01	Drugs and Pharmaceuticals Technology	3	1	0	4	CHEM

19	20CHO02	Process Automation	3	1	0	4	CHEM
20	20FTO01	Baking Technology	3	0	2	4	FT
21	20FTO02	Food Processing Technology	3	1	0	4	FT
22	20CDO01	Fundamentals of User Experience Design	3	1	0	4	CSD
23	20ADO01	Data Warehousing and Data Mining	3	0	2	4	AIDS
24	20ALO01	Business Intelligence	3	1	0	4	AIML
25	20PHO01	Thin Film Technology	3	1	0	4	PHY
26	20CYO01	Instrumental Methods of Analysis	3	1	0	4	CHEMIS
		SEMESTER - V					
27	20CEO02	Disaster Management	3	1	0	4	CIVIL
28	20MEO02	Design of Experiments	3	0	2	4	MECH
29	20MTO02	Factory Automation	3	0	2	4	MTS
30	20MTO03	Data Acquisition and Virtual Instrumentation	3	0	2	4	MTS
31	20AUO02	Automotive Electronics	3	0	2	4	AUTO
32	20ECO04	PCB Design and Fabrication	3	0	2	4	ECE
33	20EEO04	Energy Conservation and Management	3	1	0	4	EEE
34	20EIO02	Industrial Automation	3	1	0	4	EIE
35	20EIO03	Measurements and Instrumentation	3	1	0	4	EIE
38	20ITO05	Data Science	3	1	0	4	IT
39	20ITO06	Advanced Java Programming	3	1	0	4	IT
40	20CHO03	Renewable Bioenergy Resources	3	1	0	4	CHEM
41	20CHO04	Intelligent Controllers	3	1	0	4	CHEM
42	20FTO03	Processing of Milk and Milk Products	3	0	2	4	FT
43	20FTO04	Processing of Fruits and Vegetables	3	0	2	4	FT
44	20CDO02	Fundamentals of User Interactive Design	3	0	2	4	CSD
45	20ADO02	Computer Vision	3	0	2	4	AIDS
46	20ALO02	Data Exploration and Visualization Techniques	3	0	2	4	AIML
47	20PHO02	High Energy Storage Devices	3	0	0	3	PHY
48	20CYO02	Corrosion Science and Engineering	3	1	0	4	CHEMIS
49	20CYO03	Chemistry of Cosmetics in Daily Life	3	1	0	4	CHEMIS
50	20CYO04	Chemistry of Nutrition for Women Health	3	1	0	4	CHEMIS
51	20MAO01	Mathematical Foundations for Machine Learning	3	1	0	4	MATHS
52	20MAO02	Graph Theory and its Applications	3	1	0	4	MATHS
		SEMESTER - VI					
53	20CEO03	Introduction to Smart Cities	3	0	0	3	CIVIL
54	20CEO04	Environmental Health and Safety	3	0	0	3	CIVIL
55	20MEO03	Fundamentals of Ergonomics	3	0	0	3	MECH

56	20MEO04	Principles of Management and Industrial Psychology	3	0	0	3	MECH
57	20MTO04	3D Printing and Design	3	0	0	3	MTS
58	20MTO05	Drone System Technology	3	0	0	3	MTS
59	20MTO06	Virtual and Augument Reality in Industry 4.0	3	0	0	3	MTS
60	20AUO03	Vehicle Maintenance	3	0	0	3	AUTO
61	20ECO05	Electronic Hardware and Troubleshooting	2	0	2	3	ECE
62	20ECO06	Bioinspired Computing Technologies	2	0	2	3	ECE
63	20EEO05	Micro Grid and Smart Grid	3	0	0	3	EEE
64	20EEO06	E-Waste Management	3	0	0	3	EEE
65	20EIO04	Biomedical Instrumentation and Applications	3	0	0	3	EIE
66	20EIO05	PLC Programming and Its Applications	3	0	0	3	EIE
67	20EIO06	Instrumentation for Industry 4.0	3	0	0	3	EIE
71	20ITO07	Bio Natural Language Processing	3	0	0	3	IT
72	20ITO08	Disaster Management for Information Technology	3	0	0	3	IT
73	20CHO05	Food as Medicine	3	0	0	3	CHEM
74	20CHO06	Organic Farming	3	0	0	3	CHEM
75	20FTO05	Principles of Food Safety	3	0	0	3	FT
76	20FTO06	Fundamentals of Food Packaging and Storage	3	0	0	3	FT
77	20CDO03	Introduction to Mobile Game Design	3	0	0	3	CSD
78	20ADO03	Neural Networks and Deep Learning	3	0	0	3	AIDS
79	20ALO03	Industrial Machine Learning	3	0	0	3	AIML
80	20PHO03	Structural and Optical Characterization of Materials	3	0	0	3	PHY
81	20CYO05	Chemistry Concepts for Competitive Examinations	3	0	0	3	CHEMIS
82	20CYO06	Waste and Hazardous Waste Management	3	0	0	3	CHEMIS
83	20MAO03	Data Analytics using R Programming	3	0	2	4	MATHS
84	20MAO04	Number Theory and Cryptography	3	1	0	4	MATHS
		SEMESTER - VIII					
85	20CEO05	Infrastructure Planning and Management	3	0	0	3	CIVIL
86	20CEO06	Environmental Laws and Policy	3	0	0	3	CIVIL
87	20MEO05	Safety Measures for Engineers	3	0	0	3	MECH
88	20MEO06	Energy Conservation in Thermal Equipments	3	0	0	3	MECH
89	20MTO06	Robotics	3	0	0	3	MTS
90	20MTO07	Virtual and Augment Reality in Industry 4.0	3	0	0	3	MTS
91	20AUO04	Public Transport Management	3	0	0	3	AUTO
92	20AUO05	Autonomous Vehicles	3	0	0	3	AUTO
93	20ECO07	Optical Engineering	3	0	0	3	ECE

94	20EEO07	Electric Vehicle	3	0	0	3	EEE
95	20EIO07	Graphical Programming using Virtual Instrumentation	3	0	0	3	EIE
96	20EIO08	Testing of Materials	3	0	0	3	EIE
100	20ITO09	Modern Application Development	3	0	0	3	IT
101	20ITO10	Object Oriented System Development using UML	3	0	0	3	IT
102	20ITO11	Reinforcement Learning	3	0	0	3	IT
103	20CHO07	Cosmetics and Personal Health Care Products	3	0	0	3	CHEM
104	20CHO08	Brewing and Alcohol Technology	3	0	0	3	CHEM
105	20FTO07	Food Ingredients	3	0	0	3	FT
106	20FTO08	Food and Nutrition	3	0	0	3	FT
107	20CDO04	Introduction to Graphics Design	3	0	0	3	CSD
108	20ADO04	Business Analytics	3	0	0	3	AIDS
109	20ALO04	Machine Learning for Smart Cities	3	0	0	3	AIML
110	20MAO05	Advanced Linear Algebra	3	0	0	3	MATHS
111	20MAO06	Optimization Techniques	3	0	0	3	MATHS

GENERAL OPEN ELECTIVE
(Common to All BE/BTech branches)

S.No	Course Code	Course Title	L	T	P	C	Semester	Offering Dept.
1.	20GEO01	German Language Level 1	4	0	0	4	IV/V/VII/VIII	ECE
2.	20GEO02	Japanese Language Level 1	4	0	0	4	IV/V/VII/VIII	ECE
3.	20GEO03	Design Thinking for Engineers	3	1	0	4	V	CSE
4.	20GEO04	Innovation and Business Model Development	3	1	0	4	VI	MTS
5.	20GEO05	German Language Level 2	4	0	0	4	IV/V/VII/VIII	ECE
6.	20GEO06	German Language Level 3	3	0	0	3	IV/V/VII/VIII	ECE
7.	20GEO07	German Language Level 4	3	0	0	3	IV/V/VII/VIII	ECE
8.	20GEO08	Japanese Language Level 2	4	0	0	4	IV/V/VII/VIII	ECE
9.	20GEO09	Japanese Language Level 3	3	0	0	3	IV/V/VII/VIII	ECE
10.	20GEO10	Japanese Language Level 4	3	0	0	3	IV/V/VII/VIII	ECE
11.	20GEO11	NCC Studies (Army Wing) - I	3	0	2	4	V/VI	EEE
12.	20GEO12	NCC Studies (Air Wing) - I	3	0	2	4	V/VI	IT
13.	20GEO13	French Language Level 1	4	0	0	4	IV/V/VII/VIII	ECE
14.	20GEO14	French Language Level 2	4	0	0	4	IV/V/VII/VIII	ECE
15.	20GEO15	French Language Level 3	3	0	0	3	IV/V/VII/VIII	ECE
16.	20GEO16	Spanish Language Level 1	4	0	0	4	IV/V/VII/VIII	ECE
17.	20GEO17	Spanish Language Level 2	4	0	0	4	IV/V/VII/VIII	ECE
18.	20GEO18	Spanish Language Level 3	3	0	0	3	IV/V/VII/VIII	ECE
19.	20GEO19	Entrepreneurship Development	3	0	0	3	VIII	MTS

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

Sem.	Course1	Course2	Course3	Course4	Course5	Course6	Course7	Course8	Course9	Course10	Credits
I	20EGT1 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)	20CSC11 Problem Solving and Programming (3-0-2-3)	20CSC11 Basics of Electrical and Electronics Engineering (3-0-2-4)	20PHL11 Physical Sciences Laboratory – I (0-0-2-1)	20MNT11 Induction Training Program (0-0-0-0)			**22**
II	20EGT21 Advanced Communicatio n Skills (3-0-0-3)	20MAC21 Multivariable Calculus and Complex Analysis (3-1*-2*-4)	20PHT23 Physics for Communication and Computer Science Engineering (3-0-0-3)	20CYT23 Chemistry of Electronic Materials (3-0-0-3)	20VEC11 Yoga Values for Holistic Development (1-0-1-1)	20MEC11 Engineering Drawing (2-0-2-3)	20CST21 Programming and Linear Data Structures (3-0-2-4)	20PHL27 Physical Sciences Laboratory – II (0-0-2-1)	20MEL11 Engineering Practices Laboratory (0-0-2-1)		**23**
III	20MAT34 Discrete Mathematical Structures (3-1-0-4)	20CSC32 Digital Principles and Design (3-0-2-4)	20CST31 Data Structures (3-0-0-3)	20CST32 Object Oriented Programming (3-0-0-3)	20CST33 Computer Organization (3-1-0-4)	20CSL31 Data Structures Laboratory (0-0-2-1)	20CSL32 Object Oriented Programming Laboratory (0-0-2-1)	20EGL31 English for Work Place Communication (0-0-2-1)	20GET51 Universal Human Values (2-0-0-2)		**23**
IV	2MAT42 Probability and Statistics (3-1-0-4)	20CST41 Database Management Systems (3-0-0-3)	20CST42 Python Programming and Frameworks (3-0-0-3)	20CSC42 Design and Analysis of Algorithms (3-0-2-4)	20CST43 Operating Systems (3-1-0-4)	Open Elective I (3-1-2-4)	20CSL41 Database Management Systems Laboratory (0-0-2-1)	20CSL42 Python Programming and Frameworks Laboratory (0-0-2-1)	20MNT31 Environmental Science (2-0-0-0)		**24**
V	20CST51 Computer Networks (3-0-0-3)	20CST52 Machine Learning (3-0-0-3)	20CST53 Agile Methodologies (3-0-0-3)	Professional Elective - I (3-0-0-3)	Open Elective – II (3-1-2-4)	20CSL51 Network Laboratory (0-0-2-1)	20CSL52 Machine Learning Laboratory (0-0-2-1)	20CSL53 Software Development Laboratory (0-0-2-1)	20GEL51 20GEI51 Professional Skills Training I / Industrial Training I (0-0-0-2)		**21**
VI	20CST61 Principles of Compiler Design (3-0-0-3)	20CST62 Internet of Things and Cloud (3-0-0-3)	20CST63 Mobile Communication (3-0-0-3)	Open Elective II (3-0-0-3)	20CSL61 Compiler Design Laboratory (0-0-2-1)	20CSL62 Internet of Things and Cloud Laboratory (0-0-2-1)	20CSL63 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)	20CSP61 Project Work I Phase I (0-0-4-2)	**21**
VII	20GET71 Engineering Economics and Management (3-0-0-3)	20CSC71 Deep Learning (3-0-0-3)	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)	20CSP71 Project Work I Phase II (0-0-12-6)				**22**
VIII	Open Elective IV (3-0-0-3)	Professional Elective VI (3-0-0-3)	18CSP81 Project Work II Phase II (0-0-8-4)								**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	20CST11	Problem Solving and Programming	✓	✓	✓		✓								✓	✓
1	20CSC11	Basics of Electrical and Electronics Engineering	✓	✓	✓		✓								✓	✓
1	20EGT11	English Language Skills						✓			✓	✓	✓	✓		
1	20CSL11	Problem Solving and Programming Laboratory	✓	✓	✓	✓	✓					✓				
1	20PHL11	Physical Sciences Laboratory - I				✓										
1	20MNT11	Induction Training Program														
2	20EGT21	Advanced Communication Skills						✓			✓	✓	✓	✓		
2	20MAC21	Multivariable Calculus and Complex Analysis	✓	✓	✓		✓									
2	20PHT23	Physics for Communication and Computer Science Engineering	✓	✓	✓											
2	20CYT23	Chemistry of Electronic Materials	✓	✓	✓	✓			✓							
2	20VEC11	Yoga Values for Holistic Development						✓		✓	✓			✓		
2	20MEC11	Engineering Drawing	✓	✓	✓	✓						✓	✓	✓	✓	✓
2	20CST21	Programming and Linear Data Structures	✓	✓	✓	✓									✓	✓
2	20PHL27	Physical Sciences Laboratory - II			✓											
2	20MEL11	Engineering Practices Laboratory	✓		✓	✓	✓	✓			✓	✓		✓		
3	20MAT34	Discrete Mathematical Structures	✓	✓	✓										✓	
3	20CSC32	Digital Principles and Design	✓	✓	✓	✓	✓					✓			✓	✓
3	20CST31	Data Structures	✓	✓	✓										✓	✓
3	20CST32	Object Oriented Programming	✓	✓	✓										✓	✓
3	20CST33	Computer Organization	✓	✓	✓										✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	20CSL31	Data Structures Laboratory	✓	✓	✓	✓	✓								✓	✓
3	20CSL32	Object Oriented Programming Laboratory	✓	✓	✓	✓	✓								✓	✓
3	20EGL31	English for Workplace Communication Laboratory									✓	✓		✓		
3	20GET31	Universal Human Values						✓	✓	✓						
4	20MAT42	Probability and Statistics	✓	✓	✓	✓									✓	
4	20CST41	Database Management Systems	✓	✓	✓										✓	✓
4	20CST42	Python Programming and Frameworks	✓	✓	✓										✓	✓
4	20CSC42	Design and Analysis of Algorithms	✓	✓	✓	✓	✓								✓	✓
4	20CST43	Operating Systems	✓	✓	✓										✓	✓
4	20CSL41	Database Management Systems Laboratory	✓	✓	✓	✓	✓					✓	✓		✓	✓
4	20CSL42	Python Programming and Frameworks Laboratory	✓	✓	✓	✓	✓								✓	✓
4	20MNT31	Environmental Science	✓	✓	✓				✓					✓	✓	✓
5	20CST51	Computer Networks	✓	✓	✓										✓	✓
5	20CST52	Machine Learning	✓	✓	✓										✓	✓
5	20CST53	Agile Methodologies	✓	✓	✓						✓	✓			✓	✓
5	20CSL51	Network Laboratory	✓	✓	✓	✓	✓								✓	✓
5	20CSL52	Machine Learning Laboratory	✓	✓	✓	✓	✓								✓	✓
5	20CSL53	Software Development Laboratory	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓
5	20GEL51/ 20GEI51	Professional Skills Training - I / Industrial Training - I	✓	✓				✓	✓		✓	✓	✓	✓		
6	20CST61	Principles of Compiler Design	✓	✓	✓										✓	✓
6	20CST62	Internet of Things and Cloud	✓	✓	✓		✓								✓	✓
6	20CST63	Mobile Communication	✓	✓	✓										✓	✓
6	20CSL61	Compiler Design Laboratory	✓	✓	✓	✓	✓								✓	✓
6	20CSL62	Internet of Things and Cloud Laboratory	✓	✓	✓	✓	✓								✓	✓
6	20CSL63	Open Source Systems Laboratory	✓	✓	✓	✓	✓								✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
6	20GEP61	Comprehensive Test / Viva	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
6	20GEL61/ 20GEI61	Professional Skills Training - II / Industrial Training - II	✓	✓				✓	✓		✓	✓	✓	✓		
6	20CSP61	Project Work I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	20GET71	Engineering Economics and Management	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓
7	20CST71	Deep Learning	✓	✓	✓	✓	✓								✓	✓
7	20CSP71	Project Work – II Phase -I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	20CSP81	Project work - II Phase - II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
5	20CSE01	Theory of Computation	✓	✓	✓										✓	✓
5	20CSE02	Data science	✓	✓	✓										✓	✓
5	20CSE03	Building Enterprise Applications	✓	✓	✓										✓	✓
5	20CSE04	Artificial Intelligence	✓	✓	✓										✓	✓
5	20CSE05	Multicore Architecture	✓	✓	✓										✓	✓
5	20CSE06	Unix Internals	✓	✓	✓										✓	✓
5	20CSE07	Graph theory	✓	✓	✓										✓	✓
5	20CSE08	Game Theory and its Applications	✓	✓	✓										✓	✓
7	20CSE09	Wireless and Sensor Networks	✓	✓	✓										✓	✓
7	20CSE10	Optimization Techniques	✓	✓	✓										✓	✓
7	20CSE11	Data Warehousing and Data Mining	✓	✓	✓		✓								✓	✓
7	20CSE12	Distributed Systems	✓	✓	✓										✓	✓
7	20CSE13	Full Stack Development	✓	✓	✓	✓									✓	✓
7	20CSE14	Graphics and Multimedia	✓	✓	✓										✓	✓
7	20CSE15	Blockchain Technologies	✓	✓	✓										✓	✓
7	20CSE16	Total Quality Management	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	20CSE17	Decision Support Systems	✓	✓	✓										✓	✓
7	20CSE18	Social Network Analysis	✓	✓	✓										✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
7	20CSE19	Human Computer Interface	✓	✓	✓										✓	✓
7	20CSE20	Business Intelligence and its Applications	✓	✓	✓										✓	✓
7	20CSE21	Web Mining	✓	✓	✓		✓								✓	✓
7	20CSE22	Cryptography and Network Security	✓	✓	✓										✓	✓
7	20CSE23	Modeling and Simulation	✓	✓	✓										✓	✓
7	20CSE24	Parallel Computing Architecture and Programming	✓	✓	✓		✓								✓	✓
7	20CSE25	Digital Marketing	✓	✓	✓										✓	✓
7	20CSE26	Big Data Analytics	✓	✓	✓	✓	✓								✓	✓
7	20CSE27	Cross platform application development	✓	✓	✓		✓				✓	✓			✓	✓
7	20CSE28	Approximation Algorithms	✓	✓	✓										✓	✓
7	20GEE01	Fundamental of Research	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	20CSE29	Software Defined Networks	✓	✓	✓		✓								✓	✓
7	20CSE30	Information Security	✓	✓	✓										✓	✓
7	20CSE31	Intelligent Systems	✓	✓	✓										✓	✓
7	20CSE32	Software Project Management	✓	✓	✓										✓	✓
7	20CSE33	Data Visualization Techniques	✓	✓	✓										✓	✓
7	20CSE34	Information Retrieval	✓	✓	✓										✓	✓
8	20CSE35	Computer Vision	✓	✓	✓										✓	✓
8	20CSE36	Natural Language Processing	✓	✓	✓										✓	✓
8	20CSE37	Cyber Forensics	✓	✓	✓										✓	✓
8	20CSE38	Augmented and Virtual Reality	✓	✓	✓										✓	✓
8	20CSE39	Predictive Data Analytics	✓	✓	✓										✓	✓
8	20CSE40	Software Quality and Testing	✓	✓	✓										✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
8	20CSE41	Randomized Algorithms	✓	✓	✓										✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		OPEN ELECTIVE														
4	20CEO01	Remote Sensing and its Applications	✓	✓	✓	✓		✓			✓			✓		
4	20MEO01	Renewable Energy Sources	✓	✓		✓			✓		✓	✓				
4	20MTO01	Design of Mechatronics Systems	✓	✓	✓	✓	✓							✓		
4	20AUO01	Automotive Engineering	✓	✓	✓		✓				✓	✓				
4	20ECO01	Wearable Technology	✓	✓	✓	✓		✓		✓				✓		
4	20ECO02	Basics of Electronics in Automation Appliances	✓	✓	✓	✓		✓	✓	✓			✓	✓		
4	20ECO03	Principles of Quantum Computing	✓	✓	✓	✓	✓				✓	✓		✓		
4	20EEO01	Solar and Wind Energy Systems	✓	✓	✓				✓							
4	20EEO02	Electrical Wiring and Lighting	✓	✓	✓	✓	✓									
4	20EEO03	Electrical Safety	✓	✓	✓											
4	20EIO01	Digital Image Processing and Its Applications	✓	✓	✓	✓	✓									
4	20ITO01	Artificial Intelligence	✓	✓	✓	✓										
4	20ITO02	Web Technologies	✓	✓	✓											
4	20ITO03	Introduction to Operating Systems	✓	✓	✓	✓										
4	20ITO04	Programming in Python			✓		✓							✓		
4	20CHO01	Drugs and Pharmaceuticals Technology	✓	✓	✓	✓	✓									
4	20CHO02	Process Automation	✓	✓	✓		✓									
4	20FTO01	Baking Technology	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓		
4	20FTO02	Food Processing Technology	✓	✓	✓	✓								✓		
4	20CDO01	Fundamentals of User Experience Design	✓	✓	✓	✓					✓	✓	✓			
4	20ADO01	Data Warehousing and Data Mining	✓	✓	✓											
4	20ALO01	Business Intelligence	✓	✓	✓											
4	20PHO01	Thin Film Technology	✓	✓	✓											
4	20CYO01	Instrumental Methods of Analysis	✓	✓	✓	✓										

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
5	20CEO02	Disaster Management	✓	✓	✓			✓	✓					✓		
5	20MEO02	Design of Experiments	✓	✓	✓	✓	✓						✓			
5	20MTO02	Factory Automation	✓	✓	✓	✓	✓	✓			✓	✓		✓		
5	20MTO03	Data Acquisition and Virtual Instrumentation	✓	✓	✓	✓	✓				✓	✓		✓		
5	20AUO02	Automotive Electronics	✓	✓	✓	✓	✓				✓	✓		✓		
5	20ECO04	PCB Design and Fabrication	✓	✓	✓		✓			✓	✓	✓		✓		
5	20EEO04	Energy Conservation and Management	✓	✓	✓		✓									
5	20EIO02	Industrial Automation	✓	✓	✓	✓	✓									
5	20EIO03	Measurements and Instrumentation	✓	✓	✓	✓	✓									
5	20ITO05	Data Science	✓	✓	✓	✓										
5	20ITO06	Advanced Java Programming	✓	✓	✓											
5	20CHO03	Renewable Bioenergy Resources	✓	✓	✓	✓			✓							
5	20CHO04	Intelligent Controllers	✓		✓	✓		✓								
5	20FTO03	Processing of Milk and Milk Products	✓	✓	✓		✓	✓		✓	✓	✓		✓		
5	20FTO04	Processing of Fruits and Vegetables	✓	✓	✓		✓	✓		✓	✓	✓		✓		
5	20CDO02	Fundamentals of User Interactive Design	✓	✓	✓											
5	20ADO02	Computer Vision	✓	✓	✓	✓	✓									
5	20ALO02	Data Exploration and Visualization Techniques	✓	✓	✓	✓	✓									
5	20PHO02	High Energy Storage Devices	✓	✓	✓											
5	20CYO02	Corrosion Science and Engineering	✓	✓	✓	✓										
5	20CYO03	Chemistry of Cosmetics in Daily Life	✓	✓	✓											
5	20CYO04	Chemistry of Nutrition for Women Health	✓	✓	✓											
5	20MAO01	Mathematical Foundations for Machine Learning	✓	✓		✓	✓									
5	20MAO02	Graph Theory and its Applications	✓	✓	✓											

Sem .	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
6	20CEO03	Introduction to Smart Cities	✓	✓	✓											
6	20CEO04	Environmental Health and Safety	✓	✓	✓	✓										
6	20MEO03	Fundamentals of Ergonomics	✓	✓	✓	✓	✓	✓	✓					✓		
6	20MEO04	Principles of Management and Industrial Psychology						✓		✓	✓	✓	✓			
6	20MTO04	3D Printing and Design	✓	✓	✓	✓	✓						✓	✓		
6	20MTO05	Drone System Technology	✓	✓	✓	✓	✓						✓	✓		
6	20MTO06	Virtual and Augument Reality in Industry 4.0														
6	20AUO03	Vehicle Maintenance	✓	✓	✓	✓								✓		
6	20ECO05	Electronic Hardware and Troubleshooting	✓	✓	✓	✓	✓	✓								
6	20ECO06	Bioinspired Computing Technologies	✓	✓	✓		✓				✓					
6	20EEO05	Micro Grid and Smart Grid	✓	✓	✓	✓										
6	20EEO06	E-Waste Management	✓	✓	✓	✓										
6	20EIO04	Biomedical Instrumentation and Applications	✓	✓	✓	✓	✓	✓								
6	20EIO05	PLC Programming and Its Applications	✓	✓	✓	✓	✓									
6	20EIO06	Instrumentation for Industry 4.0	✓	✓	✓	✓	✓									
6	20ITO07	Bio Natural Language Processing	✓	✓	✓	✓										
6	20ITO08	Disaster Management for Information Technology	✓	✓	✓	✓										
6	20CHO05	Food as Medicine	✓	✓	✓	✓		✓						✓		
6	20CHO06	Organic Farming	✓		✓			✓	✓	✓	✓		✓	✓		
6	20FTO05	Principles of Food Safety	✓	✓	✓		✓	✓	✓	✓				✓		
6	20FTO06	Fundamentals of Food Packaging and Storage	✓	✓	✓		✓	✓		✓				✓		
6	20CDO03	Introduction to Mobile Game Design	✓	✓	✓											
6	20ADO03	Neural Networks and Deep Learning	✓	✓	✓											
6	20ALO03	Industrial Machine Learning	✓	✓	✓											

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
6	20PHO03	Structural and Optical Characterization of Materials	✓	✓	✓											
6	20CYO05	Chemistry Concepts for Competitive Examinations	✓	✓	✓											
6	20CYO06	Waste and Hazardous Waste Management	✓	✓	✓	✓			✓							
6	20MAO03	Data Analytics using R Programming	✓	✓	✓	✓	✓									
6	20MAO04	Number Theory and Cryptography	✓	✓	✓		✓									
8	20CEO05	Infrastructure Planning and Management	✓	✓	✓											
8	20CEO06	Environmental Laws and Policy	✓	✓	✓	✓										
8	20MEO05	Safety Measures for Engineers	✓			✓		✓	✓	✓						
8	20MEO06	Energy Conservation in Thermal Equipments	✓	✓												
8	20MTO06	Robotics	✓	✓	✓	✓	✓							✓		
8	20MTO07	Virtual and Augment Reality in Industry 4.0	✓	✓	✓	✓	✓	✓						✓		
8	20AUO04	Public Transport Management	✓	✓				✓	✓	✓	✓	✓	✓	✓		
8	20AUO05	Autonomous Vehicles	✓	✓	✓											
8	20ECO07	Optical Engineering	✓	✓	✓	✓		✓		✓	✓			✓		
8	20EEO07	Electric Vehicle	✓	✓	✓	✓										
8	20EIO07	Graphical Programming using Virtual Instrumentation	✓	✓	✓	✓	✓									
8	20EIO08	Testing of Materials	✓	✓	✓	✓	✓									
8	20ITO09	Modern Application Development	✓	✓	✓	✓										
8	20ITO10	Object Oriented System Development using UML	✓	✓	✓	✓										
8	20ITO11	Reinforcement Learning	✓	✓	✓	✓										
8	20CHO07	Cosmetics and Personal Health Care Products	✓		✓			✓		✓				✓		
8	20CHO08	Brewing and Alcohol Technology	✓	✓												
8	20FTO07	Food Ingredients	✓	✓	✓			✓						✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
8	20FTO08	Food and Nutrition	✓	✓	✓			✓						✓		
8	20CDO04	Introduction to Graphics Design	✓	✓	✓											
8	20ADO04	Business Analytics	✓	✓	✓											
8	20ALO04	Machine Learning for Smart Cities	✓	✓	✓											
8	20MAO05	Advanced Linear Algebra	✓	✓	✓											
8	20MAO06	Optimization Techniques	✓	✓	✓											
		GENERAL OPEN ELECTIVE														
4,5,6,8	20GEO01	German Language Level 1								✓	✓	✓		✓		
4,5,6,8	20GEO02	Japanese Language Level 1								✓	✓	✓		✓		
5	20GEO03	Design Thinking for Engineers	✓	✓	✓											
6	20GEO04	Innovation and Business Model Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
4,5,6,8	20GEO05	German Language Level 2								✓	✓	✓		✓		
4,5,6,8	20GEO06	German Language Level 3								✓	✓	✓		✓		
4,5,6,8	20GEO07	German Language Level 4								✓	✓	✓		✓		
4,5,6,8	20GEO08	Japanese Language Level 2								✓	✓	✓		✓		
4,5,6,8	20GEO09	Japanese Language Level 3								✓	✓	✓		✓		
4,5,6,8	20GEO10	Japanese Language Level 4								✓	✓	✓		✓		
4,5,6,8	20GEO11	NCC Studies (Army Wing) - I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
4,5,6,8	20GEO12	NCC Studies (Air Wing) - I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
4,5,6,8	20GEO13	French Language Level 1								✓	✓	✓		✓		
4,5,6,8	20GEO14	French Language Level 2								✓	✓	✓		✓		
4,5,6,8	20GEO15	French Language Level 3								✓	✓	✓		✓		
4,5,6,8	20GEO16	Spanish Language Level 1								✓	✓	✓		✓		
4,5,6,8	20GEO17	Spanish Language Level 2								✓	✓	✓		✓		
4,5,6,8	20GEO18	Spanish Language Level 3								✓	✓	✓		✓		
8	20GEO19	Entrepreneurship Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		

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(For the candidates admitted in the academic year 2020-21)

SEMESTER – I

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks			Cate gory
		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
20CST11	Problem Solving and Programming	3	0	0	3	50	50	100	PC
20CSC11	Basics of Electrical and Electronics Engineering	3	0	2	4	50	50	100	ES
Practical/Employability Enhancement									
20CSL11	Problem Solving and Programming Laboratory	0	0	2	1	50	50	100	PC
20PHL11	Physical Sciences Laboratory - I	0	0	2	1	50	50	100	BS
20MNT11	Student Induction Program	-	-	-	0	100	0	100	MC
						Total	**22**		

*Alternate week

SEMESTER – II

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks			Cate gory
		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
20PHT23	Physics for Communication and Computer Science Engineering	3	0	0	3	50	50	100	BS
20CYT23	Chemistry of Electronic Materials	3	0	0	3	50	50	100	BS
20VEC11	Yoga and Values for Holistic Development	1	0	1	1	100	0	100	HS
20MEC11	Engineering Drawing	2	0	2	3	50	50	100	ES
20CST21	Programming and Linear Data Structures	3	0	2	4	50	50	100	PC
Practical/Employability Enhancement									
20PHL27	Physical Sciences Laboratory - II	0	0	2	1	50	50	100	BS
20MEL11	Engineering Practices Laboratory	0	0	2	1	50	50	100	ES
				Total	**23**				

*Alternate week

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SEMESTER – III

Course Code	Course Title	Hours / 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
20CSC32	Digital Principles and Design	3	0	2	4	50	50	100	ES
20CST31	Data Structures	3	0	0	3	50	50	100	PC
20CST32	Object Oriented Programming	3	0	0	3	50	50	100	PC
20CST33	Computer Organization	3	1	0	4	50	50	100	PC
Practical / Employability Enhancement									
20CSL31	Data Structures Laboratory	0	0	2	1	50	50	100	PC
20CSL32	Object Oriented Programming Laboratory	0	0	2	1	50	50	100	PC
20EGL31	English for Workplace Communication Laboratory	0	0	2	1	50	50	100	HS
20GET31	Universal Human Values	2	0	0	2	100	0	100	HS
Total Credits to be earned					**23**				

SEMESTER – IV

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20MAT42	Probability and Statistics	3	1	0	4	50	50	100	BS
20CST41	Database Management Systems	3	0	0	3	50	50	100	PC
20CST42	Python Programming and Frameworks	3	0	0	3	50	50	100	PC
20CSC42	Design and Analysis of Algorithms	3	0	2	4	50	50	100	PC
20CST43	Operating Systems	3	1	0	4	50	50	100	PC
	Open Elective - I	3	1/0	0/2	4	50	50	100	OE
Practical / Employability Enhancement									
20CSL41	Database Management Systems Laboratory	0	0	2	1	50	50	100	PC
20CSL42	Python Programming and Frameworks 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**				

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(For the candidates admitted in the academic year 2020-21)

SEMESTER – V										
Sl.No.	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Cate gory**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
20CST51	Computer Networks	3	0	0	3	50	50	100	PC
20CST52	Machine Learning	3	0	0	3	50	50	100	PC
20CSC51	Agile Methodologies	3	0	2	4	50	50	100	PC
	Professional Elective - I	3	0	0	3	50	50	100	PC
	Open Elective - II	3	1/0	0/2	4	50	50	100	OE
Practical / Employability Enhancement									
20CSL51	Network Laboratory	0	0	2	1	50	50	100	PC
20CSL52	Machine Learning Laboratory	0	0	2	1	50	50	100	PC
20GEL51/ 20GEI51	Professional Skills Training - I / Industrial Training - I *	--	--	--	2	100	0	100	EC
Total Credits to be earned					**21**				

SEMESTER – VI									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Cate gory**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
20CST61	Principles of Compiler Design	3	0	0	3	50	50	100	PC
20CST62	Internet of Things and Cloud	3	0	0	3	50	50	100	ES
20CST63	Mobile Communication	3	0	0	3	50	50	100	ES
	Open Elective – III	3	0	0	3	50	50	100	OE
Practical / Employability Enhancement									
20CSL61	Compiler Design Laboratory	0	0	2	1	50	50	100	PC
20CSL62	Internet of Things and Cloud Laboratory	0	0	2	1	50	50	100	ES
20CSL63	Open Source Systems Laboratory	0	0	2	1	50	50	100	PC
20GEP61	Comprehensive Test / Viva	---	---	---	2	100	0	100	EC
20GEL61/ 20GEI61	Professional Skills Training - II / Industrial Training - II @	---	---	---	2	100	0	100	EC
20CSP61	Project Work I #	0	0	4	2	100	0	100	EC
Total Credits to be earned					**21**				

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SEMESTER – VII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
20GET71	Engineering Economics and Management	3	0	0	3	50	50	100	HS
20CSC71	Deep Learning	3	0	2	4	50	50	100	PC
	Professional Elective - II	3	0	0	3	50	50	100	PE
	Professional Elective - III	3	0	0	3	50	50	100	PE
	Professional Elective - IV	3	0	0	3	50	50	100	PE
	Professional Elective - V	3	0	0	3	50	50	100	PE
Practical / Employability Enhancement									
20CSP71	Project Work – II Phase - I	0	0	12	6	50	50	100	EC
Total Credits to be earned					**25**				

SEMESTER – VIII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
	Open Elective - IV	3	0	0	3	50	50	100	OE
	Professional Elective - VI	3	0	0	3	50	50	100	PE
Practical / Employability Enhancement									
20CSP81	Project work - II Phase - II	---	---	8	4	50	50	100	EC
Total Credits to be earned					**10**				

Total Credits : 169

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(with the inclusion of Amendment No.2022.18.07)

(For the candidates admitted in the academic year 2021-22)

SEMESTER – I

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks			Cate gory
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20EGT11	English Language Skills	3	0	0	3	40	60	100	HS
20MAC11	Matrices and Differential Equations	3	1*	2*	4	50	50	100	BS
20PHT11	Applied Physics	3	0	0	3	40	60	100	BS
20CYT11	Applied Chemistry	3	0	0	3	40	60	100	BS
20CST11	Problem Solving and Programming	3	0	0	3	40	60	100	PC
20CSC11	Basics of Electrical and Electronics Engineering	3	0	2	4	50	50	100	ES
Practical/Employability Enhancement									
20CSL11	Problem Solving and Programming Laboratory	0	0	2	1	60	40	100	PC
20PHL11	Physical Sciences Laboratory - I	0	0	2	1	60	40	100	BS
20MNT11	Student Induction Program	-	-	-	0	100	0	100	MC
						Total	**22**		

*Alternate week

SEMESTER – II

Course Code	Course Title	Hours/ Week			Credit	Maximum Marks			Cate gory
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20EGT21	Advanced Communication Skills	3	0	0	3	40	60	100	HS
20MAC21	Multivariable Calculus and Complex Analysis	3	1*	2*	4	50	50	100	BS
20PHT23	Physics for Communication and Computer Science Engineering	3	0	0	3	40	60	100	BS
20CYT23	Chemistry of Electronic Materials	3	0	0	3	40	60	100	BS
20VEC11	Yoga and Values for Holistic Development	1	0	1	1	100	0	100	HS
20MEC11	Engineering Drawing	2	0	2	3	50	50	100	ES
20CST21	Programming and Linear Data Structures	3	0	2	4	50	50	100	PC
Practical/Employability Enhancement									
20PHL27	Physical Sciences Laboratory - II	0	0	2	1	60	40	100	BS
20MEL11	Engineering Practices Laboratory	0	0	2	1	60	40	100	ES
				Total	**23**				

*Alternate week

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(For the candidates admitted in the academic year 2021-22)

SEMESTER – III

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20MAT34	Discrete Mathematical Structures	3	1	0	4	40	60	100	BS
20CSC32	Digital Principles and Design	3	0	2	4	50	50	100	ES
20CST31	Data Structures	3	0	0	3	40	60	100	PC
20CST32	Object Oriented Programming	3	0	0	3	100	0	100	PC
20CST33	Computer Organization	3	1	0	4	40	60	100	PC
Practical / Employability Enhancement									
20CSL31	Data Structures Laboratory	0	0	2	1	100	0	100	PC
20CSL32	Object Oriented Programming Laboratory	0	0	2	1	100	0	100	PC
20EGL31	English for Workplace Communication Laboratory	0	0	2	1	60	40	100	HS
20GET31	Universal Human Values	2	0	0	2	100	0	100	HS
Total Credits to be earned					**23**				

SEMESTER – IV

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20MAT42	Probability and Statistics	3	1	0	4	40	60	100	BS
20CST41	Database Management Systems	3	0	0	3	40	60	100	PC
20CST42	Python Programming and Frameworks	3	0	0	3	100	0	100	PC
20CST44	Design and Analysis of Algorithms	3	1	0	4	40	60	100	PC
20CST43	Operating Systems	3	1	0	4	40	60	100	PC
	Open Elective - I	3	1/0	0/2	4	40/ 50	60/ 50	100	OE
Practical / Employability Enhancement									
20CSL41	Database Management Systems Laboratory	0	0	2	1	60	40	100	PC
20CSL42	Python Programming and Frameworks Laboratory	0	0	2	1	100	0	100	PC
20GEL51/ 20GEI51	Professional Skills Training - I / Industrial Training – I *	--	--	--	2	100	0	100	EC
Total Credits to be earned					**26**				

* 80 hours of training

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SEMESTER – V										
Sl.No.	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
20CST51	Computer Networks	3	0	0	3	40	60	100	PC
20CST52	Machine Learning	3	0	0	3	40	60	100	PC
20CSC51	Agile Methodologies	3	0	2	4	50	50	100	PC
	Professional Elective - I	3	0	0	3	40	60	100	PC
	Open Elective - II	3	1/0	0/2	4	40/ 50	60/ 50	100	OE
Practical / Employability Enhancement									
20CSL51	Network Laboratory	0	0	2	1	60	40	100	PC
20CSL52	Machine Learning Laboratory	0	0	2	1	60	40	100	PC
20GEL61/ 20GEI61	Professional Skills Training - II / Industrial Training - II @	---	---	---	2	100	0	100	EC
Total Credits to be earned					**21**				

SEMESTER – VI									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
20CST61	Principles of Compiler Design	3	0	0	3	40	60	100	PC
20CST62	Internet of Things and Cloud	3	0	0	3	40	60	100	ES
20CST63	Mobile Communication	3	0	0	3	40	60	100	ES
	Open Elective – III	3	0	0	3	40	60	100	OE
Practical / Employability Enhancement									
20CSL61	Compiler Design Laboratory	0	0	2	1	60	40	100	PC
20CSL62	Internet of Things and Cloud Laboratory	0	0	2	1	60	40	100	ES
20CSL63	Open Source Systems Laboratory	0	0	2	1	60	40	100	PC
20GEP61	Comprehensive Test / Viva	---	---	---	2	100	0	100	EC
20MNT31	Environmental Science	2	0	0	0	100	0	100	MC
20CSP61	Project Work I #	0	0	4	2	100	0	100	EC
Total Credits to be earned					**19**				

B.E. DEGREE IN COMPUTER SCIENCE AND ENGINEERING
CURRICULUM UNDER REGULATIONS 2020
(For the candidates admitted in the academic year 2021-22)

SEMESTER – VII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Cate gory**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
20GET71	Engineering Economics and Management	3	0	0	3	40	60	100	HS
20CSC71	Deep Learning	3	0	2	4	50	50	100	PC
	Professional Elective - II	3	0	0	3	40	60	100	PE
	Professional Elective - III	3	0	0	3	40	60	100	PE
	Professional Elective - IV	3	0	0	3	40	60	100	PE
	Professional Elective - V	3	0	0	3	40	60	100	PE
Practical / Employability Enhancement									
20CSP71	Project Work – II Phase - I	0	0	12	6	50	50	100	EC
Total Credits to be earned					**25**				

SEMESTER – VIII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Categor y**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
	Open Elective - IV	3	0	0	3	40	60	100	OE
	Professional Elective - VI	3	0	0	3	40	60	100	PE
Practical / Employability Enhancement									
20CSP81	Project work - II Phase - II	---	---	8	4	50	50	100	EC
Total Credits to be earned					**10**				

Total Credits : 169

LIST OF PROFESSIONAL ELECTIVE (PE)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**	**Domain/ Stream**
		Elective 1						
1.	20CSE01	Theory of Computation	3	0	0	3	V	SD
2.	20CSE02	Data science	3	0	0	3	V	AI
3.	20CSE03	Building Enterprise Applications	3	0	0	3	V	SDE
4.	20CSE04	Artificial Intelligence	3	0	0	3	V	AI
5.	20CSE05	Multicore Architecture	3	0	0	3	V	SD
6.	20CSE06	Unix Internals	3	0	0	3	V	SD
7.	20CSE07	Graph theory	3	0	0	3	V	SD
		Elective 2						
8.	20CSE08	Game Theory and its Applications	3	0	0	3	VII	AI
9.	20CSE09	Wireless and Sensor Networks	3	0	0	3	VII	NS
10	20CSE10	Optimization Techniques	3	0	0	3	VII	SDE
11	20CSE11	Data Warehousing and Data Mining	3	0	0	3	VII	SDE
12	20CSE12	Distributed Systems	3	0	0	3	VII	SDE
13	20CSE13	Full Stack Development	3	0	0	3	VII	SD
14	20CSE14	Graphics and Multimedia	3	0	0	3	VII	SD
		Elective 3						
15.	20CSE15	Blockchain Technologies	3	0	0	3	VII	NS
16.	20CSE16	Total Quality Management	3	0	0	3	VII	GE
17.	20CSE17	Decision Support Systems	3	0	0	3	VII	AI
18.	20CSE18	Social Network Analysis	3	0	0	3	VII	SD
19.	20CSE19	Human Computer Interface	3	0	0	3	VII	SDE
20.	20CSE20	Business Intelligence and its Applications	3	0	0	3	VII	SDE
21.	20CSE21	Web Mining	3	0	0	3	VII	SDE
		Elective 4						
22.	20CSE22	Cryptography and Network Security	3	0	0	3	VII	NS
23.	20CSE23	Modeling and Simulation	3	0	0	3	VII	SD
24.	20CSE24	Parallel Computing Architecture and Programming	3	0	0	3	VII	SD
24.	20CSE25	Digital Marketing	3	0	0	3	VII	SDE

25.	20CSE26	Big Data Analytics	2	0	2	3	VII	SDE
26.	20CSE27	Cross Platform Application Development	3	0	0	3	VII	SDE
28.	20CSE28	Approximation Algorithms	3	0	0	3	VII	AI
29.	20GEE01	Fundamental of Research	3	0	0	3	VII	GE
		Elective 5						
30.	20CSE29	Software Defined Networks	3	0	0	3	VII	NS
31	20CSE30	Information Security	3	0	0	3	VII	NS
32	20CSE31	Intelligent Systems	3	0	0	3	VII	AI
33	20CSE32	Software Project Management	3	0	0	3	VII	SDE
34	20CSE33	Data Visualization Techniques	3	0	0	3	VII	SDE
35	20CSE34	Information Retrieval	3	0	0	3	VII	SD
36	20CSE35	Computer Vision	3	0	0	3	VII	AI
		Elective 6						
37	20CSE36	Natural Language Processing	3	0	0	3	VIII	SD
38	20CSE37	Cyber Forensics	3	0	0	3	VIII	NS
39	20CSE38	Augmented and Virtual Reality	3	0	0	3	VIII	AI
40	20CSE39	Predictive Data Analytics	3	0	0	3	VIII	SDE
41	20CSE40	Software Quality and Testing	3	0	0	3	VIII	SDE
42	20CSE41	Randomized Algorithms	3	0	0	3	VIII	AI
		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.	20CSO01	Fundamentals of Databases	3	0	2	4	4
2.	20CSO02	Python Programming and Frameworks	3	0	2	4	4
3.	20CSO03	Computational science for Engineers	3	1	0	4	5
4.	20CSO04	Formal Languages and Automata Theory	3	1	0	4	5
5.	20GEO03	Design Thinking for Engineers	3	1	0	4	5
6.	20CSO05	Java Programming	2	0	2	3	6
7.	20CSO06	Web Engineering	2	0	2	3	6
8.	20CSO07	Nature inspired optimization techniques	3	0	0	3	6
9.	20CSO08	Fundamentals of Internet of Things	3	0	0	3	8
10.	20CSO09	Machine Translation	3	0	0	3	8
11.	20CSO10	Fundamentals of Blockchain	3	0	0	3	8
12.	20CSO11	Programming with Java	3	0	2	4	5
13.	20CSO12	Introduction to Web Engineering	3	0	2	4	5

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^nsinax and x^ncosax – 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 – metallurgical coke - 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 BOOK:

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)**

20CST11 - PROBLEM SOLVING AND PROGRAMMING

Programme & Branch	BE – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	PC	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 BOOK:

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

REFERENCES:

1.	Yashavant Kanetkar, "Let us C", 16th Edition, BPB Publications, 2018.
2.	Reema Thareja., “Programming in C ”, 2nd Edition, Oxford University Press, New Delhi, 2018.
3.	Balagurusamy E., "Programming in ANSI C", 7th Edition, Mc Graw Hill Education, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	outline the basics of computers and apply problem solving techniques to express the solution for the given problem	Applying (K3)
CO2	identify the appropriate looping and control statements in C and develop applications using these statements	Applying (K3)
CO3	develop simple C programs using the concepts of arrays and modular programming	Applying (K3)
CO4	recall the basic concepts of pointers and develop C programs using strings and pointers	Applying (K3)
CO5	make use of user defined data types to solve given 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								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)**

20CSC11 - BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

Programme & Branch	BE – Computer Science and Engineering	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)**

20CSL11 - PROBLEM SOLVING AND PROGRAMMING LABORATORY

Programme & Branch	BE – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	PC	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 – product description – complaints and redressal – environmental issues – 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 – texts on environmental issues – **Writing** – Online reviews, articles and writing web content – **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, learning and the choice of courses – various services needed in daily life – 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 strategies and learning styles – using texts about personality development – **Writing** – Writing about hobbies – 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 about social organization, culture and social practices – **Writing** – Biographical sketches – historical events – 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 and infer 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)**

20PHT23 - PHYSICS FOR COMMUNICATION AND COMPUTER SCIENCE ENGINEERING

(Common to Electronics and Communication Engineering, Computer Science and Engineering and Information Technology branches)

Programme & Branch	BE, Electronics and Communication Engineering, BE-Computer Science and Engineering, BTech- Information Technology	Sem.	Category	L	T	P	Credit
Prerequisites	Applied Physics	2	BS	3	0	0	3

Preamble	This course aims to impart the knowledge on the physics of conductors, superconductors, semiconductors, magnetic materials, dielectrics, optoelectronic materials and nano materials. It also describes the working of the select solid state and optoelectronic devices and the applications of aforementioned materials in Communication Engineering and Computer Science and Engineering and Information Technology and provides motivation towards innovations.	
Unit - I	**Conducting and Superconducting Materials:**	**9**
Conducting Materials: Introduction - Classical free electron theory of metals - Electrical conductivity - Drawbacks of classical free electron theory - Quantum free electron theory - Quantum statistics: Fermi distribution function and Effect of temperature on Fermi function - Superconducting Materials: Introduction - Properties of superconductors - Type I and Type II superconductors - Applications: Cryotron - Superconducting quantum interference device (SQUID).		
Unit - II	**Semiconducting Materials and Devices:**	**9**
Introduction - Intrinsic semiconductor: Carrier concentration, Fermi level in intrinsic semiconductor, Variation of intrinsic conductivity with temperature and Determination of band gap - Extrinsic semiconductor: Carrier concentration in N-type and P-type semiconductors, Fermi level in Extrinsic semiconductors, Variation of Fermi level with temperature and impurity concentration - Hall effect: Determination of Hall coefficient and its applications - Uni-junction Transistor: Construction and characteristics – Junction field Effect Transistor: Construction and characteristics.		
Unit - III	**Magnetic and Dielectric Materials:**	**9**
Magnetic materials: Introduction - Classification of magnetic materials based on magnetic moment - Ferromagnetism: Domain theory of ferromagnetism, Hysteresis loss, Soft and hard magnetic materials and Application: Transformer core. Dielectrics Materials: Introduction - Dielectric constant - Types of polarization (qualitative) - Temperature dependence of polarization - Frequency dependence of total polarization - Dielectric loss (qualitative) - Dielectric breakdown – Ferroelectricity and its applications.		
Unit - IV	**Optoelectronic Materials and Devices:**	**9**
Introduction - Photodetectors: p-i-n photo diode - Avalanche photo diode – Effect of Anisotropic crystals in light propagation: Index ellipsoid of uniaxial and biaxial crystals -Electro-Optic effect: Pockel's effect and Kerr effect - Light modulators - Types of light modulators - Electro refractive modulators: Electro-optic amplitude and Phase modulators - Electro absorptive modulators: Franz - Keldysh and Stark effect modulators.		
Unit - V	**Nano Materials:**	**9**
Introduction - Properties of nano-materials - Low dimensional structures: Quantum dot, quantum wire and quantum well - Production techniques: Ball Milling, lithographic method, physical vapor deposition method, chemical vapor deposition method and sol gel method - Applications of nano-materials – Carbon nanotubes: Structures, properties, synthesis by laser ablation method - Applications of carbon nanotubes.		

Lecture :45 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 for Unit I, II, III and Unit V.
2.	Palanisamy P.K., "Semiconductor Physics and Opto electronics", 2nd Edition, Sci Tech Publications, Chennai, 2010, for Unit IV.

REFERENCES:

1.	Kachhava C.M., "Solid State Physics, Solid State Device and Electronics", 1st Edition, New Age International, New Delhi, 2003.
2.	Charles Kittel, "Introduction to Solid State Physics", 8th Edition, John Wiley& Sons, New Jersey, 2004.
3.	Tamilarasan K. and Prabu K., "Materials Science", 1st Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply the concepts of classical and quantum free electron theory of metals to compute the electrical conductivity of metals and to comprehend the effect of temperature on Fermi function and to summarize the types, properties and applications of superconductors (Cryotron and Superconducting quantum interference device).	Applying (K3)
CO2	use the concept of density of states to compute the carrier concentration, electrical conductivity and band gap of intrinsic semiconductors and to compute the carrier concentration of extrinsic semiconductors, and also to explain the phenomenon related to Hall Effect and the working of UJT and JFET.	Applying (K3)
CO3	apply the domain theory of ferromagnetism to explain hysteresis and to apply the concept of electric dipole moment and electric polarization to comprehend the select polarization mechanisms in dielectrics and to describe the related phenomenon.	Applying (K3)
CO4	apply the theory of photoconductivity and p-n junction to describe the materials, construction, working and applications of the select optoelectronic devices and to apply the concept of index ellipsoid of uniaxial and biaxial crystals to explain the principle, working and application of opto-electric modulators.	Applying (K3)
CO5	utilize appropriate methods to prepare nano-materials and carbon nano-tubes, and to comprehend their properties, types and 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											
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	40	40				100
CAT3	25	35	40				100
ESE	20	40	40				100

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

20CYT23 - CHEMISTRY OF ELECTRONIC MATERIALS

Programme & Branch	B.E – ECE, CSE, EEE, EIE & B.TECH- IT branches	Sem.	Category	L	T	P	Credit
Prerequisites	Applied Chemistry	2	BS	3	0	0	3

Preamble	Chemistry of electronic materials aims to equip the engineering students to realize the importance of chemistry in polymeric materials, metal finishing, organic electronic materials, fuel cells, renewable energy and e-waste management.	
Unit - I	**Chemistry of Polymeric and Composite Materials :**	**9**
Introduction - structure and property relationship of polymers - plastics - properties and uses of plastics as engineering materials - rubbers (elastomers) - natural rubber- processing of latex- vulcanization of rubber - synthetic rubbers- preparation, properties and uses of thiokol and butyl rubber- polymer blends and alloys - fibres-physical properties-types-spinning processes- composites - classification of composites - fibre reinforced plastics- processing , properties and uses of fiber reinforced plastics		
Unit - II	**Industrial Metal Finishing :**	**9**
Introduction – technological importance of metal finishing- methods of metal finishing - manufacturing of electronic component- PCB fabrication- essential of metal finishing: polarization, decomposition potential and overpotential - surface preparation - Electroplating – Process - effect of plating variables on the nature of electrodeposit - electroplating of chromium and silver. Electroless plating - electroless copper plating on printed circuit board - electroless nickel plating process -Distinction between electroplating and electroless plating- advantages of electroless plating.		
Unit - III	**Chemistry of Organic Electronic Materials and Fuel Cells:**	**9**
Introduction-Organic semiconducting materials – principle and applications - advantages over inorganic semiconducting materials - P-type and N-type organic semiconducting materials (definition and examples) - conducting polymers and its applications - organic dielectrics (principle and example) - organic light emitting diodes - working and applications. Fuel Cells: Importance and classification of fuel cells - description, principle, components, applications and environmental aspects of fuel cells: alkaline fuel cells, phosphoric acid, molten carbonate and direct methanol fuel cells.		
Unit - IV	**Renewable Energy Resources:**	**9**
Introduction – global energy consumption scenario- types of energy resources - nuclear energy - nuclear power reactor - breeder reactors - applications and disadvantages of nuclear energy - design, working, advantages and disadvantages of solar energy, hydropower, wind energy, geothermal energy, tidal and wave power, ocean thermal energy - biomass and biofuels - hydrogen as an alternate fuel - hydrogen production - advantages ,disadvantages and applications - nanotechnology for energy sector.		
Unit - V	**E-Waste and its Management:**	**9**
E- Waste – definition - sources of e-waste– hazardous substances in e-waste - effects of e-waste on environment and human health- need for e-waste management– e-waste handling rules - waste minimization techniques for managing e-waste – recycling of e-waste - disposal treatment methods of e- waste – global Scenario of E-waste – E-waste in India- case studies.		

Lecture :45 Total: 45

TEXT BOOK:

1.	Wiley editorial board. "Wiley Engineering Chemistry". 2nd Edition, Wiley India Pvt. Ltd, New Delhi, Reprint 2019, for Units I,II,IV.
2.	Palanisamy P.N., Manikandan P., Geetha A., Manjula Rani K.& Kowshalya V.N., “Environmental Science”, Revised Edition, Pearson Education, New Delhi, 2019 for Units I, III, IV, V.

REFERENCES:

1.	Palanna O., "Engineering Chemistry" , McGraw Hill Education, New Delhi, 2017 for Units II,III.
2.	B.Joshi & Shashank Deep, “Engineering Chemistry”, Oxford University Press, New Delhi, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	utilize the polymeric and composite materials for various applications	Applying (K3)
CO2	employ the concept of coating techniques in industrial metal finishing	Applying (K3)
CO3	apply the concepts of fuel cells, organic electronic materials and its applications	Applying (K3)
CO4	explain the role of renewable energy resources to attain sustainability	Understanding (K2)
CO5	utilize the knowledge to handle the e-waste and reduce its impacts on environment	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	1												
CO4	3	2	1	1			3							
CO5	3	2	1	1			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	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)**

20VEC11 – YOGA 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).

Lecture :20 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)**

20MEC11 – ENGINEERING DRAWING
(Common to ECE, EEE, EIE, CSE, IT Branches)

Programme & Branch	BE(ECE, EEE, EIE,CSE) &BTech(IT)	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**2**	**ES**	**2**	**0**	**2**	**3**

Preamble	To impart knowledge on orthographic, isometric projections, sectional views and development of surfaces by solving different application oriented problems.	
Unit - I	**General Principles of Orthographic Projection:**	**9**
Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications - Size, layout and folding of drawing sheets - Lettering and dimensioning - Projections of Points, Lines and Planes - General principles of orthographic projection - First angle projection - Layout of views - Projection of points located in all quadrant and straight lines located in the first quadrant - Determination of true lengths and true inclinations and location of traces - Projection of polygonal surface and circular lamina inclined to both reference planes.		
Unit - II	**Projections of Solid:**	**9**
Projections of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.		
Unit - III	**Sectioning of Solids:**	**9**
Sectioning of solids - prisms, pyramids, cylinder and cone in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other - Obtaining true shape of section.		
Unit - IV	**Development of Surfaces:**	**9**
Development of lateral surfaces of simple solids like prisms, pyramids, cylinders and cones – development of simple truncated solids involving prisms, pyramids, cylinders and cones.		
Unit - V	**Isometric Projection and Introduction to AutoCAD:**	**9**
Principles of isometric projection - Isometric scale - Isometric projections of simple and truncated solids like prisms, pyramids, cylinders and cones - Conversion of isometric projection into orthographic projection - Introduction to AutoCAD.		

Lecture:30, Practical:30, Total:60

TEXT BOOK:

1.	Venugopal K. and Prabhu Raja V., “Engineering Graphics”, 15th Edition, New Age International Pvt. Ltd., New Delhi, 2018.

REFERENCES:

1.	Basant Agrawal, Agrawal C.M., “Engineering Drawing”, 2nd Edition, McGraw Hill Education, 2019.
2.	Gopalakrishnana K.R. “Engineering Drawing”, Volume. I & II, Subhas Publications, Bengaluru, 2014.
3.	Parthasarathy N.S., Vela Murali. “Engineering Drawing”, 1st Edition, Oxford University Press, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret international standards of drawings and sketch the projections of points, lines and planes.	Understanding (K2)
CO2	draw the projections of 3D primitive objects like prisms, pyramids, cylinders and cones.	Applying (K3)
CO3	construct the various sectional views of solids like prisms, pyramids, cylinders and cones.	Applying (K3)
CO4	develop the lateral surfaces of simple and truncated solids.	Applying (K3)
CO5	sketch the isometric projections of simple and truncated solids and convert isometric drawing in to orthographic projection.	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	2	2	2	3
CO2	3	2	1	1						3	2	3	2	3
CO3	3	2	1	1						3	2	3	2	3
CO4	3	2	1	1						3	2	3	2	3
CO5	3	2	1	1						3	2	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	20	40	40				100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	25	35	40				100

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

20CST21 - PROGRAMMING AND LINEAR DATA STRUCTURES

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Problem solving and Programming**	**2**	**PC**	**3**	**0**	**2**	**4**

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.		

List of Exercises:

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 and Queue using array and linked list
10.	Infix to Postfix conversion, postfix evaluation using stack

Lecture: 45, Practical: 30, Total: 75

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.
REFERENCE:	
1.	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	make use of pointers to perform array and string operations	Applying (K3)
CO2	implement functions and structures with pointers	Applying (K3)
CO3	demonstrate file operations and preprocessor directives	Applying (K3)
CO4	describe the different operations on singly linked list and make use of it for developing simple applications	Applying (K3)
CO5	manipulate the operations on stacks and queues	Applying (K3)
CO6	implement programs to solve problems using pointers to arrays and structures	Applying (K3), Precision (S3)
CO7	develop programs using files and preprocessor directives	Applying (K3), Precision (S3)
CO8	use appropriate linear data structure for solving given 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									2	1
CO2	3	2	1	1									2	1
CO3	3	2	1	1									2	1
CO4	3	2	1										2	1
CO5	3	2	1	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	10	80				100
CAT2	10	10	80				100
CAT3	10	20	70				100
ESE	10	30	60				100

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

20PHL27 - PHYSICAL SCIENCES LABORATORY II

Prog. & Branch	BE - Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Pre requisite	Nil	2	BS	0	0	2	1

Preamble	This course aims to impart hands on training in the determination of physical parameters such as specific resistance, band gap, hysteresis loss and thickness of a nano-structured material and also the working UJT, and to develop the skills in handling different basic instruments. This course also aims to impart the significance of Cl^-, Cr^{6+}, DO, Fe^{2+} and Cu^{2+} and thereby, to improve the analytical capability.

List of Exercises / Experiments:

1.	Determination of the specific resistance of the material of a wire using Carey-Foster's bridge.
2.	Determination of the band gap of a semiconductor using post office box.
3.	Observation of the I-V characteristics of a uni junction transistor.
4.	Determination of hysteresis loss in a ferromagnetic material.
5.	Determination of the thickness of a nano-structured material using air-wedge arrangement.
6.	Estimation of chloride ion in the given water sample using Argentometric method.
7.	Estimation of chromium (Cr^{6+}) in wastewater sample.
8.	Determination of dissolved oxygen in the given wastewater sample.
9.	Estimation of iron using permanganometry.
10.	Estimation of copper in the given solution by Iodometric method.

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, Kalaikathir Publishers, Coimbatore, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	determine the specific resistance of conducting materials and the band gap of semiconducting materials using the concept of electrical conductivity and to obtain the V-I characteristics of a UJT using the concept of creation of a region with negative resistance.	Applying (K3), Precision (S3)
CO2	determine the hysteresis loss in ferromagnetic materials using the concept of domain theory of ferromagnetism and to determine the thickness of nano-crystalline thin films using the concept of interference of light. Estimation of Chloride and Chromium (Cr^{6+}) in the given water sample and also to determine the dissolved oxygen in the given wastewater sample.	Applying (K3), Precision (S3)
CO3	estimation of iron and copper in 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

20MEL11 –ENGINEERING PRACTICES LABORATORY
(Common to ECE, EEE, EIE, CSE & IT Branches)

Programme & Branch	BE (ECE, EEE, EIE, CSE) & 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

20MAT34 - DISCRETE MATHEMATICAL STRUCTURES

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

Programme & Branch	**BE – Computer Science and Engineering & BTech – 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)**

20CSC32 - DIGITAL PRINCIPLES AND DESIGN

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	3	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 i) Half Adder and Full Adder ii) Half Subtractor and Full Subtractor
3.	Design and Implement 4- Bit Adder /Subtractor.
4.	Design and Implement BCD Adder /Subtractor.
5.	Design and implement a 4-bit binary to gray and gray to binary code converter.
6.	Simulation of Multiplexer and Demultiplexer circuits using Virtual labs
7.	Design and implement decoders and encoders.
8.	Implement various Flip-flops using Logic gates.
9.	Design and implement various Shift Registers.
10.	Design and implement various Synchronous counters.

Lecture: 45, Practical:30, Total:75

TEXT BOOK:

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)**

20CST31 - DATA STRUCTURES

Programme & Branch	B.E. – Computer Science and Engineering	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.		

Total: 45

TEXT BOOK:

1.	Weiss M. A., “Data Structures and Algorithm Analysis in C”, 2nd Edition, Pearson Education, 2016 for Units I,II,III,V.
2.	Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, “Introduction to Algorithms”, 3rd Edition, Mcgraw Hill, 2009 for Unit IV.

REFERENCE:

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)**

20CST32 - OBJECT ORIENTED PROGRAMMING

Programme & Branch	B.E. – Computer Science and Engineering	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 BOOK:

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

REFERENCE:

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)**

20CST33 - COMPUTER ORGANIZATION

Programme& Branch	B.E. – Computer Science and Engineering	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**	**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	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)**

20CSL31 - DATA STRUCTURES LABORATORY

Programme & Branch	B.E. – Computer Science and Engineering	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 i) Store the element in hash table ii)Search an element from the table 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: 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

20CSL32 - OBJECT ORIENTED PROGRAMMING LABORATORY

Programme & Branch	B.E. – Computer Science and Engineering	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.

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 / 4	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:**	**6**
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:**	**6**
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:**	**6**
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:**	**6**
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 Profes sional Ethics:**	**6**
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: 30

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	restate 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	infer 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	transform themselves to co-exist with nature by realizing interconnectedness and four orders of nature.	Understanding (K2)
CO5	distinguish between ethical and unethical practices, and stand ethical and moral practices for a better living.	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	2	3	2	2				
CO2						2	2	3	2	2				
CO3						2	2	3	2	2				
CO4						2	2	3	2	2				
CO5						2	2	3	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	25	75					100
CAT2	25	75					100
CAT3	NA						
ESE	NA						

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

20MAT42 - PROBABILITY AND STATISTICS

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

Programme & Branch	**BE - Computer Science Engineering & BTech – Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	**BS**	**3**	**1**	**0**	**4**

Preamble	To provide an in-depth knowledge about random variables, correlation, sampling theory and promote the ability to use probability distributions and analysis of variance to experimental data.	
Unit - I	**Random Variables:**	**9+3**
Introduction to Probability – Random VariableS – Discrete and Continuous random variables – Probability Mass and Probability density functions – Mathematical expectation and Variance – Moments – Moment generating function – Functions of random variable.		
Unit - II	**Standard Probability Distributions:**	**9+3**
Discrete Distributions: Binomial distribution – Poisson distribution – Geometric distribution – Continuous Distributions: Uniform distribution – Exponential distribution – Normal distribution.		
Unit - III	**Two Dimensional Random Variables:**	**9+3**
Introduction – Joint probability distributions – Marginal and conditional distributions – Covariance – Correlation and regression – Transformation of random variables.		
Unit - IV	**Testing of Hypothesis:**	**9+3**
Introduction – Critical region and level of significance – Types of Errors – Large sample tests: Z-test for single proportion and difference of two sample proportions – Z-test for single mean and difference of means – Small sample tests: Student’s t-test for testing significance of single mean and difference of means – F-test for comparison of variances – Chi-square test: Test of goodness of fit – Test of independence of attributes.		
Unit - V	**Design of Experiments:**	**9+3**
Analysis of variance – One way classification: Completely Randomized Design – Two way classification: Randomized Block Design – Three way classification: Latin Square Design.		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Veerarajan, T, “Probability, Statistics, Random Processes and Queuing Theory”, 1st Edition, Tata McGraw-Hill, New Delhi, 2019.

REFERENCES:

1.	William Mendenhall, Robert J. Beaver and Barbara M. Beaver, “Introduction to Probability and Statistics”, 14th Edition, Cengage Learning, USA, 2013.
2.	Jay L. Devore, “Probability and Statistics for Engineering and the Sciences”, 9th Edition, Cengage Learning, USA, 2016.
3.	Walpole R.E., Myers R.H., Myers S.L. and Ye K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2016.
4.	Douglas C. Montgomery & George C. Runger, "Applied Statistics and Probability for Engineers ", 7th Edition, John Wiley and Sons, USA, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	interpret the concept of random variables.	Applying (K3)
CO2	apply different types of distributions in engineering problems.	Applying (K3)
CO3	understand the concepts of two dimensional random variables and regression.	Applying (K3)
CO4	apply statistical tests for solving engineering problems involving small and large samples.	Applying (K3)
CO5	apply the concepts of analysis of variance to experimental data.	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	1	1										1	
CO2	3	2	1										2	
CO3	3	2	1										1	
CO4	3	2	1	3									2	
CO5	3	2	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	20	70				100
CAT2	10	20	70				100
CAT3	10	30	60				100
ESE	10	25	65				100

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

20CST41 - DATABASE MANAGEMENT SYSTEMS

Programme & Branch	B.E. – Computer Science and Engineering	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)**

20CST42 - PYTHON PROGRAMMING AND FRAMEWORKS

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	4	PC	3	0	0	3

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		

Total: 45

TEXT BOOK:

1.	Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016 (Units I – III) .
2.	Jake Vander Plas, "Python Data Science Handbook Essential Tools for Working with Data", 1st Edition, O'Reilly Publishers, 2016 (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 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)

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	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)**

20CSC42 - DESIGN AND ANALYSIS OF ALGORITHMS
(For the students admitted in the academic year 2020-21)

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Data Structures	4	PC	3	0	2	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.		

List of Exercises:

1. Find the order of growth of the given problems. Identify the basic operation and count the number of times the basic operation is executed
2. Analyze the different sorting algorithms and find out the best algorithm with respect to space and time
3. Using Decrease and conquer technique, compute the k^{th} smallest element in the list of 'n' numbers. Also, find the time complexity
4. Write the heap sort algorithm to sort 'n' numbers using transform and conquer
5. Compare top down and bottom-up approaches of solving the Knapsack problem using Dynamic Programming
6. Construct the huffman code for the given data. Also perform encoding and decoding (use Greedy technique).
7. Apply backtracking to solve the given instance of subset sum problem
8. Solve the travelling salesman problem of the given graph using branch and bound technique

Lecture: 45, Practical:30, Total: 75

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)
CO6	evaluate the Space and Time efficiency of various algorithms	Analyzing (K4) Precision (S3)
CO7	estimate the performance of various algorithm design techniques	Analyzing (K4) Precision (S3)
CO8	use appropriate design strategies for solving a given problem	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										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
CO6	3	2	1	2	1								3	2
CO7	3	2	1	2	1								3	2
CO8	3	2	1	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)**

20CST44 - DESIGN AND ANALYSIS OF ALGORITHMS
(For the students admitted in the academic year 2021-22)

Programme& Branch	B.E. – Computer Science and Engineering	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+3**
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 and Divide & Conquer**	**9+3**
Brute Force:Selection and Bubble Sort, Sequential search and String Matching - closest pair and convex hull problem. Divide and Conquer: Merge sort - Quick sort - Binary tree traversals and related properties - Multiplication of large integers and Strassen's Matrix Multiplication - closest pair and convex hull problem.		
Unit – III	**Decrease &Conquer and Transform & Conquer**	**9+3**
Decrease & Conquer: 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 and Greedy Technique**	**9+3**
Dynamic Programming: 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 and codes.		
Unit – V	**Backtracking and Branch & Bound**	**9+3**
Backtracking: 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		
		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	60				100
ESE	10	10	60	20			100

* ±3% may be varied (CAT 1&2 – 60 marks & ESE – 100 marks)

20CST43 - OPERATING SYSTEMS

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	4	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)**

20CSL41 - DATABASE MANAGEMENT SYSTEMS LABORATORY

Programme & Branch	B.E. – Computer Science and Engineering	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) Sample Applications: Inventory Control System Hospital Management System Railway Reservation System Web Based User Identification System Hotel Management System Student Information System 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: 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

20CSL42 - PYTHON PROGRAMMING AND FRAMEWORKS LABORATORY

Programme & Branch	**B.E. – Computer Science and Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**NIL**	**4**	**PC**	**0**	**0**	**2**	**1**
Preamble	This course provides knowledge to solve real time problems using OOP concepts in python and to perform data manipulation and visualization using python packages.						

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

Total: 30

REFERENCES / MANUALS / SOFTWARES:

1.	Python 3 interpreter for Windows/Linux
2.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	write, test and debug simple Python programs using control structures and functions	Applying (K3), Precision(S3)
CO2	develop real time applications using Object Oriented Programming concepts and database programming	Applying (K3), Precision(S3)
CO3	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	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														

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)**

20CST51 - COMPUTER NETWORKS

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

Preamble	This course provides an overview of the basics of data communications and networking. The course presents the top-down approach of layers with distinct concepts, functionalities and protocols.	
Unit - I	**Introduction to Internet**	**9**
Internet – Network edge – Access networks – Physical media – Network core: Packet switching – Circuit switching – Network of networks – Delay, loss and throughput in packet-switched networks – Protocol layers and their service models.		
Unit - II	**Application Layer**	**9**
Principles of Network applications – The web and HTTP – Electronic mail in the Internet – DNS-Internet's directory service – Peer-to-peer applications – Video Streaming and content distribution networks – Socket programming: Creating Network applications.		
Unit - III	**Transport Layer**	**9**
Introduction and transport layer services – Multiplexing and demultiplexing – Connectionless transport: UDP – Principles of reliable data transfer – Connection-oriented transport: TCP – Principles of congestion control – TCP congestion control.		
Unit - IV	**Network Layer**	**9**
Overview – Inside a router – Internet Protocol (IP): IPv4, addressing, IPv6 – Generalized forwarding and SDN – Routing algorithms: Link state and distance vector – Intra AS routing in the Internet: OSPF – Routing among the ISPs: BGP – The SDN control plane –ICMP.		
Unit - V	**Link Layer and LAN**	**9**
Introduction to Link layer – Error detection and correction – Multiple access links and protocols – Switched LAN – Link Virtualization: A Network as a Link Layer – Data Center Networking. Security in Computer Networks: Introduction to Network Security – Principles of Cryptography.		

Total:45

TEXT BOOK:

1.	Kurose James F. and Ross Keith W., "Computer Networking: A Top-Down Approach", 8^{th} Edition, Pearson Education, New Delhi, 2020.

REFERENCES:

1.	Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks", 5^{th} Edition, Pearson Education, 2013.
2.	Behrouz A. Forouzan, "Data Communications and Networking", 5^{th} Edition, McGraw Hill Education, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the fundamentals of internetworking and evaluate network QoS parameters	Applying (K3)
CO2	develop client-server applications using UDP/TCP socket program and explain various standard application layer protocols.	Applying (K3)
CO3	apply congestion control techniques and explain transport layer services	Applying (K3)
CO4	make use of the knowledge of Internet Protocol, addressing schemes and apply various routing protocols for a given network scenario	Applying (K3)
CO5	determine suitable data link layer techniques and protocols	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	40	30				100
CAT2	30	40	30				100
CAT3	30	40	30				100
ESE	30	40	30				100

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

20CST52 - MACHINE LEARNING

Programme & Branch	B.E. & Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Python programming and Frameworks**	**5**	**PC**	**3**	**0**	**0**	**3**

Preamble	This course focuses on finding patterns or making predictions from empirical data. The course also explores the 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, Micheline Kamber, "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)**

20CSC51 – AGILE METHODOLOGIES

Programme & Branch	**B.E. – Computer Science and Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PC**	**3**	**0**	**2**	**4**

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. It also focuses on providing hands-on experience in designing and developing software systems. Students will undertake a group project, working through a number of stages of a software development.	
Unit – I	**Process Models, Analysis and Design**	**9**
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.		
Unit – II	**Agile Principles and Scrum**	**9**
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**	**9**
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**	**9**
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**	**9**
Software Project Management Concepts–Process and Project Metrics: Software Measurement- Metrics for Software Quality–Estimation for Software Projects: Decomposition Techniques – COCOMO Model–Project Scheduling :Basic Principles – Scheduling-Earned Value Analysis–Risk Management– Software Process Improvements (SPI) – The SPI Process –Capability Maturity Model Integration(CMMI)		

LIST OF EXPERIMENTS / EXERCISES:

1.	Create a product back log with stories.
2.	Determine Release plan to decide which stories can be accomplished in the release.
3.	Write Sprint plan to determine which features can be accomplished in the first iteration, or sprint.
4.	Manage your workload
5.	Use several predefined and user created queries to Track project progress.
6.	Schedule the sprint review to allow team members to add their thought and review the discussion at the meeting.
7.	Create a plan to shut down the first sprint and get ready to start the next one
8.	Identify use cases and develop business use case model (System use case diagram).
9.	Identify the conceptual classes (boundary, controller and entity classes) and develop a domain model with UML Class diagram.
10.	Develop user interface using Python and Database creation using MySQL and Perform unit and integration testing.

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Roger S.Pressman & Bruce R.Maxim, "Software Engineering: A Practitioner's Approach", 7thEdition, McGraw-Hill Education, 2019.(Units —1,4,5)
2.	Andrew Stellman and Jennifer Greene, "Learning Agile: Understanding Scrum, XP, Lean and Kanban", First Edition, O'Reilly Media Inc,2015. (Units3,4)

REFERENCES/ MANUAL / SOFTWARE:

1.	Ian Sommerville, "Software Engineering",10th Edition, Pearson Education,2014.
2.	Infosys spring board contents provided by Infosys at https://infyspringboard.onwingspan.com/web/en/page/home

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	Applying(K3)
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)
CO6	Design and implement projects using scrum process template	Applying (K3), Precision(S3)
CO7	Make use of UML analysis and design diagrams in various applications	Applying (K3), Precision (S3)
CO8	Apply appropriate testing and project management tools for the real world scenarios	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										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
CO6	3	2	1	1	1				1	1	2	1	3	1
CO7	3	2	1	1	1				1	1	2	1	3	1
CO8	3	2	1	1	1				1	1	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	75	15				100
CAT2	10	75	15				100
ESE	10	75	15				100

* ±3% may be varied (CAT 1 & 2 – 60 marks & ESE – 100 marks)

20CSL51 - NETWORK LABORATORY

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	5	PC	0	0	2	1

Preamble	It provides an exposure to investigate the various services offered by application, transport, network and link layers and to analyze the operations of different protocols by capturing various packet traces.

List of Exercises / Experiments :

1. Installation and exploration of the packet analyzer/protocol analyzer tool Wireshark
2. Capture HTTP packets by retrieving different HTML files and experiment HTTP GET/POST connections and HTTP authentication using Wireshark
3. Capture the DNS packets that are generated by ordinary web-surfing activity and produce the details of DNS query and response messages using Wireshark
4. Create UDP and TCP based network applications using socket programming
5. Capture UDP packet traces through SNMP and DNS messages and prepare UDP datagrams with the packet summary fields using Wireshark
6. Transfer a file to a remote server, analyze the traces of the TCP segments sent and received and investigate the behaviours of TCP using Wireshark
7. Implement Go-Back-N and Selective repeat flow control protocols
8. Capture packets from an execution of traceroute/tracert program and analyse the IPv4 datagram, IP fragmentation, IPv6 datagrams and NAT router using Wireshark
9. Capture and Analyse the packet traces of DHCP and ICMP using Wireshark
10. Implement bit stuffing and error detection techniques
11. Capture packet traces by retrieving an HTML file and investigate the operations of Ethernet protocol and the ARP protocol using Wireshark

Total :30

REFERENCES / MANUALS / SOFTWARES:

1. Wireshark
2. C / Java / Python
3. Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explore the operations of application layer protocols by capturing HTTP and DNS packets	Applying (K3), Precision(S3)
CO2	investigate the behavior of transport layer protocols by capturing UDP and TCP packets	Applying (K3), Precision(S3)
CO3	examine the functionalities of network layer and LAN protocols by capturing packet traces of IPv4, IPv6, NAT, DHCP, ICMP, Ethernet and ARP	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

20CSL52 - MACHINE LEARNING LABORATORY

Programme & Branch	B.E. & Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Python Programming and Frameworks	5	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 model using 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

20GEL51 - PROFESSIONAL SKILLS TRAINING - I
(Common to all BE/ BTech / MSc / MCA /BSc Branches)

Programme & Branch	All BE / BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	5	EC	0	0	80	2

Preamble	This subject is to enhance the employability skills and to develop career competency	
Unit - I	**Soft Skills – I**	**20**
Soft skills and its importance: Pleasure and pains of transition from an academic environment to work environment-Need for change- Fear, stress and competition in the professional world-Importance of positive attitude- Self motivation and continuous knowledge upgradation-Self-confidence. Professional grooming and practices: Basics of corporate culture-Key pillars of business etiquette- Basics of etiquette-Introductions and greetings-Rules of the handshake, earning respect, business manners-Telephone etiquette- Body Language.		
Unit - II	**Quantitative Aptitude & Logical Reasoning - I**	**30**
Problem solving level I: Number System-LCM &HCF-Divisibility test-Surds and indices-Logarithms- Ratio-proportions and variation-Partnership-Time speed and distance-Data interpretation-data representation. Logical reasoning: Family tree-Deductions-Logical connectives-Binary logic Linear arrangements- Circular and complex arrangement		
Unit - III	**Written Communication & Verbal Aptitude**	**30**
Writing Skills: Writing strategies and formats – Importance of Résumés – Writing a Cover letter – Writing a fresher's CV / Résumés – Responding to Job Advertisements – Professional e-mail Writing – Responding to e-mails and business letters – Technical Report writing – Interpretation of Technical Data (Transcoding) – Writing One-page Essays. Verbal Aptitude – Synonyms – Antonyms – Homonyms – One word substitution – Idioms and Phrases – Paired words – Analogies – Spelling test – Cloze test – using suitable verb forms – using appropriate articles and prepositions; Spotting Errors – Sentence Correction and Formation – Grammar Based questions (Transformation : Active-Passive & Direct-Indirect); Rearranging Jumbled Sentences & Jumbled paragraphs, Identifying Facts, Inferences and Judgements statements.		

Total: 80

TEXT BOOK:

1	Thorpe, Showick and Edgar Thorpe, "Objective English For Competitive Examination", 6th Edition, Pearson India Education Services Pvt Ltd, 2017.

REFERENCES:

1	Bailey Stephen, "Academic Writing: A practical guide for students", Routledge, New York, 2011.
2	Raman, Meenakshi and Sharma, Sangeeta, "Technical Communication - Principles and Practice", 3rd Edition, Oxford University Press, New Delhi, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	develop the soft skills of learners to support them work efficiently in an organization as an individual and as a team	Applying (K3), Precision (S3)
CO2	solve real time problems using numerical ability and logical reasoning	Applying (K3), Precision (S3)
CO3	apply communication skills effectively to understand and deliver information in various written discourses grammatically with accuracy	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				3	3		3		3	2		
CO2	3	2				3	3		3		3	2		
CO3		2				3	3		3	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	20	50	30				100
CAT2		50	50				100
CAT3		50	50				100
ESE	**NA**						

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

20CST61 - PRINCIPLES OF COMPILER DESIGN

Programme & Branch	**B.E. – Computer Science and Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**NIL**	**6**	**PC**	**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. (Units 1-5)

REFERENCE:

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

COURSE OUTCOMES: 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)**

20CST62 - INTERNET OF THINGS AND CLOUD

Programme & Branch	**B.E. – Computer Science and Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Computer Communication Network	**6**	**ES**	**3**	**0**	**0**	**3**

Preamble	The course describes various communication protocols for IoT, IoT levels and design methodologies and illustrates the development of simple real time IoT applications. This course also explores the next generation cloud for IoT applications and IoT services in Amazon Web Services.	
Unit - I	**Introduction to Internet of Things:**	**9**
Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT Communication Models - IoT Communication APIs – IoT enabling Technologies- IoT Levels and Templates – Domain Specific IoT- IoT and M2M - IoT Platform Design methodologies		
Unit - II	**Infrastructure and Service Discovery Protocols for the IoT System**	**9**
Low Power Wide Area Networking Technologies - Layered Architecture of IoT-Protocol architecture of IoT-Infrastructure Protocols – Device or Service Discovery for IoT – Protocols for IoT Service Discovery		
Unit - III	**Python for IoT and Introduction to Raspberry Pi:**	**9**
Python packages for IoT-Introduction to Raspberry Pi – Interfaces (serial, SPI, 12C) Programming – Python program with Raspberry Pi (interfacing external devices) – controlling output – reading input from pins – connecting IoT to Cloud (ThingSpeak).		
Unit - IV	**The Next Generation Cloud for IoT Applications and Analytics:**	**9**
Cloud computing Service models-Types of Cloud- Cloud Technology-Cloud Service Ecosystem-Cloud Enabled Environment-Cloud Inspired Enterprise Transformations- IoT and Cloud Inspired Smarter Environments- Hybrid Clouds- Federated Clouds-Special Purpose Clouds-The Emergence of Edge/Fog clouds-The Architectural Components of the Smarter Traffic System-The building blocks of Software Defined Clouds-Software Defined Storage		
Unit - V	**AWS IoT: Developing and Deploying an Internet of Things**	**9**
AWS IoT Core services – Creation of IoT resources –Rules Engine for building IoT applications-Benefits of Device Shadows-Protocols for communication with and between devices- Creation of web based application for device Communication- Benefits of AWS IoT analytics		

Total:45

TEXT BOOK:

1.	ArshdeepBahga and Vijay Madisetti, “Internet of Things - A Hands-on Approach”, Universities Press, 2015

REFERENCES:

1.	Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms, and Use Cases”, CRC Press, 2017
2.	https://www.coursera.org/learn/aws-iot-developing-and-deploying-an-internet-of-things

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	analyze the various IoT levels and choose an appropriate level and also develop design methodologies for a given application	Analyzing (K4)
CO2	design an architecture and choose an appropriate protocols for simple IoT applications	Applying (K3)
CO3	outline the role of Python packages for IoT applications and develop simple IoT applications using Raspberry Pi and Python	Applying (K3)
CO4	analyse the various types of cloud and choose an appropriate cloud for a given IoT applications	Analyzing (K4)
CO5	develop and deploy IoT applications using AWS IoT	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										3	2
CO3	3	2	1										3	2
CO4	3	3	2										3	2
CO5	3	2	1		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	20	30	30	20			100
CAT2	20	40	40				100
CAT3	20	30	30	20			100
ESE	20	30	30	20			100

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

20CST63 - MOBILE COMMUNICATION

Programme& Branch	**B.E. – Computer Science and Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Computer Networks**	**6**	**ES**	**3**	**0**	**0**	**3**

Preamble	This course provides an insight on wireless communication technologies from 2G to 5G. System and Protocol architectures are also explored in design aspects with usecase scenarios.	
Unit - I	**Introduction to Wireless Communication:**	**9**
Wireless transmission – Frequencies for radio transmission – Signals – Antennas – Signal Propagation – Multiplexing – Spread spectrum –cellular systems- MAC for Motivation – SDMA – FDMA – TDMA – CDMA		
Unit - II	**Telecommunication and Satellite systems:**	**9**
GSM: Mobile services - System architecture - Radio interface - Protocols - Localization and calling – Handover - Security - New data services– Satellite Systems – Basics – Routing - Localization-Handover.		
Unit - III	**Wireless LAN:**	**9**
Wireless LAN - Infrared Vs Radio Transmission – Infrastructure Networks and Ad-hoc Networks. IEEE 802.11 –System architecture- Protocol architecture – Physical layer – Medium access control layer – MAC management. Bluetooth-User Scenarios-Architecture.		
Unit - IV	**Mobile Network and Transport Layer:**	**9**
Mobile IP- Goals, assumptions and requirements – Entities and terminologies – IP packet delivery – Agent discovery – Registration – Tunneling and Encapsulation – Dynamic Host Configuration Protocol – Mobile ad-hoc networks. Traditional TCP – Classical TCP improvements		
Unit - V	**Advanced Wireless Technologies**	**9**
LTE Radio Access – Basic technologies – Radio interface architecture – Overall system architecture – 5G wireless access – 5G general design principles – 5G key technology components		

Total:45

TEXT BOOK:

1.	Jochen Schiller, “Mobile Communications”, Second Edition, PHI/Pearson Education, 2014

REFERENCE:

2.	Erik Dahlman, Stefan Parkvall, Johan Skold, “4G, LTE-Advanced Pro and The Road to 5G”, Third Edition, Academic Press, 2016

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Summarize the fundamentals of wireless communication and determine the suitable medium access control techniques.	Applying (K3)
CO2	Demonstrate the GSM and Satellite system and protocol architectures	Applying (K3)
CO3	Analyse the Wireless LAN medium access control methods and associated technologies	Analysing (K4)
CO4	Implement the routing protocols and TCP congestion control mechanisms in wireless network	Applying (K3)
CO5	Summarize the advanced wireless technologies and determine the suitable technology for the wireless scenarios.	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										3	2
CO3	3	3	3										3	2
CO4	3	3	2										3	2
CO5	3	3	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	10	40	50				100
CAT2	10	40	30	20			100
CAT3	10	30	60				100
ESE	20	40	30	10			100

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

20CSL61 - COMPILER DESIGN LABORATORY

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	PC	0	0	2	1
Preamble	This course introduces the basic working principles of open-source compiler construction tools like LEX and YACC. It also introduces programmatic simulation of various phases of compilers.						

List of Exercises / Experiments:

1.	Develop a lexical analyzer to recognize patterns (Ex. identifiers, constants, comments, operators etc.) and create a symbol table, while recognizing identifiers in C
2.	Design NFA from the given Regular expression
3.	Calculate ε-Closure of all the states in the given NFA
4.	Using LEX, implement finite automata that accept strings
5.	Using LEX, generate the finite automata for a given pattern
6.	Find FIRST and FOLLOW of the given grammar
7.	Implement Predict parser of the given grammar
8.	Calculate Leading and Trailing for the operator Grammar
9.	Design a parser using YACC Tool for the given pattern
10.	Generate three address codes for a simple program
11.	Implement simple code optimization techniques (Constant folding, Strength reduction and Algebraic transformation)
12.	Implement back-end of the compiler for which the three-address code is given as input and the assembly language code is produced as output

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Operating System : Windows/Linux
2.	Software : C / LEX and YACC Tool
3.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	experiment LEX tool to recognize tokens in the given source program.	Applying (K3), Precision(S3)
CO2	design a parser for the given grammar.	Applying (K3), Precision(S3)
CO3	make use of YACC tool to perform syntax analysis.	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

20CSL62 -INTERNET OF THINGS AND CLOUD LABORATORY

Programme & Branch	**B.E. – Computer Science and Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Computer Communication Networks**	**6**	**ES**	**0**	**0**	**2**	**1**
Preamble	This course demonstrates the working of various communication technologies like GSM, ZigBee, and BLE. Various environmental conditions like temperature, humidity etc will be sensed and transmitted using these technologies and the values will be uploaded onto cloud. This course also explores the development of simple real time applications using Raspberry Pi and Cloud Computing service models.						

List of Exercises / Experiments :

Mobile Communication Experiments:	
1.	Experiments on GSM / GPRS • Basic AT Commands, Voice calls / Voice communication, Phone Book, SMS
2.	Experiments using ZigBee • Data communication between co-ordinator and device module
3.	Experiments on interfacing BLE mote
Internet of Things Experiments:	
4.	Simulating traffic light controller
5.	Web page integration with Raspberry Pi
6.	Sensing and Sending the sensor value via SMS
7.	Sending images and video via Gmail
8.	Measuring sensor value and uploading the content onto cloud for analysis
Cloud Experiments using Cloud Service Providers (AWS, Google Cloud Platform, etc.):	
9.	Develop applications using Platform as a Service (like AWS greengrass/ AWS Elastic Bean Stack)
10.	Develop applications implementing Infrastructure as a Service (like AWS s3)
11.	Develop applications using Software as a Service (like AWS Lambda)
12.	Mini Project

Total:30

REFERENCES/MANUAL/SOFTWARE:

1.	Operating System : Windows/Linux
2.	Software : Win X Talk, Python IDE, Thingspeak
3.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	demonstrate the basic working principles of different communication systems like GSM, WiFi, ZigBee and Bluetooth	Applying (K3), Precision (S3)
CO2	develop simple real time IoT applications using sensors and upload onto cloud	Applying (K3), Precision (S3)
CO3	design applications using cloud computing service models	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

20CSL63 - OPEN SOURCE SYSTEMS LABORATORY

Programme & Branch	**B.E. – Computer Science and Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**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 the latest kernel source code from kernel.org, compile the kernel and install it in the local system.
2.	Working with Linux commands for • directory operations, displaying directory structure in tree format. • operations such as redirection, pipes, filters, job control, changing ownership/permissions of files/links/directory.
3.	Working with advanced Linux commands curl, wget, ftp, ssh, grep and more.
4.	Write shell script to show various system configuration like • Currently logged user and login name • Current shell • Home directory • Operating system type • Current path setting • Current working directory • Number of users currently logged in
5.	Write shell script to show various system configurations such as • OS and version, release number, kernel version • all available shells • computer CPU information like processor type, speed etc • memory information • hard disk information like size of hard-disk, cache memory, model etc • 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. • Creating a repository • Checking out a repository • Adding content to the repository • Committing the data to a repository • Updating the local copy • Comparing different revisions • Revert • Conflicts and a conflict Resolution
8.	Working with the following remote repository operations in GitHub • Fork and clone • Pull request • Fetch • Rebase • 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

20GEP61 – COMPREHENSIVE TEST AND VIVA
(Common to all BE/BTech branches)

Programme & Branch	**All BE/BTech branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**EC**	**0**	**0**	**0**	**2**

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	demonstrate knowledge in their respective programme domain.	Applying (K3)
CO2	defend any type of interviews, viva-voce, and aptitude tests conducted for career progression	Applying (K3)
CO3	exhibit professional etiquette and solve related 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	3	2	2					1	2	2	3	3	2
CO2	3	3	2	2					1	2	2	3	3	2
CO3	3	3	2	2					1	2	2	3	3	2

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

20GEL61 PROFESSIONAL SKILLS TRAINING - II
(Common to all BE/ BTech / MSc/ MCA /BSc Branches)

Programme & Branch	**ALL BE / BTech branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**NIL**	**6**	**EC**	**0**	**0**	**80**	**2**

Preamble	This subject is to enhance the employability skills and to develop career competency	
Unit - I	**Soft Skills – II**	**20**
Group discussions: Advantages of group discussions-Structured GD- Team work: Value of team work in organizations- Definition of a team, why team-Elements of leadership, disadvantages of a team, stages of team formation- Group development activities. Facing an interview: Foundation in core subject- industry orientation / knowledge about the company- professional personality-Communication skills-Activities before Interview, upon entering interview room, during the interview and at the end Mock interviews.		
Unit - II	**Quantitative Aptitude & Logical Reasoning - II**	**30**
Problem solving level II: Money related problems-Mixtures-Symbol base problem-Clocks and calendars-Simple-linear-quadratic and polynomial equations-Special, equations-Inequalities-Sequence and series-Set theory-Permutations and combinations-Probability-Statistics-Data sufficiency- Geometry-Trigonometry-Heights and distances-Co-ordinate geometry-Mensuration. Logical reasoning: Conditionality and grouping-Sequencing and scheduling- Selections-Networks:-Codes; Cubes-Venn diagram in logical reasoning- Quant based reasoning-Flaw detection- Puzzles-Cryptarithms.		
Unit - III	**Reading & Speaking Skills**	**30**
Reading: Reading comprehension– Effective Reading strategies – Descriptive, Inferential, & Argumentative reading passages – Identifying and locating factual information within a text – global reading/skimming for general understanding – selective comprehension / scanning for specific information – detailed comprehension / intensive reading – understanding the development of an argument – identifying the writer's attitude and opinions – Reading news articles in business magazines, newspapers – Reading notices and book reviews –Interpreting graphic data & Advertisements. Speaking: Mock Interviews –Self-Introduction – Sharing of Real Time Experience; Conversational Practices –Role Play – Short Talks / TED Talks –Extempore; Giving a Presentation on Various Topics – Technical / Non-Technical Topics – Project Review Presentation – Oratory and Effective Public Speaking; Pair Discussion – Group Discussion – The process of Group Discussion – Strategies to be adopted – Skills Assessed – Telephonic Conversations & Skills – Negotiating Skills.		

Total: 80

TEXT BOOK:

1	Thorpe, Showick and Edgar Thorpe, "Objective English For Competitive Examination", 6th Edition, Pearson India Education Services Pvt Ltd, 2017.

REFERENCES:

1	Aruna Koneru, "Professional Speaking Skills," Oxford University Press India, 2015.
2	Thorpe, Showick and Edgar Thorpe, "Winning at Interviews," 5th edition, Pearson Education, India, 2013.
3	Rizvi, Ashraf M, "Effective Technical Communication," 2nd Edition, McGraw Hill Education India, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	develop the soft skills of learners to support them work efficiently in an organization as an individual and as a team	Applying (K3), Precision (S3)
CO2	solve real time problems using numerical ability and logical reasoning	Applying (K3), Precision (S3)
CO3	apply reading and speaking skills effectively for various academic and professional purposes	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	0	0	0	3	3	0	3	0	3	2		
CO2	3	2	0	0	0	3	3	0	3	0	3	2		
CO3	0	2	0	0	0	3	3	0	3	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	20	40	40				100
CAT2		50	50				100
CAT3		50	50				100
ESE							

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

20CSP61 - PROJECT WORK I

Programme & Branch	B.E. & Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	EC	0	0	4	2

Total: 60

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.	Creating (K6), Precision (S3)
CO2	perform literature search in the area of interest.	Evaluating (K5), Precision (S3)
CO3	conduct experiments, design and analysis, solution iterations and document the results.	Evaluating (K5), Precision (S3)
CO4	perform error analysis and synthesise the results and arrive at scientific conclusions.	Evaluating (K5), Precision (S3)
CO5	document the results in the form of technical report and give oral presentation	Creating (K6), 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	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	2	2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	2	2	3	3	3	3	3	3	3	3	3
CO4	3	3	3	2	2	3	3	3	3	3	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

20GET71 - ENGINEERING ECONOMICS AND MANAGEMENT

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

Programme & Branch	B.E. & Computer Science and Engineering	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)**

20CSC71 - DEEP LEARNING

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	**PE**	**3**	**0**	**2**	**4**

Preamble	This course provides an overview Neural Networks and Deep learning techniques for solving real world problems.	
Unit - I	**Neural Network**	**9**
Neural Network-Building Intelligent Machines-Limits of Traditional Computer Programs-Mechanics of Machine Learning-Neuron-Linear Perceptrons as Neurons-Feed-Forward Neural Networks-Linear Neurons and Their Limitations-Sigmoid, Tanh, and ReLU Neurons-Softmax Output Layers **Training Feed-Forward Neural Networks:**Gradient Descent-Delta Rule and Learning Rates-Gradient Descent with Sigmoidal Neurons-Backpropagation Algorithm-Stochastic and Minibatch Gradient Descent-Test Sets, Validation Sets, and Overfitting-Preventing Overfitting in Deep Neural Networks		
Unit - II	**Learning in Neural Network**	**9**
Challenges with Gradient Descent- Local Minima in the Error Surfaces of Deep Networks - Model Identifiability - Local Minima in Deep Networks - Flat Regions in the Error Surface - Gradient Points in the Wrong Direction - Second-Order Methods -Momentum-Based Optimization-Learning Rate Adaptation		
Unit - III	**Convolutional Neural Networks**	**9**
Convolutional Neural Networks-Neurons in Human Vision-Shortcomings of Feature Selection-Vanilla Deep Neural Networks-Filters and Feature Maps-Description of the Convolutional Layer-Max Pooling-Architectural Description of Convolution Networks-Accelerating Training with Batch Normalization- Visualizing Learning in Convolutional Networks-Convolutional Filters to Replicate Artistic Styles-Convolutional Filters for Other Problem Domains		
Unit - IV	**Autoencoders and Recurrent Neural Networks**	**9**
Embedding and Representation Learning-Principal Component Analysis-Autoencoder Architecture-Denoising to Force Robust Representations-Sparsity in Autoencoders- Models for Sequence Analysis- Tackling seq2seq with Neural N-Grams- Implementing a Part-of-Speech Tagger- Dependency Parsing and SyntaxNet- Beam Search and Global Normalization- Stateful Deep Learning Models- Recurrent Neural Networks- Challenges with Vanishing Gradients- Long Short-Term Memory (LSTM) Units- Augmenting Recurrent Networks with Attention- Dissecting a Neural Translation Network		
Unit - V	**Case studies- Applications**	**9**
Introduction to Keras and Tensorflow- Building a CNN for image classification - Sentiment Analysis Model using LSTM – Deep Learning for Network intrusion detection – Speech recognition using Deep learning		

Lecture:45, Practical:30, Total:75

List of Exercises / Experiments:

1.	Exploration of deep learning frameworks Tensorflow and Keras
2.	Create a simple Neural network to perform classification
3.	Test the performance of multi-layer neural network with different activation functions
4.	Improve the performance of the neural network with hyper parameter tuning
5.	Implement a Convolutional Neural Network model for image classification
6.	Improve performance of Convolutional Neural Network by tuning hyper parameters
7	Implement an Auto encoder for dimensionality reduction
8	Implement Object detection using Convolution Neural Network
9	Develop a sentiment analysis model using LSTM
10	Improve performance of LSTM by tuning hyper parameters

TEXT BOOK:

1.	Nikhil Buduma , Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms, 1st Edition, O‟Reilly Series, June 2017

REFERENCES:

1.	Ian Goodfellow, Yoshua Bengio, and Aaron Courvill, “Deep Learning”, MIT Press, 1st Edition, 2016.
2.	Josh Patterson and Adam Gibson, "Deep Learning – A Practitioner‟s Approach", 1 Edition, O‟Reilly Series, 2017.
3.	Indra den Bakker, "Python Deep Learning Cookbook", 1 Edition, Packt Publishing, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply the concepts of neural network to solve simple problems	Applying (K3)
CO2	Utilize different approaches to improve learning in neural networks	Applying (K3)
CO3	exemplify the concepts of CNN models and apply it for solving computer vision related problems	Applying (K3)
CO4	Make use of autoencoders for dimensionality reductions and Apply the concepts of RNN models for solving sequential modeling problems	Applying (K3)
CO5	Identify suitable deep learning models for developing real world applications	Applying (K3)
CO6	Develop a neural network model to perform classification for the given data	Applying (K3), Precision(S3)
CO6	develop deep learning model to classify a given image and identify the object	Applying (K3), Precision(S3)
CO8	Implement autoencoder for dimensionality reduction and perform sentiment classification	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	50	30				100
CAT2	20	50	30				100
CAT3	15	50	35				100
ESE	20	40	40				100

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

20CSP71 - PROJECT WORK II PHASE I

Programme & Branch	B.E. & Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	EC	0	0	12	6

Total: 180

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.	Creating (K6), Precision (S3)
CO2	perform literature search in the area of interest.	Evaluating (K5), Precision (S3)
CO3	conduct experiments, design and analysis, solution iterations and document the results.	Evaluating (K5), Precision (S3)
CO4	perform error analysis and synthesise the results and arrive at scientific conclusions.	Evaluating (K5), Precision (S3)
CO5	document the results in the form of technical report and give oral presentation	Creating (K6), 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	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	2	2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	2	2	3	3	3	3	3	3	3	3	3
CO4	3	3	3	2	2	3	3	3	3	3	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

20CSP81 - PROJECT WORK II PHASE II

Programme & Branch	B.E. & Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	8	EC	0	0	8	4

Total: 120

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.	Creating (K6), Precision (S3)
CO2	perform literature search in the area of interest.	Evaluating (K5), Precision (S3)
CO3	conduct experiments, design and analysis, solution iterations and document the results.	Evaluating (K5), Precision (S3)
CO4	perform error analysis and synthesise the results and arrive at scientific conclusions.	Evaluating (K5), Precision (S3)
CO5	document the results in the form of technical report and give oral presentation	Creating (K6), 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	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	2	2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	2	2	3	3	3	3	3	3	3	3	3
CO4	3	3	3	2	2	3	3	3	3	3	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

20CSE01 - THEORY OF COMPUTATION

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	5	PE	3	0	0	3

Preamble	This course helps the learners to know the models of computation, along with their variants in the context of formal languages and their recognizers and to familiarize students with the foundations and principles of computer science.	
Unit - I	**Automata and Regular Expressions**	**9**
Introduction to formal proof – Finite Automata (FA) – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) – Equivalence between NFA and DFA – Finite Automata with Epsilon transitions – Conversion of NFA into DFA – Equivalence and minimization of automata.		
Unit - II	**Regular Expressions and Languages**	**9**
Regular expression – Equivalence of finite automata and regular expressions – Proving languages not to be regular (Pumping Lemma) – Closure properties of regular languages.		
Unit - III	**Context Free Grammar and Languages**	**9**
Context-Free Grammar (CFG) – Parse trees – Ambiguity in grammars and languages – Definition of the pushdown automata (PDA) – Languages of pushdown automata – Equivalence of pushdown automata and CFG – CFG to PDA-PDA to CFG – Deterministic Pushdown Automata.		
Unit - IV	**Context Free Languages and Turing Machines**	**9**
Normal forms for CFG – Chomsky Normal Form and Greibach Normal Form – Pumping lemma for CFL – Closure properties of Context Free Languages. Turing machines: Basic model – definition and representation – Instantaneous Description – Language acceptance by TM – Variants of Turing Machine – TM as Computer of Integer functions – Programming techniques for Turing machines (subroutines).		
Unit - V	**Computational complexity theory**	**9**
A language that is not Recursively Enumerable (RE) – An undecidable problem that is RE – Undecidable problems about Turing machine – Post's correspondence problem – The classes P and NP – Kruskal's algorithm – Traveling Salesman Problem.		

Total:45

TEXT BOOK:

1.	Hopcroft J.E., Motwani R. and Ullman J.D., "Introduction to Automata Theory, Languages and Computations", 3rd Edition, Pearson Education, New Delhi, 2008.

RFERENCES:

1.	Martin J., "Introduction to Languages and the Theory of Computation", 4th Edition, Tata McGraw-Hill, New Delhi, 2010.
2.	Linz P., "Introduction to Formal Language and Computation", 4th Edition, Narosa Publishing, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply induction and contradiction methods for theorem proving.	Applying (K3)
CO2	design finite automata and regular expression for regular languages.	Applying (K3)
CO3	develop and normalize context free grammar for context free languages and demonstrate the recognition of context free languages using push down automata.	Applying (K3)
CO4	construct Turing Machine to accomplish specific task and argue formally about its correctness.	Applying (K3)
CO5	make use of Turing machines to distinguish decidable / undecidable problems and compare different classes of 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	10	30	60				100
CAT2	10	30	60				100
CAT3	10	30	60				100
ESE	10	20	70				100

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

20CSE02 - DATA SCIENCE

Programme & Branch	**B.E. – Computer Science and Engineering**	**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		

Total:45

TEXT BOOK:

1.	Chirag Shah, “A Hands-On Introduction to Data Science”, 1st Edition, Kindle Edition, 2020. (Unit I, II)
2.	Douglas C. Montgomery, George C. Ranger, Applied Statistics and Probability for Engineers, Sixth Edition, Wiley, 2013. (Units I, III, IV, V)

REFERENCE:

1.	Joel Grus, "Data Science from the Scratch", NA Edition, O’Reilly, NA, 2015.
2.	Frank Kane, “Hands-On Data Science and Python Machine Learning”, First edition, Packt Publication, 2017

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 random variables	Applying (K3)
CO4	make use of the statistical foundations and analyze the degree of certainty of predictions 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)**

20CSE03 - BUILDING ENTERPRISE APPLICATIONS

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	5	PE	3	0	0	3

Preamble	This course offers an insight into enterprise application development and deployment.	
Unit - I	**Analysis and Modeling**	**9**
Introduction to enterprise applications and their types – Software engineering methodologies – Life cycle of raising an enterprise application – Introduction to skills required to build an enterprise application – Key determinants of successful enterprise applications – Measuring the success of enterprise applications. Inception of enterprise applications – Enterprise analysis – business modelling – requirements elicitation – use case modelling – prototyping – Non functional requirements – requirements validation – planning and estimation.		
Unit - II	**Architecting and Designing**	**9**
Concept of architecture – Views and viewpoints – Enterprise architecture – Logical architecture – Technical architecture and Design, Different technical layers, Object – Oriented Analysis and Design – Best practices – Data architecture and design – relational, XML, and other structured data representations.		
Unit - III	**Architectural Design**	**9**
Technical architecture – Infrastructure architecture and design elements – Networking, Internetworking, and Communication Protocols – IT Hardware and Software – Middleware –Policies for Infrastructure Management, Deployment Strategy, Documentation of application architecture and design.		
Unit - IV	**Construction**	**9**
Construction readiness of enterprise applications – defining a construction plan – defining a package structure, setting up a configuration management plan – setting up a development environment – introduction to the concept of Software Construction Maps – construction of technical solutions layers – methodologies of code review – static code analysis – build and testing. Dynamic code analysis – code profiling and code coverage.		
Unit - V	**Testing and Rolling out Enterprise Applications**	**9**
Testing an enterprise application – Testing levels and approaches – Testing environments – integration testing – performance testing – penetration testing – usability testing – globalization testing and interface testing – user acceptance testing – rolling out an enterprise application.		

Total:45

TEXT BOOK:

1.	Anubhav Pradhan, Satheesha B. Nanjappa, Senthil K. Nallasamy, Veerakumar Esakimuthu, "Raising Enterprise Applications", 1st Edition, Wiley India Pvt. Ltd., 2010.

REFERENCES:

1.	Brett McLaughlin, "Building Java Enterprise Applications", 1st Edition, O"Reilly Media Publications, 2002.
2.	Soren Lauesen, "Software Requirements: Styles &Techniques", 1st Edition, Addison–Wesley Professional Publications, 2002.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply the concepts of enterprise analysis and business modelling for an application	Applying (K3)
CO2	design and document the application architecture.	Applying (K3)
CO3	determine the importance of application framework and design application components.	Applying (K3)
CO4	perform code review, code analysis and build process to implement enterprise applications.	Applying (K3)
CO5	illustrate various testing strategies and deploy enterprise 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	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)**

20CSE04 - ARTIFICIAL INTELLIGENCE

Programme & Branch	B.E. – Computer Science and Engineering	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 1st Unit, Unit 2,3,4,5)
2.	Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition, Pearson Education, 2013. (First half of 1st Unit)

REFERENCE:

1.	Elaine Rich, Kelvin Knight & Shivashankar B Nair, "Artificial Intelligence", 3rd Edition, McGraw Hill Education, India, 2017.

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:	determine optimal 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)**

20CSE05 - MULTICORE ARCHITECTURE

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Computer Organization	5	PE	3	0	0	3

Preamble	This course focuses on performance improvement using instruction level, data level, thread level and request level parallelism.	
Unit - I	**Fundamentals of Quantitative Design and Analysis**	**9**
Classes of Computers – Trends in Technology, Power, Energy and Cost – Dependability – Measuring, Reporting and Summarizing Performance – Quantitative Principles of Computer Design – Classes of Parallelism ILP, DLP, TLP and RLP – Multi Threading – SMT and CMP Architectures – Limitations of Single Core Processors – The Multicore era – Case Studies of Multicore Architectures.		
Unit - II	**Memory Hierarchy Design**	**9**
Introduction – Basics of Memory Hierarchies – Memory Technology and Optimizations – Ten Advanced Optimizations of Cache Performance – Virtual Memory and Virtual Machines – Design of Memory Hierarchies – Case Studies		
Unit - III	**Data Level Parallelism**	**9**
Introduction – Vector Architectures – SIMD Instruction Set Extensions for Multimedia – Graphics Processing Units – Detecting and Enhancing Loop Level Parallelism – Comparison of a GPU and a MIMD With Multimedia SIMD – Case Studies		
Unit - IV	**Thread Level Parallelism**	**9**
Centralized Shared-Memory Architectures – Performance of Symmetric Shared-Memory Multiprocessors – Distributed Shared-Memory and Directory-Based Coherence – Synchronization basics – Models of Memory Consistency introduction – Inter Connection Networks – Buses, Crossbar and Multi-stage interconnection networks – Performance and Energy Efficiency of the Intel i7 920 Multicore – Shared Memory Programming with OpenMP		
Unit - V	**RLP and DLP in Warehouse Scale Computers**	**9**
Programming Models and Workloads for Warehouse scale Computers – Computer Architecture of Warehouse-Scale Computers – Domain Specific Architectures: Introduction – Guidelines for DSAs – Example Domain: Deep Neural Network – Google's Tensor Processing Unit, an interface Data Center Accelerator		

Total:45

TEXT BOOK:

1. John L. Hennessey and David A. Patterson, "Computer Architecture – A Quantitative Approach", 6th Edition, Morgan Kaufmann, Elsevier, 2019.

REFERENCE:

1. Richard Y. Kain, "Advanced Computer Architecture: A Systems Design Approach", 1st Edition, Prentice Hall, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	investigate the limitations of ILP and the need for multicore architectures	Analyzing (K4)
CO2	analyze the importance of memory hierarchy and benefits of cache memory	Analyzing (K4)
CO3	explain the architecture of Vector/GPU processor and make use of loop level parallelism to achieve data level parallelism	Applying (K3)
CO4	analyze the cache coherence issues using different memory architectures and different types of inter connection networks	Analyzing (K4)
CO5	inspect the architectures of GPUs, warehouse scale computers and choose an appropriate model for a given problem	Analyzing (K4)

		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	2
CO4	3	3	2										3	2
CO5	3	3	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	20	30	30	20			100
CAT2	20	40	40				100
CAT3	20	30	30	20			100
ESE	10	30	30	30			100

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

20CSE06 - UNIX INTERNALS

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Operating Systems	5	PE	3	0	0	3

Preamble	This course describes the internal algorithms and structures that form the basis of UNIX operating system and their relationship to the programmer interface.	
Unit - I	**Overview and Buffer Cache**	**9**
General Overview of the System: History – System structure – User perspective – Operating System Services – Assumptions about Hardware. Introduction to the Kernel: Architecture of the UNIX Operating System – Introduction to System Concept. The Buffer Cache: Buffer headers – Structure of the Buffer Pool – Scenarios for Retrieval of a Buffer – Reading and Writing Disk Blocks – Advantages and Disadvantages of the Buffer Cache.		
Unit - II	**Internal Representation and System Calls for the file system**	**9**
Internal Representation of Files: Inodes – Structure of a Regular File – Directories –Conversion of a Path Name to an Inode – Super Block – Inode Assignment to a New File – Allocation of Disk Blocks. System Calls: Open – Read/Write – File And Record Locking – Adjusting the Position of File I/O – lseek – close – File Creation – Creation of Special Files – Changing Directory – Root – Owner - Mode – stat and fstat – Pipes – dup – Mounting and Unmounting File Systems – link – unlink.		
Unit - III	**Processes**	**9**
Process States and Transitions – Layout of System Memory – The Context of a Process – Saving the Context of a Process – Manipulation of the Process Address Space. Process Control: process Creation – Signals – Process Termination – Awaiting Process Termination – Invoking other programs – User Id of a Process – Changing the size of a Process – Shell – System Boot and the INIT Process – Process Scheduling.		
Unit - IV	**Memory Management and I/O Sub systems**	**9**
Memory Management Policies:- Swapping – Demand Paging – A Hybrid System with Swapping and Demand Paging. The I/O Subsystem: Driver Interfaces System configuration – Systems calls and Driver interfaces – Interrupt Handlers – Disk Drivers – Terminal Drivers – Streams.		
Unit - V	**Interprocess Communication and Multiprocessor Systems**	**9**
Interprocess Communication: Process Tracing – System V IPC – Messages – Shared memory – Semaphores – Network communications – Sockets. Multiprocessor Systems: Problems – Solution with Master/Slave Processors, and Semaphores.		

Total:45

TEXT BOOK:

1.	Maurice J. Bach, “The Design of the Unix Operating System”, 1st Edition, Pearson Education, 2015.

REFERENCE:

1.	Robert Love, "Linux Kernel Development", 3rd Edition, Addison Wesley, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	discuss the system structure, architecture of Unix operating system, buffer cache and apply for reading and writing disk blocks	Applying (K3)
CO2	apply various system calls for file manipulations	Applying (K3)
CO3	express process state transitions and apply process scheduling in real world cases	Applying (K3)
CO4	make use of memory swapping and I/O driver interfaces for given scenarios	Applying (K3)
CO5	employ the concepts of inter process communication for the given scenario	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	60	25				100
CAT2	15	55	30				100
CAT3	15	50	35				100
ESE	15	55	30				100

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

20CSE07 - GRAPH THEORY

Programme& Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Discrete Mathematics**	**5**	**PE**	**3**	**0**	**0**	**3**

Preamble	The course introduces various concepts behind graphs and trees and their applications to solve real-world problems.	
Unit - I	**Introduction, Paths and Circuits**	**9**
Introduction: Graph- Definition and terminologies - Applications of graphs - Finite and infinite graphs – Incidence and degree - Isolated vertex - Pendant vertex - Null graph . **Paths and Circuits:** Isomorphism – Sub-graphs – Walks, paths and circuits – Connected graphs, disconnected graphs and components - Euler graphs – Operations on graphs - Hamiltonian paths and circuits -Traveling-salesman problem.		
Unit - II	**Trees and Cut Sets**	**9**
Trees – Properties of trees - Pendant vertices in a tree - Distance and centers in trees - Rooted and binary trees - On counting trees – Fundamental circuits - Finding all spanning trees of a graph - Spanning trees in a weighted graph - Cutsets – Properties of Cutsets – All Cutsets in a graph - Fundamental circuit and cut-set - Connectivity and separability – Network flows.		
Unit - III	**Planarity and Vector space of a graph**	**9**
Combinatorial vs. geometric graphs - Planar graph – Kuratowski's two graphs - Different representations of a planar graph - Detection of planarity - Geometric and combinatorial dual - Thickness and crossings - Vector spaces - Sets with one operation and two operations - Modular arithmetic and Galois fields - Vectors and vector spaces - Vector space associated with a graph.		
Unit - IV	**Matrices, Coloring, Covering and Partitioning**	**9**
Matrix representation - Incidence matrix - Sub-matrices - Circuit matrix - Cut-set matrix - Path matrix – Adjacency matrix - Graph coloring - Chromatic number - Chromatic partitioning - Chromatic polynomial - Matching - Covering – The four color problem.		
Unit - V	**Directed graphs and Enumeration of graphs**	**9**
Directed graphs – Types - Digraphs and binary relations - Directed paths and connectedness - Euler digraphs - Fundamental circuits in digraphs – Adjacency matrix of a digraph – Paired comparisons and tournaments. Enumeration of graphs – Types - Counting labeled trees and unlabeled trees.		

Total:45

TEXT BOOK:

1.	Narsingh Deo, "Graph Theory with Application to Engineering & Computer Science", 1st Edition, Dover Publications, Inc, 2016.

REFERENCES:

1.	L.R.Foulds , "Graph Theory Applications", Springer , 2016.
2.	Bondy, J. A. and Murty, U.S.R., "Graph Theory with Applications", North Holland Publication, 2008.
3.	West, D. B., Introduction to Graph Theory, Pearson Education, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Apply graphs for a given scenario	Applying (K3)
CO2	Utilize Trees and Cutsets to solve real-world problems	Applying (K3)
CO3	Make use of Planarity and Vector space of a graph for a given problem	Applying (K3)
CO4	Understand graph representations and make use of Coloring and partitioning of graphs	Applying (K3)
CO5	Utilize digraphs and enumeration of graphs to solve for real-world problems	Applying (K3)

apping 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	30	40	30				100
ESE	30	40	30				100

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

20CSE08 - GAME THEORY AND ITS APPLICATIONS

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Design and Analysis of Algorithms**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course deals with mathematical modeling of strategic interaction among rational and irrational agents along with its applications.	
Unit - I	**Introduction**	**9**
Game- Reasoning about behavior in game – Best Responses and Dominant Strategies – Multiple equilibria – Mixed Strategies – Pareto-Optimality and Social Optimality.		
Unit - II	**Non-cooperative Games**	**9**
Discrete static games : Examples of Two-Person Finite Games - General Description of Two-Person Finite Games - N-person Finite Games – Continuous static games: Examples of Two-Person Continuous Games - Examples of N-Person Continuous Games- Relation to other Mathematical Problems: Nonlinear optimization- Fixed point problems.		
Unit - III	**Equlibria and Dynamic Games**	**9**
Existence of Equilibria – Computation of Equilibria – Special matrix games : Matrix with Identical Elements - The Case of Diagonal Matrix – Symmetric Matrix Games – Uniqueness of Equilibria – Repeated and Dynamic games: Leader-Follower Games – Dynamic Games with Simultaneous Moves – Dynamic Games with Sequential Moves.		
Unit - IV	**Cooperative Games**	**9**
Solutions based on characteristic function – Conflict Resolution: The Nash Bargaining Solution – Alternative Solution Concepts. – Multi objective optimization: lexicographic method – The ε-constraint Method – The Weighting Method – Distance-Based Methods – Direction-Based Methods.		
Unit - V	**Case studies and Applications**	**9**
Social choice: Methods with symmetric players – Methods with power of players –Case studies and Applications: A salesman's Dilemma – Oligopoly in water management – A forestry management problem – International fishing – Water distribution problem.		

Total:45

TEXT BOOK:

1.	David Easley and Jon Kleinberg, " Networks, Crowds and Markets: Reasoning about a highly Connected World", Cambridge University, 2010 (Unit-1)
2.	Matsumoto A.and Szidarovszky F. "Game Theory and Applications", Springer,2016 (Unit 2-5)

REFERENCE:

1.	Anna R. Karlin and Yuval Peres, "Game Theory, Alive", AMS, 2016
2.	E.M.Barron," Game Theory: An Introduction", Wiley, 2009
3,	Leon Petrosjan, Valdimir V.Mazalov, :"Game Theory &Applications", Nova Science Publishers Inc,2015

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	utilize the fundamental concepts of game theory and illustrate the importance of Nash Equilibria	Applying (K3)
CO2	experiment with different kinds of Non-cooperative games	Applying (K3)
CO3	interpret the concept of Equilibria and dynamic games to identify the certainty of games.	Applying (K3)
CO4	solve Problems in cooperative games and relate to multi objective optimization	Applying (K3)
CO5	model some real world problems using the principles of game theory and its 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										2	2
CO2	3	2	1										2	2
CO3	3	2	1										2	2
CO4	3	2	1										2	2
CO5	3	2	1										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	30	50				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)**

20CSE09 - WIRELESS AND SENSOR NETWORKS

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Computer networks	7	PE	3	0	0	3

Preamble	This course makes the learners to know the architecture, protocols for information gathering and energy management in wireless sensor network. This course also gives insight into challenges, various attacks and countermeasures for attacks in wireless sensor networks.	
Unit - I	**Wireless Sensor Networks Architecture**	**9**
Introduction: Sensors – Sensor Node Architecture – Sensor Network Architecture – Mote Technology – Comparison of MANET and WSN – Requirements of a WSN – Challenges for a WSN – WSN Applications – Wireless Sensor Networks Architecture: Introduction – Network Protocol Stack – Communication Standards – IEEE 802.11 – IEEE 802.15.4 – ZigBee – 6LoWPAN.		
Unit - II	**Information Gathering**	**9**
Introduction – Routing – Flat-based Routing Algorithms – Sensor Protocols for Information Negotiation (SPIN) –Hierarchical Routing Algorithms – LEACH Routing Protocol – Information Gathering Based on Geographic Locations – Geographical Routing – Greedy Perimeter Stateless Routing – Landmark-based Routing – Data Aggregation – Content-based Naming.		
Unit - III	**Energy Management in WSN**	**9**
Introduction – Duty Cycling – Independent Strategies – Dependent Strategies – Independent Sleep/Wakeup Schemes – Asynchronous Schemes – TDMA-based MAC Protocols – Contention-based MAC Protocols – Hybrid MAC Protocols – Data-driven Approaches – Energy-aware Routing Protocols – Hierarchical Energy-aware Routing – Location-based Routing – Data Aggregation-based Routing.		
Unit - IV	**Security in WSN**	**9**
Introduction – Challenges in WSN – Attacks in WSN – Protection against Attacks – Key Management – Secure Routing in WSNs – Attacks on Routing Protocols – Countermeasures for Attacks – Intrusion Detection in WSN.		
Unit - V	**Operating Systems for WSNs**	**9**
Introduction – Architecture – Execution Model – Scheduling – Power Management – Communication – Case Study on Popular Operating Systems- Programming WSNs : Introduction – TinyOS – Contiki – Castalia – NS-3.		

Total:45

TEXT BOOK:

1.	Nandini Mukherjee, Sarmistha Neogy, Sarbani Roy, "Building Wireless Sensor Networks Theoretical & Practical Perspectives", 3rd Edition, CRC Press, Taylor & Francis Group, 2016.

REFERENCE:

1.	Ibrahiem M. M. El Emary, S. Ramakrishnan, "Wireless Sensor Networks From Theory to Applications", CRC Press, 1st Edition, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explore the fundamentals of wireless sensor networks and identify an appropriate wireless network for the given scenario	Applying (K3)
CO2	demonstrate various routing protocols for gathering information in Wireless sensor networks	Applying (K3)
CO3	utilize energy management schemes in wireless sensor networks	Applying (K3)
CO4	examine various challenges, attacks and counter measures for attacks in wireless sensor networks	Applying (K3)
CO5	determine an appropriate operating system for a wireless sensor 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	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)**

20CSE10- OPTIMIZATION TECHNIQUES

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	PE	3	0	0	3

Preamble	This course provides an insight modern optimization technique 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.	George Bernard Dantzig, MukundNarain Thapa, "Linear programming", Springer series in operations research 3rd Edition, 2003
2.	H.A. Taha, "Operations Research: An Introduction", 8th Edition, Pearson/Prentice Hall, 2007.

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)**

20CSE11 - DATA WAREHOUSING AND DATA MINING

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	PE	3	0	0	3

Preamble	The course provides a comprehensive knowledge about building a data warehouse and perform data mining using various techniques.	
Unit - I	**Introduction**	**9**
Data Mining – Steps in Knowledge Discovery Process – Kinds of Data and Patterns –Technologies used – Targeted applications – Major issues in Data Mining – Data objects and attribute types – Statistical descriptions of data – Measuring data similarity and dissimilarity.		
Unit - II	**Data Preprocessing and Data Warehousing**	**9**
Data Cleaning – Integration – Reduction – Transformation and Discretization – Data Warehouse: Concepts – Modeling – Design – Implementation.		
Unit - III	**Frequent Pattern Mining**	**9**
Basic concepts – Frequent itemset mining methods: Apriori algorithm – A pattern growth approach for mining frequent itemsets – Pattern evaluation methods – multilevel – multi dimensional frequent pattern mining.		
Unit - IV	**Classification**	**9**
Basic Concepts – Decision Tree Induction – Bayesian Classification – Classification by Back Propagation – Support Vector Machines – k-Nearest Neighbor Classifier – Model Evaluation and Selection.		
Unit - V	**Cluster Analysis**	**9**
Basic Concepts – Partitioning Methods – Hierarchical Methods – Density based Methods – Grid based Methods – Data Mining Applications.		

Lecture:30, Tutorial:15, Total:45

TEXT BOOK:

1.	Han Jiawei, and Kamber Micheline, "Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kaufmann Publishers, 2012.

REFERENCE:

1.	Berson Alex, and Smith Stephen J, “Data Warehousing, Data Mining and OLAP”, 1st 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	describe the concepts of data mining and perform statistical analysis of data	Applying (K3)
CO2	apply preprocessing techniques and design data warehouse	Applying (K3)
CO3	apply association rule mining methods to solve the given problem	Applying (K3)
CO4	apply classification techniques to solve real world problems	Applying (K3)
CO5	utilize different clustering methods for various 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		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
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	15	25	60				100
CAT3	20	40	40				100
ESE	20	30	50				100

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

20CSE12 - DISTRIBUTED SYSTEMS

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Operating Systems and Computer Networks	7	PE	3	0	0	3

Preamble	This course provides an understanding of distributed systems architecture and the principles on which the internet and distributed applications and file systems are developed.	
Unit - I	**Characteristics and System Models**	**9**
Characteristics: Introduction – Examples – Trends – focus on resource sharing – Challenges in distributed systems – Case study: The World Wide Web. System models: physical – Architectural and Fundamental models.		
Unit - II	**Interprocess Communication, Remote Invocation and Indirect Communication**	**9**
Inter process communications: Introduction – the API for the Internet protocol – External data representation and Marshalling – Multicast Communication – Network Virtualization – Case study: MPI. Remote Invocation: Introduction – request-reply protocol – Remote Method Invocations – Case study: Java RMI. Indirect Communication: Group communication – Publish-Subscribe systems – message queues and shared memory approaches.		
Unit - III	**Peer to Peer Systems, Distributed File Systems and Name Services**	**9**
Peer-to-peer Systems: Introduction – Napster and its legacy – Peer-to-peer – Middleware – Routing overlays Case study: Pastry. Distributed File System: Introduction – file service architecture – Case Study – Andrew File System. Name Services: Introduction – Name Services and DNS – directory services – case study: Global Name Service.		
Unit - IV	**Time Synchronization, Transactions and Concurrency Control, Distributed Transactions**	**9**
Time Synchronization: Introduction – clocks – events and process states – synchronizing physical clocks – logical time and logical clocks. Transaction and Concurrency Control: transactions – nested transaction – locks – optimistic concurrency control and timestamp ordering. Distributed transactions: – flat and nested – atomic commit protocols and concurrency control.		
Unit - V	**Replication, Distributed Multimedia Systems and Designing Distributed Systems**	**9**
Replication: System model and group communications – fault tolerant services – Case Study: The p architecture. Distributed Multimedia Systems: Characteristics of multimedia data – Quality of service management – Resource Management – Stream Adaptation – Case Study: – BitTorrent. Designing Distributed Systems: GOOGLE Case Study – architecture and design philosophy – communication paradigms – data Storage and coordination services – Distributed Computation services.		

Total:45

TEXT BOOK:

1. Coulouris. George, Dollimore, Jean and Kindberg Tim., “Distributed Systems Concepts and Design”, 5th Edition, Pearson Education, 2013

REFERENCE:

1. Tanenbaum A.S., Van Steen M., “Distributed Systems: Principles and Paradigms”, 2nd Edition, Pearson Education, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	discuss the characteristics, models of distributed system and apply it for application development	Applying (K3)
CO2	apply different communication models in distributed application development	Applying (K3)
CO3	express the services offered by distributed systems and apply it in real world cases	Applying (K3)
CO4	apply synchronization and concurrency in transactions	Applying (K3)
CO5	determine a suitable architecture for fault-tolerant and multimedia distributed 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	60	25				100
CAT2	15	55	30				100
CAT3	15	50	35				100
ESE	15	55	30				100

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

20CSE13 - FULL STACK DEVELOPMENT

Programme& Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Web Technology	7	PE	3	0	0	3

Preamble	This course provides advanced concepts of Bootstrap, Client Side JS and Server Side JS Framework. The course also addresses the application of AngularJS for developing web applications.	
Unit - I	**UI Design : BOOTSTRAP5 (BS5) :**	**9**
Introduction to BS5 – Containers – Typography – Colors – Tables – Images – Jumbotron – Alerts – Buttons - Button Groups - Progress Bars – Pagination - List Groups – Dropdowns – Collapse – Navs – Navbar – Carousel – Offcanvas - BS5 Forms: Select Menus - Checks and Radios – Range – Input Groups – Floating Labels – Form Validation.		
Unit - II	**MongoDB**	**9**
MongoDB Overview – Advantages – Environment – Data Modeling – Create Database – Drop Database – Create Collection – Drop Collection – Data Types – Insert Document – Query Document – Update Document – Delete Document – Projection – Limiting Records – Sorting Records – Indexing – Aggregation – Case Study**.**		
Unit - III	**PHP**	**9**
PHP Introduction – Syntax – Variables – Data Types – Strings – Numbers – Math – Operators – If…Else…Elseif – Switch – Loops – Function – Arrays. PHP Forms : Form Handling – Validation – Form Required. PHP Advanced: Date and Time – Include – File Handling – File Upload – Sessions – Implementation of Curd Operation.		
Unit - IV	**TypeScript and Angular 6.0:**	**9**
TypeScript: Introduction – Features – Variables – Data types – Enum – Array – Tuples – Functions – OOP concepts – Interfaces – Classes – Modules – Decorators. Angular 6.0 : Introduction – Needs – Features – Evolution – Setup and Configuration – Components and Modules – Templates – Change Detection – Directives – Nested Components.– Data Binding – Pipe.		
Unit - V	**Client-side JS Framework:**	**9**
Services – HTTP – Routing – Forms in Angular – Template Driven Forms – Model Driven Forms \ Reactive Forms – Custom Validators – Dependency Injection		

Total:45

TEXT BOOK:

1.	https://www.w3schools.com for units I and III.
2.	https:tutorialspoint.com for units II.
3.	Infosys campus connect material shared by infy for units IV and V.

REFERENCE:

1.	Paul Deitel, Harvey M.Deitel and Abbey Deitel, “Internet and World Wide Web - How To Program”, 5th Edition, Prentice Hall, 2011.
2.	Andrew Grant, “ Beginning Angular JS”, 1st Edition, Apress,2014

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	design static web pages using Bootstrap5.	Applying (K3)
CO2	Identify the significant features of MongoDB Database	Applying (K3)
CO3	develop a web application using PHP with database connectivity	Applying (K3)
CO4	apply the features of Angular to develop web applications.	Applying (K3)
CO5	utilize client side JS framework to develop web 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	1									3	2
CO2	3	2	1	1									3	2
CO3	3	2	1	1									3	2
CO4	3	2	1	1									3	2
CO5	3	2	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	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)**

20CSE14 - GRAPHICS AND MULTIMEDIA

Programme & Branch	B.E. & Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PE	3	0	0	3

Preamble	**Preamble:** This course provides knowledge on how the graphical objects are represented in a computer system and presented to the end user. It also demonstrates how those objects are manipulated through various transformations. In addition to this, this course explores the ways of representing the different types of digital content over Internet and demonstrates the creation of simple 2D animation.	
Unit - I	**Introduction to Graphics**:	**9**
Introduction to Graphics: Introduction - Graphics applications -Graphics systems – Output Primitive: Line, Circle and - Ellipse drawing algorithms – Attributes of Output Primitives		
Unit - II	**Two Dimensional Modeling:**	**9**
Two Dimensional Modeling: Two Dimensional Geometric Transformations – Two Dimensional Clipping and Viewing – Structures and Hierarchical Modeling.		
Unit - III	**Three Dimensional Modeling:**	**9**
Three Dimensional Modeling: Three dimensional geometric and modeling transformations - Visible surface detection methods - Color models and Color applications		
Unit - IV	**Introduction to Multimedia**	**9**
Introduction to Multimedia: Introduction – Uses of Multimedia – Interaction Technologies and Devices – Text – Digital Images		
Unit - V	**Audio, Video, and Animation:**	**9**
Audio, Video, and Animation: Digital Audio – Audio-Visual Media: Video and Animation – Creating Animation in Flash – Designing Multimedia		

Total:45

TEXT BOOK:

1.	Hearn Donald and Baker M. Pauline, “Computer Graphics C Version”, 2nd Edition, Pearson Education, 2008, for Units I,II,III.
2.	Ashok Banerji and Ananda Mohan Ghosh, “Multimedia Technologies”, 1st Edition, Tata McGraw Hill, 2010 for Units IV, V.

REFERENCES:

1.	Jeffcoate, Judith, “Multimedia in Practice: Technology and Applications”, 1st Edition, Prentice Hall of India, 2007
2.	Foley James D., Van Dam, Andries, Feiner Steven K. and Hughes John F., “Computer Graphics: Principles and Practice”, 2nd Edition, Pearson Education, 2005.

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 the components that constitute 2D and 3D graphics and develop simple applications	Applying (K3)
CO2	manipulate 2D objects by applying transformation, clipping, and viewing operations	Applying (K3)
CO3	Interpret 3D object transformations and the various methods for detecting visible surfaces and color in a 3D scene	Applying (K3)
CO4	develop 2D animations using multimedia components	Applying (K3)
CO5	apply the different phases in multimedia design to design a multimedia project	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										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	50	30				100
CAT3	20	40	40				100
ESE	20	40	40				100

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

20CSE15- BLOCKCHAIN TECHNOLOGIES

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**7**	**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.

REFERENCE:

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	30	50	20				100
CAT2	20	50	30				100
CAT3	10	50	40				100
ESE	20	50	30				100

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

20CSE16-TOTAL QUALITY MANAGMENT

Programme & Branch	**B.E. – Computer Science and Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**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.

REFERENCE:

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	Applying (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						2	2	2	2	2	2	2		2
CO2						3	3	3	3	2	2	2		2
CO3	3	2	2	2	2	1		2	2	2	3	3	3	
CO4				2	2	1		2	2	2	3	3		3
CO5						2	2	3	2	2	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	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)**

20CSE17 - DECISION SUPPORT SYSTEMS

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Database Management Systems	7	PE	3	0	0	3

Preamble	This course focuses on various Decision Support Systems and their technologies collectively represented as analytics and the fundamental methods, techniques and the software used to design and develop these systems.	
Unit - I	**Decision Making and Analytics**	**9**
Foundations and Technologies for Decision Making – Introduction – Phases of Decision Making Process – The Intelligence phase – Design Phase – Choice Phase – Implementation Phase – Decision Support System Capabilities – Classification – Components of Decision Support System – Application case study.		
Unit - II	**Descriptive Analytics**	**9**
Data Warehousing – Definition – Data warehousing process overview – Data warehouse architecture – ETL process – Data warehouse development with application case study – Data warehouse implementation Issues – Real time Data warehouse with application case study – Data warehouse administration and security issues.		
Unit - III	**Predictive Analytics**	**9**
Text Analytics, Text Mining and Sentiment Analysis – Concepts – Natural Language Processing – Text mining approaches – Text mining process with application case study – Text mining tools – Sentiment Analysis overview – Sentiment analysis applications – Sentiment analysis process.		
Unit - IV	**Web Analytics, Web Mining and Social Analytics**	**9**
Web Analytics, Web Mining and Social Analytics – Web mining overview – Web content and web structure mining – Web usage mining – Web analytics maturity model and web analytics tools – Social analytics and social network analysis with application case study – Social media concepts – Social media analytics.		
Unit - V	**Prescriptive Analytics**	**9**
Model based decision making – DSS modeling – Structure – Certainty, Uncertainty and Risk – Decision modeling with spreadsheets – Decision analysis with decision tables and trees – Automated Decision Systems and Expert Systems – Artificial intelligence – Basic concepts of expert systems – Structure of expert systems with application case study – Knowledge engineering – Development of Expert system.		

Total: 45

TEXT BOOK:

1.	Ramesh Sharda, Dursun Delen, Efraim Turban, "Business Intelligence and Analytics Systems for Decision Support", 10th Edition, Pearson Education, 2018.

REFERENCE:

1.	Vicki L Sauter, "Decision Support Systems for Business Intelligence", 2nd Edition, Wiley Education, 2011	Ramesh Sha Edition, Pears
2.	Efraim Turban, Jay E. Aronson, Ting-Peng Liang, "Decision Support Systems and Intelligent Systems", 7th Edition, Pearson Education, 2004.	

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	adapt to different phases, components and classifications in decision support systems	Applying(K3)
CO2	carry out descriptive analytics process and data warehouse development	Applying (K3)
CO3	perform text analytics, text mining and sentiment analysis for the given application	Applying (K3)
CO4	perform web analytics, web mining and social analytics for the specified application	Applying (K3)
CO5	demonstrate model based decision support system and expert system for an 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	20	40	40				100
CAT3	20	40	40				100
ESE	10	40	50				100

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

20CSE18 - SOCIAL NETWORK ANALYSIS

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Machine Learning	7	PE	3	0	0	3

Preamble	This course introduces various methods, models and concepts behind social network analysis. This course also describes about how to manipulate, analyze and visually display social network data.	
Unit - I	**Introduction and Random Walks in Social Networks**	**9**
Statistical Properties of Social Networks – Preliminaries – Static Properties – Dynamic Properties – Random Walks on Graphs: Background – Random Walk based Proximity Measures – Other Graph-based Proximity Measures – Graph-theoretic Measures for Semi-supervised Learning – Clustering with random walk based measures – Algorithms – Applications – Evaluation and datasets.		
Unit - II	**Community Discovery and Node Classification in Social Networks**	**9**
Communities in Context – Core Methods – Quality Functions – The Kernighan-Lin(KL) algorithm – Agglomerative/Divisive Algorithms – Spectral Algorithms – Multi-level Graph Partitioning – Markov Clustering – Node Classification in Social Networks: Problem Formulation – Methods using Local Classifiers – Random Walk based Methods – Applying Node Classification to Large Social Networks.		
Unit - III	**Social Influence Analysis and Expert Location in Social Networks**	**9**
Influence Related Statistics – Social Similarity and Influence – Influence Maximization in Viral Marketing – Expert Location in Social Networks: Expert Location without Graph Constraints – Expert Location with Score Propagation – Expert Team Formation – Other related approaches.		
Unit - IV	**Link Prediction and Privacy In Social Networks**	**9**
Feature based Link Prediction – Feature Set Construction – Classification Models – Bayesian Probabilistic Models – Link Prediction by Local Probabilistic Models – Network Evolution based Probabilistic Model – Hierarchical Probabilistic Model – Probabilistic Relational Models: Relational Bayesian Network – Relational Markov Network – Privacy in Social Networks: Privacy breaches in social networks – Privacy definitions for publishing data – Privacy preserving mechanisms.		
Unit - V	**Visualization and Text Mining in Social Networks**	**9**
Structural Visualization – Semantic and Temporal Visualization – Statistical Visualization – Text Mining in Social Networks: Keyword Search: Query Semantics and Answer Ranking – Keyword search over XML and relational data – Keyword search over graph data – Classification Algorithms – Clustering Algorithms.		

Total:45

TEXT BOOK:

1. Charu C. Aggarwal, "Social Network Data Analytics", 1st Edition Springer, 2015.

REFERENCES:

1. Peter Mika, "Social Networks and the Semantic Web", 1st Edition, Springer, 2007.
2. BorkoFurht, "Handbook of Social Network Technologies and Applications", 1st Edition, Springer, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	summarize statistical properties of Social Networks and apply random walk approaches for social network analysis	Applying (K3)
CO2	make use of statistical methods for classification and community discovery in Social Networks	Applying (K3)
CO3	carry out social influence and expert location in Social Networks	Applying (K3)
CO4	apply statistical methods for link prediction and describe privacy preservation methods in Social Networks	Applying (K3)
CO5	summarize visualization and apply text mining techniques in Social Networks	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	40	35				100
CAT2	25	40	35				100
CAT3	30	40	30				100
ESE	30	40	30				100

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

20CSE19 - HUMAN COMPUTER INTERFACE

Programme & Branch	**B.E. & Computer Science and Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**NIL**	**7**	**PE**	**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 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	**Development Processes and Evaluating Interface Designs**	**9**
Managing design processes – Organizational Design to Support Usability – Four Pillars of Design – Development Methodologies – Scenario Development – Social Impact Statement for Early Design Review. Evaluating Interface Designs: Expert Reviews – Usability Testing and Laboratories – Survey Instruments – Acceptance Tests – Evaluation during Active Use – Controlled Psychologically Oriented Experiments.		
Unit - III	**Interaction Styles**	**9**
Direct Manipulation and Virtual Environments – Introduction – Examples of Direct Manipulation – Discussion of Direct Manipulation – 3D Interfaces – Tele-operation – Virtual and Augmented Reality. Menu Selection, Form Filling and Dialog Boxes – Command and Natural Languages – Case Study.		
Unit - IV	**Interaction Devices**	**9**
Introduction – Keyboards and Keypads – Pointing Devices – Speech and Auditory Interfaces – Displays Small and Large. Collaboration and Social Media Participation: Goals of Collaboration and Participation – Asynchronous Distributed Interfaces – Synchronous Distributed Interfaces – Face-to-Face Interfaces.		
Unit - V	**Design Issues, Information Search and Information Visualization**	**9**
Quality of Service – Models of Response Time Impacts – Expectations and Attitudes – User Productivity – Variability in Response Time. Information Search: Searching in Textual Documents and Database Querying – Multimedia Document Searches – Advanced Filtering and Search Interface. Information Visualization: Data Type by Task Taxonomy – Challenges for Information Visualization.		

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.

REFERENCES:

1.	Alan Cooper, Robert Reinmann, David Cronin & Christopher Noessel, "About Face – The Essentials of Interaction Design", 4th Edition, Wiley, 2014.
2.	Helen Sharp and Yvonne Rogress, "Interaction Design beyond Human Computer Interaction", 4th Edition, John Wiley, 2015.

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	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	50	35				100
CAT2	10	40	50				100
CAT3	15	70	15				100
ESE	10	60	30				100

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

20CSE20 - BUSINESS INTELLIGENCE AND ITS APPLICATIONS

Programme & Branch	B.E. – Computer Science and Engineering	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.		

Total:45

TEXT BOOK:

1.	Prasad R.N. and Seema Acharya, "Fundamentals of Business Analytics", 2nd Edition, Wiley-India Publication, 2016

REFERENCE:

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)**

20CSE21 - WEB MINING

Programme& Branch	B.E. Computer Science and Engineering	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 (Units 1,2,3,5, & unit 4 part 1)
2.	Zdravko Markov, Daniel T. Larose, "Data Mining the Web: Uncovering Patterns in Web Content, Structure, and Usage", John Wiley & Sons, Inc., 2010 (Unit :4 part 2)

REFERENCE:

1,	Guandong Xu ,Yanchun Zhang, Lin Li, "Web Mining and Social Networking: Techniques and Applications", Springer; 1st Edition.2010
2.	Soumen Chakrabarti, "Mining the Web: Discovering Knowledge from Hypertext Data", Morgan Kaufmann; edition 2007

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)**

20CSE22 - CRYPTOGRAPHY AND NETWORK SECURITY

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Computer Networks	7	PE	3	0	0	3

Preamble	This course describes cryptographic algorithms deployed for offering confidentiality, integrity, authentication and non repudiation.	
Unit - I	**Introduction to Network Security and Symmetric Ciphers**	**9**
Computer Security Concepts – The OSI Security Architecture – Security Attacks – services and mechanisms – Model for Network Security – Classical encryption techniques – Block ciphers and Data Encryption Standard – Advanced Encryption Standard – Block cipher operation.		
Unit - II	**Asymmetric Ciphers**	**9**
Public key cryptography and RSA – Other Public key cryptosystems – Diffie-Hellman Key Exchange – Elgamal Cryptographic System – Elliptic Curve Arithmetic – Elliptic Curve Cryptography		
Unit - III	**Cryptographic Data Integrity Algorithms**	**9**
Cryptographic hash functions – Message authentication codes: Message Authentication Requirements – Message Authentication Functions – Requirements for Message Authentication Codes – Security of MACs – MACs Based on Hash Functions: HMAC – Digital signatures: Elgamal Digital Signature Scheme – Schnorr Digital Signature Scheme – NIST Digital Signature Algorithm – Elliptic Curve Digital Signature Algorithm.		
Unit - IV	**Mutual Trust**	**9**
Key management and distribution: symmetric key distribution using symmetric and asymmetric encryption – Distribution of public keys – X.509 Certificates – Public key infrastructure – User authentication: Remote user authentication principles – Remote user authentication using symmetric and asymmetric encryption – Kerberos – Federated identity management – Personal identity verification.		
Unit - V	**Network and Internet Security**	**9**
Network access control and cloud security –Transport level security – Wireless network security – Electronic mail security – IP security – Intruder – Firewalls.		

Total:45

TEXT BOOK:

1. William Stallings, "Cryptography and Network Security", 7th Edition, Pearson Education, 2017.

REFERENCE:

1. Behrouz A. Ferouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", 3rd Edition, Tata McGraw Hill, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply various symmetric key cryptography techniques to solve the problems	Applying (K3)
CO2	make use of various public key cryptography techniques for solving real time problems	Applying (K3)
CO3	explore hashing and digital signature techniques	Applying (K3)
CO4	demonstrate the various mutual trust and user authentication mechanisms	Applying (K3)
CO5	determine the appropriate security protocols and standards for the given 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	20	40	40				100
CAT3	20	50	30				100
ESE	10	50	40				100

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

20CSE23 - MODELING AND SIMULATION

Programme& Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course focuses on applications of computer simulation and modelling to real world simple and complex problems.	
Unit - I	**Modeling Process**	**9**
Classification of modeling – Steps of modeling – System Dynamics: Unconstrained Growth and Decay - Constrained Growth – Drug Dosage – Force and Motion: Modeling Falling and Skydiving		
Unit - II	**System Dynamics Models**	**9**
Competition – Modeling of Competition – Predator – Prey Model – Modeling the spread of SARS – SIR Model– SAR Model – Enzyme Kinetics – Enzymatic Reactions		
Unit - III	**Data Driven Models**	**9**
Functions – Empirical Models – Simulating with Randomness: Simulations – Random numbers from various distributions – Random Walk		
Unit - IV	**Cellular Automation**	**9**
Diffusion – Spreading of Fire – Periodic Boundary Conditions – Movement of Ants – Formulating a Model - -High Performance Computing: Concurrent Processing – Parallel Algorithms		
Unit - V	**Matrix Models**	**9**
Matrices for Population Studies – Population Matrices and High-Performance Computing -Time after Time – Age-Structured Model- Modeling with Markov Chains- Problems from Psychology to Genetics		

Total:45

TEXT BOOK:

1.	Angela B. Shiflet, George W. Shiflet, “Introduction to Computational Science: Modelling and Simulation for the Sciences”, 2nd Edition, Princeton University Press, 2014.

REFERENCE:

1.	Jerry Banks, John S. Carson, Barry L. Nelson, David M. Nicol, “Discrete-Event System Simulation: Pearson New International Edition”, 5th Edition, Pearson Education Limited,, 2013
2	R. Panneerselvam, P. Senthilkumar, System Simulation, Modelling and Languages, PHI learning Pvt.Ltd., 2013

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	model system dynamics with and without constraints	Applying (K3)
CO2	construct models for systems with interactions	Applying (K3)
CO3	make use of randomness and data for modelling	Applying (K3)
CO4	utilize cellular automation for modelling natural processes and explain concurrent processing and parallel algorithms	Applying (K3)
CO5	apply matrix theory in problem solving	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	40	40				100

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

20CSE24 - PARALLEL COMPUTING ARCHITECTURE AND PROGRAMMING

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Computer Organization	7	PE	3	0	0	3

Preamble	This course deals with computer architecture of uniprocessor and multiprocessor systems with an emphasis on parallel programming to achieve high performance.	
Unit - I	**Parallel Architectures**	**9**
Motivation: Modern scientific method – Evolution of supercomputing – Modern parallel computers – Seeking concurrency – Data clustering – Programming Parallel computers. Parallel Architectures: Introduction – Interconnection networks – Processor Arrays – Multiprocessors – Multicomputer – Flynn's Taxonomy.		
Unit - II	**Parallel Algorithm Design and Message-Passing Programming**	**9**
Parallel Algorithm Design: Introduction – Task/Channel model – Foster's Design methodology – Boundary value problem – finding the maximum – The n-Body problem – Adding data input. Message-Passing Programming: Message-passing model – Message-passing interface – Circuit satisfiability – Introducing collective communication – Benchmarking parallel performance.		
Unit - III	**Parallel Algorithms**	**9**
The Sieve of Eratosthenes: Sequential algorithm, Sources of parallelism – Data Decomposition options – Developing the parallel algorithm – Analysis of parallel Sieve algorithm – documenting the parallel program. Floyd's Algorithm: The All-Pairs shortest path problem – Creating arrays at run time – Designing the parallel algorithm – Point-to-point communication – Documenting the parallel program.		
Unit - IV	**Performance Analysis and Sorting**	**9**
Performance Analysis: Speedup and efficiency – Amdhal's Law – Gustafsan-Barsis's Law – The Karp-Flatt Metric – The Isoefficiency Metric. Sorting: Quick sort – A parallel quick sort – Hyper quick sort – parallel sorting by regular sampling		
Unit - V	**Shared-Memory Programming and Combining MPI and OPenMP**	**9**
Shared-Memory Programming: The Shared-memory model – Parallel for loops – Declaring private variables – Critical sections – Reductions – Performance Improvement – More general data parallelism – Functional parallelism. Combining MPI and OPenMP: Conjugate – Jacobi method.		

Total:45

TEXT BOOK:

1.	Michael J. Quinn., "Parallel Programming in C with MPI and OpenMP", 1st Edition(2003), McGraw Hill Education(India), Reprint 2014

REFERENCE:

1.	David E. Culler, Jaswinder Pal Singh, "Parallel Computing Architecture: A Hardware/ Software Approach", Morgan Kaufmann, Elsevier, 1st Edition, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the fundamental concept of computer architecture in the modern parallel computers and make use of it for designing parallel systems	Applying (K3)
CO2	utilize parallel algorithms and message passing interface methods for inter-process communication	Applying(K3)
CO3	make use of parallel programming concepts in developing parallel algorithms	Applying(K3)
CO4	analyze the performance of parallel algorithms	Analyzing(K4)
CO5	make use of MPI and openMP programming concepts for shared memory programming	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		1								3	2
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	15	55	30				100
CAT2	15	50	35				100
CAT3	15	55	30				100
ESE	15	55	30				100

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

20CSE25 - DIGITAL MARKETING

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	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.

REFERENCE:

1.	R S N Pillai, Bagavathi, "Modern marketing Priinciples and Practices",2nd Edition, 2020
2.	Dominik Kosorin, “Introduction to Programmatic Advertising”, 1 st Edition, 2017.

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)**

20CSE26 - BIG DATA ANALYTICS

Programme & Branch	B.E. – Computer Science and Engineering	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 Vs Hadoop – 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.	Develop MapReduce 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.	Seema Acharya and Subhashini Chellappan, “Big Data and Analytics”, 2nd Edition, Wiley, 2019.(unit 1-5)

REFERENCES:

1.	Dr.Anil Maheshwari, “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)**

20CSE27- CROSS PLATFORM APPLICATION DEVELOPMENT

Programme & Branch	**B.E. – Computer Science and Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Web Technology**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course gives an insight into the design and development of cross-platform mobile applications that are suitable for both Android and iOS platforms using React Native framework.	
Unit - I	**Introduction to React Native**	**9**
Introduction: Introduction to Cross-platform applications – Native vs Cross-platform Applications – Need for Cross-platform Applications – Existing Cross-platform Application Development Frameworks. React Native: Why React? – Virtual DOM – One-way Data Flow. Setting Up Your Environment - Creating a Simple React Native App - Implementing Complex User Interfaces.		
Unit - II	**Complex User Interfaces**	**9**
Implementing Complex User Interfaces – Dealing with universal applications - Detecting orientation changes - Using a WebView to embed external websites – Linking to websites and other applications - Creating a form component Implementing Complex User Interfaces – Creating a map app with Google Maps - Creating an audio player – Creating an image carousel - Adding push notifications to your app – Implementing browser-based authentication		
Unit - III	**Basic and Advanced Animations**	**9**
Adding Basic Animations to Your App: Introduction – Creating simple animations – Running multiple animations – Creating animated notifications – Expanding and collapsing containers – Creating a button with a loading animation. Adding Advanced Animations to Your App: Introduction – Removing items from a list component – Creating a Facebook reactions widget – Displaying images in fullscreen.		
Unit - IV	**Data Storage and Retrieval**	**9**
Working with Application Logic and Data: Introduction – Storing and retrieving data locally – Retrieving data from a remote API – Sending data to a remote API – Establishing real-time communication with WebSockets - Integrating persistent database functionality with Realm – Masking the application upon network connection loss - Logging in with Facebook. Implementing Redux: Introduction Installing Redux and preparing our project - Defining actions – Defining reducers – Setting up the Redux store – Communicating with a remote API - Connecting the store to the view – Storing offline content using Redux.		
Unit - V	**Third-Party Plugins and Native Functionality**	**9**
App Workflow and Third-Party Plugins: React Native development tools – Planning your app and choosing your workflow – Using NativeBase for cross-platform UI components – Using a pure React Native app (React Native CLI) – Using glamorous-native for styling UI components – Using react-native-spinkit for adding animated loading indicators – Using react-native-side-menu for adding side navigation menus – Using react-native-modal box for adding modals. Adding Native Functionality – Deploying Your App.		

Total:45

TEXT BOOK:

1. Dan Ward, "React Native Cookbook", 2nd Edition, Packt Publishing, 2019.

REFERENCE:

2. Jonathan Lebensold, "React Native Cookbook - Bringing the Web to Native Platforms", 1st Edition, O'Reilly Media, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	design a mobile application using the simple and complex UI features in React Native	Applying (K3)
CO2	develop universal mobile applications that run on mobile phones and tablets	Applying (K3)
CO3	design UI components with simple and advanced animations	Applying (K3)
CO4	make use of Redux to manage the application flow and data	Applying (K3)
CO5	employ open source third-party plugins to create React Native 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		2				1	1			3	1
CO2	3	2	1		2				1	1			3	1
CO3	3	2	1		2				1	1			3	1
CO4	3	2	1		2				1	1			3	1
CO5	3	2	1		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	40	50				100
CAT2	10	30	60				100
CAT3	10	35	55				100
ESE	10	30	60				100

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

20CSE28 - APPROXIMATION ALGORITHMS

Programme & Branch	**B.E. – Computer Science and Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Design and Analysis of Algorithms**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course explores the different approximation algorithms and their application in design of optimized solution for the computational problems.	
Unit - I	**Greedy Algorithms**	**9**
Introduction – Set Cover: The greedy algorithm – Layering – Application to shortest superstring – Steiner Tree and TSP: Metric Steiner tree – MST based algorithm – Metric TSP – A simple factor 2 algorithm – Improving the factor to 3/2 – Multiway Cut and k-Cut: The multiway cut problem – The minimum k-cut problem – k-Center: Parametric pruning applied to metric k-center – The weighted version		
Unit - II	**Layering**	**9**
Feedback Vertex Set: Cyclomatic weighted graphs – Layering applied to feedback vertex set – Shortest Superstring: A factor 4 algorithm – Improving to factor 3 – Knapsack – Bin Packing – Minimum Makespan Scheduling – Euclidean TSP		
Unit - III	**LP-Based Algorithms**	**9**
Introduction to LP-Duality: The LP-duality theorem – Min-max relations and LP-duality – Two fundamental algorithm design techniques – Set Cover via Dual Fitting – Rounding Applied to Set Cover – Set Cover via the Primal-Dual Schema – Maximum satisfiability – Scheduling on Unrelated Parallel Machine		
Unit - IV	**Graph Cuts**	**9**
Multicut and Integer Multicommodity Flows in Trees – Multiway Cut – Multicut in General Graphs – Sparsest Cut: Demands multicommodity flow – Linear programming formulation – Metrics, cut packing and l1-embeddability – Low distortion l1-embeddings for metrics – LP-rounding algorithm – Application		
Unit - V	**LP relaxation problems**	**9**
Steiner Forest: LP-relaxation and dual – Primal-dual schema with synchronization – Steiner Network: LP-relaxation and half integrity – The technique of iterated rounding – Characterizing extreme point solutions – A counting argument – Facility Location – k-Median – Semi definite Programming		

Total:45

TEXT BOOK:

1.	Vijay V. Vazirani, “Approximation Algorithms”, Second Printing, 1st Edition, Springer, 2013

REFERENCE:

2.	Teofilo F. Gonzalez, “Handbook of Approximation Algorithms and Metaheuristics”, 2nd Edition, CRC Press, 2018

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	make use of greedy techniques to approximate the general computations	Applying (K3)
CO2	implement layering techniques to obtain the optimized solutions	Applying (K3)
CO3	apply linear programming to approximate the set cover and associated problems	Applying (K3)
CO4	adapt approximation techniques for graph cut problems	Applying (K3)
CO5	use relaxation techniques to approximate the linear programming 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	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)**

20GEE01 - FUNDAMENTALS OF RESEARCH
(Common to all BE/BTech branches)

Programme & Branch	All BE/BTech branches	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)**

20CSE29 - SOFTWARE DEFINED NETWORKS

Programme & Branch	B.E. & Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Computer Networks	7	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.		

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)**

20CSE30 - INFORMATION SECURITY

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Computer Networks**	**7**	**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)**

20CSE31 - INTELLIGENT SYSTEMS

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Artificial Intelligence	7	PE	3	0	0	3

Preamble	This course covers theoretical issues, applications and implementation techniques of intelligent systems.	
Unit - I	**Problem Solving and Searching**	**9**
Evolution of Modern Computational Intelligence: Roots of AI – Modern AI- Metamodern AI – Problem Solving by Search: What is Search? – Tree Based Search – Graph Search – Search Methods Classification - Uninformed Search Methods – Informed Search: Heuristics – Best First Search – Greedy Search – A* Search – Comparisons and Remarks – A* Variants – Iterative Search: Hill Climbing Simulated Annealing – Tabu Search – Means Ends – Adversarial Search: MIN-MAX Algorithm – Alpha-beta Pruning.		
Unit - II	**Logic and Knowledge Base Systems**	**9**
Knowledge Representation and Reasoning: Propositional Logic – First Order Predicate Logic – Resolution in Propositional Logic and FOPL – Rule-Based Expert Systems: Elements – Structure – Types – Conflict Resolution – Benefits and Capabilities – Types of Expert Systems – Examples of Expert Systems – Managing Uncertainty in Rule Based Expert Systems: What Is Uncertainty and How to Deal With It? – Bayesian Theory – Certainty Factors.		
Unit - III	**Fuzzy and Neural Systems**	**9**
Fuzzy Expert Systems: Fuzzy Sets – Fuzzy Rules – Fuzzy Inference – Artificial Neural Networks: Similarities between Biological and ANN – Neural Networks Types – The Perceptron – Multi-layer Perceptron – Advanced Artificial Neural Networks: Jordan Network – Elman Network – Hopfield Network – Self Organizing Networks – Neocognitron – Application of Neural Network.		
Unit - IV	**Learning from Data**	**9**
Machine Learning: Terminology – Learning Steps – Learning Systems Classification – Machine Learning Example – Decision Trees: Building a Decision Tree – Overfitting in Decision Trees – Decision Trees Variants - Evolutionary Algorithms: Building an Evolutionary Algorithm – Genetic Algorithms – Variation Operators – Population Models – Survivor Selection and Reinsertion – Basic Genetic Algorithm – Evolutionary Meta-heuristics: Representation – Mutation – Recombination – Controlling the Evolution – Evolutionary Programming – Genetic Programming.		
Unit – V	**Bio-Inspired Intelligence**	**9**
Swarm Intelligence: Particle Swarm Optimization – Ant Colonies Optimization – Hybrid Intelligent Systems: Models of HCI Architectures – Neuro-fuzzy systems – Evolutionary Fuzzy Systems – Evolutionary Neural Networks – Hybrid Evolutionary Algorithms.		

Total:45

TEXT BOOK:

1.	Crina Grosanand, Ajith Abraham, "Intelligent Systems – A modern approach", Springer – Verlag Berlin Heidelberg, 1st Edition, 2011.

REFERENCE:

1.	Robert J. Schalkoff, “Intelligent Systems Principles, Paradigms and Pragmatics”, Jones and Bartlett Publishers, LLC, 2011. First Edition
2.	N.P.Padhy, “Artificial Intelligence and Intelligent Systems”, Oxford University Press, 2005. Illustrated Edition

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply various search techniques and heuristics for solving problems	Applying (K3)
CO2	make use of logic in knowledge representation and reasoning	Applying (K3)
CO3	determine the role of fuzzy and neural systems in building intelligent systems	Applying (K3)
CO4	utilize the machine learning techniques for data analysis	Applying (K3)
CO5	apply bio-inspired algorithms and build hybrid intelligence 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	30	45	25				100
CAT2	10	45	45				100
CAT3	25	45	30				100
ESE	20	40	40				100

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

20CSE32 - SOFTWARE PROJECT MANAGEMENT

Programme& Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Software Engineering	7	PE	3	0	0	3

Preamble	This course provides an insight into detailed project management activities including project evaluation, planning, estimation, monitoring and control activities especially for software projects.	
Unit - I	**Introduction to Software Project Management**	**9**
Introduction - Importance – Types of project – Activities – Plans, methods and methodologies – Ways of Categorizing software projects – Stakeholders – Setting objectives – Business case – Project success and failure - Management and management control – Traditional vs. Modern project management practices. Project Evaluation: Introduction – A business case – Project Portfolio Management – Evaluation of Individual Projects – Cost Benefit Evaluation Techniques – Risk Evaluation – Programme management – Managing the allocation of resources within programme – Strategic programme management – Creating a programme – Aids – Reservations – Benefits.		
Unit - II	**Project Planning**	**9**
Introduction – Select project - Identify project scope and objectives, project infrastructure – Analyse project characteristics – Identify project products and activities – Estimate effort for activity – Identify activity risks - Allocate Resources – Review plan – Execute plan. Software Effort Estimation : Introduction – Estimates – Problems with over and under estimates – Basis – Techniques – Bottom-up Estimating – Top down approach and parametric models – Expert Judgement – Estimating by analogy – Albrecht FP – FP Mark II - COSMIC FFP – COCOMO II.		
Unit - III	**Activity Planning**	**9**
Objectives – Project Schedule – Projects and Activities – Sequencing and Scheduling Activities –Network Planning Models – Formulation – Time dimension - Forward Pass – Backward Pass – Identifying the critical path - Activity Float – Shortening Project Duration – Identifying critical activities – Activity on Arrow Networks. Risk Management: Risk – Categories of Risk – Framework – Risk Identification – Risk Assessment – Risk Planning – Risk management – Applying PERT Technique – Monte Carlo Simulation – Critical chain concepts.		
Unit - IV	**Monitoring and Control**	**9**
Creating Framework – Collecting The Data – Review - Visualizing Progress – Cost Monitoring – Earned Value Analysis – Prioritizing Monitoring – Getting Project Back To Target – Change Control. Managing Contracts: Introduction – Types of Contract – Stages In Contract Placement – Typical Terms of A Contract – Contract Management – Acceptance.		
Unit - V	**Managing People**	**9**
Introduction – Understanding Behaviour – Organizational Behaviour: A Background – Selecting The Right Person For The Job – Instruction in the best methods – Motivation – The Oldham–Hackman Job Characteristics Model – Stress – Health and Safety. Working in Teams: Introduction – Becoming A Team – Decision Making– Organizational & Team Structures – Coordination Dependencies – Dispersed and virtual teams – Communication Generes – Communication Plans – Leadership.		

Total:45

TEXT BOOK:

1. Bob Hughes, Mike Cotterell and Rajib Mall, “Software Project Management”, 6th Edition, Tata McGraw Hill, New Delhi, 2017.

REFERENCES:

1. Pankaj Jalote, “Software Project Management in Practice”, 8th Edition, Pearson, 2002.
2. Watts S. Humphrey, “PSP: A self-improvement process for software engineers”, 1st Edition, Addison-Wesley, 2005.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	make use of process of software project management and apply evaluation technique to choose best project.	Applying (K3)
CO2	prepare the project plan and calculate the efforts required.	Applying (K3)
CO3	plan, schedule and sequence the activities and determine the risks.	Applying (K3)
CO4	develop visualization charts to monitor the progress of projects and to control the risks involved.	Applying (K3)
CO5	apply the methods of managing people and organising teams while developing a software project.	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							2		3	1
CO2	3	2	1	1							2		3	1
CO3	3	2	1	1							2		3	1
CO4	3	2	1	1							2		3	1
CO5	3	2	1						1		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	40	40				100
CAT2	20	35	45				100
CAT3	20	55	25				100
ESE	10	45	45				100

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

20CSE33 - DATA VISUALIZATION TECHNIQUES

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	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 (Unit I to Unit IV).
2.	Stephen Few, "Information Dashboard Design: The Effective Visual Communication of Data", O'Reilly, 2nd Edition, 2013. (Unit V)

REFERENCE:

1.	Stephen Few., "Now you see it: Simple Visualization Techniques for Quantitative Analysis", Analytics Press, 2009.
2.	Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.

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)**

20CSE34 - INFORMATION RETRIEVAL

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Machine Learning	7	PE	3	0	0	3

Preamble	This course discusses about the basic concepts of IR and various modeling techniques to build a text or multimedia based IR system.	
UNIT – I	**Introduction and Classic IR Models**	**9**
Introduction and Classic IR Models: Information Retrieval – The IR Problem – The IR System – Search Interfaces Today-Visualization in Search Interfaces. Modeling: IR Models – Classic Information Retrieval – Algebraic Models: Neural Network Model.		
UNIT – II	**Relevance Feedback, Languages and Query Properties**	**9**
Relevance Feedback, Languages and Query Properties: A Framework for feedback methods – Explicit Relevance feedback – Implicit feedback through local analysis – Global analysis. Documents: Metadata – Documents formats. Queries – Query Language – Query Properties.		
UNIT – III	**Text Operations**	**9**
Text Operations: Text Properties – Document Preprocessing – Text Compression. Text Classification: Characterization of Text Classification – Unsupervised Algorithms – Supervised Algorithms: Decision Tree – SVM Classifier – Feature Selection or Dimensionality Reduction – Evaluation Metrics: Accuracy and Error.		
UNIT – IV	**Web Retrieval and Web Crawling**	**9**
Web Retrieval and Web Crawling: The Web – Search Engine Architectures: Cluster Based Architecture – Distributed Architectures – Search Engine Ranking – Browsing. Web Crawling: Applications of a Web Crawler – Taxonomy – Architecture and Implementation – Scheduling Algorithms – Evaluation.		
UNIT – V	**Applications**	**9**
Applications: Enterprise Search – Tasks – Architecture. Library Systems: Online Public Access Catalogues – IR System and Document Databases. Digital Libraries: Architecture and Fundamentals.		
		Total: 45

TEXT BOOK:

1.	Ricardo Baeza-Yate, Berthier Ribeiro-Neto, “Modern Information Retrieval - the concepts and technology behind search”, 2nd Edition, Pearson Education Asia, 2011.

REFERENCES:

1.	Chowdhury G.G., “Introduction to Modern Information Retrieval”, 2nd Edition, Neal-Schuman Publishers, 2003.
2.	Daniel Jurafsky and James H. Martin, “Speech and Language Processing”, 1st Edition, Pearson Education, 2000.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	describe principles of various IR models and carryout issues of information retrieval in real time data	Applying (K3)
CO2	apply feedback methods for local and global analysis and also discuss about document formats and query properties	Applying (K3)
CO3	apply various text operations for the applications	Applying (K3)
CO4	make use of web crawling and web retrieval techniques for the given problems	Applying (K3)
CO5	explore different applications with IR architecture and its features	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)**

20CSE35 - COMPUTER VISION

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**NIL**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	This is a basic course on Computer Vision. Starting with fundamentals of vision, it explores image segmentation and feature based alignment. It also deals with motion and image stitching. It finally concludes with some applications for computer vision.	
UNIT – I	**Fundamentals of Vision**	**9**
Overview of computer vision – A brief history – Image formation: geometric primitives and transformation – photometric image formation – The digital camera.		
UNIT – II	**Image Processing and Feature detection**	**9**
Image Processing: point operators – linear filtering – more neighbourhood operators – Fourier transforms – pyramids and wavelets – Geometric transformations – global optimizations.Feature detection and matching: points and patches – edges – lines.		
UNIT – III	**Segmentation and Feature based Alignment**	**9**
Segmentation: Active contours – split and merge – mean shift and mode finding – normalized cuts – graph cuts and energy-based methods. Feature based alignment: 2D and 3D feature-based alignment – pose estimation – geometric intrinsic calibration.		
UNIT – IV	**Motion**	**9**
Structure from motion: Triangulation – Two-frame structure from motion – factorization – bundle adjustment – constrained structure and motion. Dense motion estimation: Translational alignment – parametric motion – spline-based motion – optical flow – layered motion. Image stitching: motion models – global alignment – compositing.		
UNIT – V	**Applications**	**9**
Recognition: Object detection – face recognition – instance recognition – category recognition – context and scene understanding – recognition databases and test-sets.		
		Total: 45

TEXT BOOK:	
1.	Richard Szeliski, " Computer Vision: Algorithms and Applications”, 1st Edition, Springer International, 2011.
REFERENCES:	
1.	Reinhard Klette, “Concise Computer Vision: An introduction into Theory and Algorithms", Springer International, 2014
2.	E.R. Davies, "Computer and Machine Vision", 4th Edition, Elsevier, 2012

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	outline the fundamental concepts of computer vision and apply to solve real case scenarios	Applying (K3)
CO2	make use of basic image processing and feature detection concepts	Applying (K3)
CO3	experiment with different types of segmentation and feature-based alignments	Applying (K3)
CO4	interpret how different types of motion affect the structure of the objects	Applying (K3)
CO5	Illustrate recognition as an application of computer vision	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	40	30	30				100
CAT2	40	30	30				100
CAT3	30	40	30				100
ESE	30	40	30				100

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

20CSE36 - NATURAL LANGUAGE PROCESSING

Programme& Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble	The course provides the foundation on Natural Language Processing concepts. Staring from words as the unit of a language, this course deals with statistical models, word embeddings and sequence modeling using advanced neural architectures. It also illustrates some practical NLP systems like Machine translation, Question Answering systems and chatbots.	
Unit - I	**Words and Their Statistical Models**	**9**
Regular Expressions – Words – Corpora – Text normalization – Minimum edit distance. N-Gram Language Models – N-Grams – Evaluating Language Models – Generalizations and zeros – Smoothing – Kneser-Ney Smoothing – Huge Language Models – Backoff – Perplexity vs. Entropy. Naïve-Bayes classifiers –Naïve-Bayes as Language Model – Evaluation – Test set and cross validation – Statistical significance testing		
Unit - II	**Vectors and Embeddings**	**9**
Lexical Semantics – Vector Semantics – Wordsand Vectors – Cosine for measuring similarity – TF-IDF: weighing terms in vectors – pointwise Mutual Information (PMI) – Applications of TF-IDF and PPMI – Word2Vec – Visualizing embeddings – Bias and Embeddings – Evaluating vector models. Neural Network Language Models – Units – XOR problem – Feed Forward Neural Networks – Training Neural Nets – Neural Language Models.		
Unit - III	**Sequence Labeling and Deep Learning Architectures**	**9**
English word classes –Part-of-Speech (PoS) Tagging – Named Entities and Named Entities Tagging – HMM PoS – Conditional Random Fields – Evaluation of Named Entity Recognition. Deep Learning Architecturesfor sequence modeling – Recurrent Neural Networks – Managing contexts in RNNs: LSTMs and GRUs – Self Attention Networks (Transformers) – Potential harms from Language Models.		
Unit - IV	**Machine Translation (MT) and Encoder-Decoder Models**	**9**
Language divergences and Typology – The Encode-Decoder model –Encoder-Decoder with RNNs – Attention – Beam Search – Encoder-Decoder with Transformers –Practical details on building MT systems – MT evaluation – Bias and ethical issues.		
Unit - V	**Practical NLP Systems**	**9**
Question Answering: Information Retrieval – IR based Factoid Question Answering – Entity Linking – Knowledge based Question Answering – Using Language Models for Question Answering – Classic QA models – Evaluation of factoid answers. **Chatbots and Dialogue systems** – Properties of human conversations – Chatbots – GUS: a simple frame-based dialogue system – Evaluating dialogue systems – Dialogue system design		

Total: 45

TEXTBOOK:

1. Daniel Jurafsky and James H. Martin, “Speech and Language Processing”, 3rd Edition, Pearson Education, New Delhi, 2020.

REFERENCES:

1. Christopher Manning and Hinrich Schuetze,” Foundations of Statistical Natural Language Processing”, 1st Edition, MIT Press, London, 2000.
2. Li Deng and Yang Liu, ” Deep Learning in Natural Language Processing“,1st Edition, Springer,2018

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply formal and statistical models for word processing	Applying (K3)
CO2	develop word vector embeddings for a given language	Applying (K3)
CO3	utilize deep learning architectures for modeling sequences in NLP	Applying (K3)
CO4	make use of encoder-decoders models to build Machine Translation systems	Applying (K3)
CO5	build question answering and chatbots for practical 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	30	40	30				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)(CAT 1,2,3 – 50 marks & ESE – 100 marks)**

20CSE37 - CYBER FORENSICS

Programme & Branch	**B.E. – Computer Science and Engineering**	**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.

REFERENCE :

1.	Nhien-An Le-Khac, Kim-Kwang Raymond Choo, "Cyber and Digital Forensic Investigations",Springer,2020
2.	Oettinger, W, “Learn Computer Forensics”, Packt Publishing,2020

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 investigation using 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)**

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20CSE38 - AUGMENTED AND VIRTUAL REALITY

Programme& Branch	**B.E. – Computer Science and Engineering**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble		
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.		
Unit - III	**Rendering and Interacting with Virtual World**	**9**
Rendering the Virtual World - Representation of the Virtual World - Visual, Aural, Haptic Representation. Rendering systems – Visual, Aural, Haptic systems. Interaction - User Interface Metaphors, Manipulating a Virtual World, Navigating in a Virtual World, Collaborative interaction, Interacting with the VR System, Software for VR.		
Unit - IV	**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 - V	**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		

Total:45

TEXT BOOK:

1.	Sherman William R, Craig Alan B., Understanding Virtual Reality: Interface, Application and Design, 1st Edition, Morgan Kaufmann Publishers, 2002.

REFERENCE:

1.	Dieter Schmalstieg, Tobias Hollerer, Augmented Reality. Principles and Practice, Addison-Wesley Publishers, 2016.
2.	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	Applying (K3)
CO2	explore the many levels at which the user interacts with a virtual world using the medium of virtual reality	Understanding (K2)
CO3	focus on rendering and interaction techniques that are required when designing VR applications.	Applying (K3)
CO4	understand the working principle of augmented reality and core technologies underlying augmented reality	Understanding (K2)
CO5	provide detailed coverage of vision, Interaction, Annotation and collaboration concepts in augmented reality	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	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)**

20CSE39 - PREDICTIVE DATA ANALYTICS

Programme & Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	8	PE	3	0	0	3

Preamble	This course provides the fundamental concepts of predictive data analytics and knowledge on the applications to solve real world problems	
Unit - I	**Predictive Analytics and Setting up the Predictive Modeling project**	**9**
Overview of Predictive Analytics: Predictive Analytics – Predictive Analytics vs. Business Intelligence – Predictive Analytics vs. Statistics – Predictive Analytics vs. Data Mining – Challenges in Using Predictive Analytics. Setting up the Predictive Modeling project: Predictive Analytics Processing Steps: CRISP-DM – Defining Data for Predictive Modeling – Defining the Target Variable – Defining Measures of Success for Predictive Models		
Unit - II	**Data Understanding and Preparation**	**9**
Data Understanding: Single Variable Summaries – Data Visualization in One Dimension – Histograms – Multiple Variable Summaries – Data Visualization Data Preparation: Variable Cleaning – Feature Creation		
Unit - III	**Descriptive Modeling**	**9**
Descriptive Modeling: Data Preparation Issues with Descriptive Modeling – Principal Component Analysis – Clustering Algorithms. Interpreting Descriptive Models: Standard Cluster Model Interpretation.		
Unit - IV	**Predictive Modeling**	**9**
Predictive Modeling: Decision Trees – Logistic Regression – K-Nearest Neighbor –Naive Bayes – Linear Regression – Assessing Predictive Models: Batch Approach to Model Assessment		
Unit - V	**Model Ensembles and Deployment**	**9**
Model Ensembles: Motivation for Ensembles – Bagging – Boosting – Improvements to Bagging and Boosting – Interpreting Model Ensembles. Model Deployment: General Deployment Considerations – Case Study		

Total: 45

TEXT BOOK:

1.	Dean Abbott, “Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst”, John Wiley & Sons, Inc., 1st Edition, 2014

REFERENCE:

2.	John D.Kelleher, Brain Mac Namee, Aoife D’Arcy, “Fundamentals of Machine Learning for Predictive Data Analytics”, MIT Press, 1st Edition, 2015

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explore the processing steps of predictive analysis for solving real time problems	Applying (K3)
CO2	make use of data for modeling project	Applying (K3)
CO3	utilize various descriptive modeling algorithms	Applying (K3)
CO4	determine the different types of predictive modeling algorithms	Applying (K3)
CO5	apply predictive analytics concepts to real world 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	45	40				100
CAT2	15	45	40				100
CAT3	15	45	40				100
ESE	10	40	50				100

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

20CSE40 - SOFTWARE QUALITY AND TESTING

Programme & Branch	B.E. & Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Software Engineering	8	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 1, 2
2.	Perry William, "Effective Methods for Software Testing", 3rd Edition, Wiley, India, 2013 for Units 3,4,5

REFERENCE:

1.	Software Testing And Quality Assurance-Theory and Practice, Kshirasagar Nak Priyadarshi Tripathy, John Wiley & Sons Inc,2008
2.	2. Software Quality Assurance, Milind Limaye, TMH ,New Delhi, 2011

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)**

20CSE41 - RANDOMIZED ALGORITHMS

Programme& Branch	B.E. – Computer Science and Engineering	Sem.	Category	L	T	P	Credit
Prerequisites	Design and Analysis of Algorithms, Data Structures and Algorithms	8	PE	3	0	0	3

Preamble	In this course, the power of randomization in the design and analysis of algorithms is introduced. The most widely used techniques for the analysis of randomized algorithms and the behaviour of random structures from a theoretical perspective are covered.	
Unit - I	**Introduction**	**9**
Min-Cut Algorithm - Binary Planar Partitions - A Probabilistic Recurrence - Computation Model and Complexity Classes-Game-theoretic techniques: Game Tree Evaluation - The Minimax principle - Randomness and Non-uniformity - Moments and deviations: Occupancy Problems, Markov and Chebyshev Inequalities.		
Unit - II	**Tail Inequalities**	**9**
Chernoff Bound - Routing in a parallel Computer - A wiring Problem – Martingales - The probabilistic method Overview - Maximum Satisfiability - Expanding Graphs - Lovasz Local Lemma - Method of Conditional Probabilities.		
Unit - III	**Markov Chains**	**9**
A 2-SAT Example - Markov Chains- Random Walks on Graphs-Electrical Networks - Cover Times- Graph Connectivity - Expanders and Rapidly Mixing Random Walks - Probability Amplification by Random Walks on Expanders		
Unit - IV	**Data Structures on Randomized algorithm**	**9**
Fundamental Data-structuring problem - Random Treaps - Skip Lists - Hash Tables Universal Family of Hash Functions - Perfect Hashing - Graph algorithms - All-pairs Shortest Paths - Min-cut Problem - Minimum Spanning Trees.		
Unit - V	**Randomized Computational Geometry**	**9**
Randomized Incremental Construction - Convex Hulls in the Plane - Delaunay Triangulations - Trapezoidal Decompositions - Random Sampling - Linear Programming Randomized Approximation Schemes-PRAM model and its sorting-Byzantine Agreement.		

Total:45

TEXT BOOK:

1. Rajeev Motwani and Prabhakar Raghavan, “Randomized Algorithms”, 1st Edition, Cambridge University Press, Reprint 2010.

REFERENCES:

1. Michael Mitzenmacher and Eli Upfal, “Probability and Computing: Randomized Algorithms and Probabilistic Analysis”, Cambridge University Press, 2005
2 Grimmett and Stirzaker, “Probability and Random Processes”, Oxford, 2001.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply the basic concepts in the design and analysis of randomized algorithms	Applying (K3)
CO2	develop tail inequalities and different probability that are frequently used in algorithmic application	Applying (K3)
CO3	determine the use of Markov chains and Random walks in the different practical applications	Applying (K3)
CO4	identify and apply the suitable data structures and graph algorithms for applications	Applying (K3)
CO5	examine the different geometrical, parallel and distributed algorithms for various randomness 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	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)**

20CSO01 - FUNDAMENTALS OF DATABASES
(Offered by Department of CSE)

Programme & Branch	All BE/BTech branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	4	OE	3	0	2	4

Preamble	This course provides the learners to know the fundamentals of database and SQL languages to depict create and manipulate the database design.	
Unit - I	**Introduction to Database Management**	**9**
Introduction – Database System – Example – Characteristics – Importance of Databases – File System Vs Database System – DBMS Users – Data abstraction – Levels of abstraction – Data Independence – Database System Architecture – Database administrator – Choosing a DBMS – Enterprise Database: Advantages, Concerns, Designing.		
Unit - II	**Data Models**	**9**
Introduction – Benefits of Data Modelling – Types Modelling – Phases of Data Modelling – ER model – Generalization, Specialization and Aggregation – Database Design Process – Strength and Weakness of ER Model – Case study of Building an ER Model. Relational Model – Data Structure – Mapping the ER Model to Relational Model – Data Manipulation – Data Integrity – Advantages of Relational Model.		
Unit - III	**SQL**	**9**
SQL – Data Definition – Keys and Constraints – Data Manipulation – Views – Embedded and Dynamic SQL.		
Unit - IV	**Functional Dependency and Normalization**	**9**
Undesirable Properties and Schema refinement – Decomposition using functional dependencies: 1NF, 2NF, 3NF, BCNF – Desirable properties of Decomposition – Multi valued Dependencies.		
Unit - V	**Indexing and Hashing**	**9**
Types of Memories – Secondary Storage – Buffer Management. File Structure – Heap file – Sequential file. Index – Types of Index – Indexed sequential file – B^+tree. Static hashing – External hashing – Dynamic Hashing.		

List of Exercises / Experiments:

1.	Write the queries using Data definition language.
2.	Implement the Integrity Constraints on Database.
3.	Write the queries using Data manipulation language.
4.	Write the queries using Data control language commands.
5.	Write the queries using TCL commands.
6.	Implement Aggregate functions and Set operations on various Relations.
7.	Perform SQL operations using index and views.

Lecture:45, Practical:30, Total: 75

TEXT BOOK:

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

REFERENCES:

1.	G K Gupta, "Database Management Systems", Tata McGraw Hill, 1st Edition, 2018.
2.	Back End : ORACLE / SQL SERVER / MYSQL
3.	Manuals: https://docs.oracle.com/cd/E11882_01/server.112/e41085.pdf

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	outline the features, architecture and applications of database system and choose an appropriate DBMS	Applying (K3)
CO2	design a relational database using ER model	Applying (K3)
CO3	manipulate the relational database with SQL statements	Applying (K3)
CO4	design relational database using normalization methods	Applying (K3)
CO5	apply indexing and hashing techniques in the design of relational database	Applying (K3)
CO6	develop queries using DDL, DML, DCL, and TCL commands	Applying (K3), Precision (S3)
CO7	design a database schema using SQL	Applying (K3), Precision (S3)
CO8	implement SQL Queries for various operations on the database	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											
CO2	3	2	1											
CO3	3	2	1											
CO4	3	2	1											
CO5	3	2	1											
CO6	3	2	1	1	1									
CO7	3	2	1	1	1									
CO8	3	2	1	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	20	50	30				100
CAT2	10	40	50				100
CAT3	10	40	50				100
ESE	20	40	40				100

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

20CSO02 – PYTHON PROGRAMMING AND FRAMEWORKS
(Offered by Department of CSE)

Programme & Branch	All BE/BTech branches except CSE	Sem.	Category	L	T	P	Credit
Prerequisites	Object Oriented Programming	4	PC	3	0	2	4

Preamble	This course provides an introduction to Python programming and skills to develop solutions for different real world problems using Python concepts and its frameworks	
Unit - I	**Basics**	**9**
Introduction - Literal Constants - Variables and Identifiers - Data Types - Input Operation – Comments - Reserved Words – Indentation - Operators and Expressions – Expressions- Operations on Strings - Other Data Types - Type Conversion - Decision Control Statements – Functions and Modules - Case Study — Tower of Hanoi		
Unit - II	**Strings, File and Data Structure**	**9**
Strings Revisited: Introduction - Concatenating, Appending, and Multiplying – Mutable vs Immutable - Formatting Operator - Built-in String Methods and Functions - Slice Operation - ord() and chr() - in and not in operators - Comparing - Iterating - String Module - Regular Expressions – File Handling - Data Structures: Sequence - Lists - Functional Programming - Tuple - Sets - Dictionaries		
Unit - III	**Object Oriented Programming**	**9**
Classes and Objects - Classes and Functions – Classes and methods – Constructor - Static Methods - Inheritance – Types of Inheritance - Composition or Containership or Complex Objects - Abstract Classes and Interfaces - Operator Overloading – Polymorphism - Error and Exception Handling, Case Study — Compressing String and Files		
Unit - IV	**GUI and Web**	**9**
GUI Programming with tkinter Package - Need for database programming – Connect Database – CRUD operations – Cursor Attributes - Data manipulation using MySQL - CGI/Web Programming		
Unit - V	**Frameworks**	**9**
Ananconda – Jupyter notebook - NumPy : NumPy Arrays – Computation on NumPy Arrays – Aggregation – Sorting Arrays Data Visualization with Pandas : Pandas Objects – Data Indexing and Selection – Operating on data – Handling missing data - Matplotlib: Line plots – Scatter Plots - Visualizing Errors		

List of Exercises / Experiments :

1	Implement linear search and binary search.
2	Program using user-defined functions with different types of argument passing methods
3	Explore string manipulation functions
4	Find the most frequent words from a given text file and copy the same into another file
5	Demonstrate tuple, list, set and dictionary operations
6	Program to illustrate the concept of constructors
7	Program to implement different types of inheritance, Aggregation and Association
8	Program to demonstrate the usage of exception handling
9	Develop an application to illustrate CRUD operations using python and MySQL
10	Program to demonstrate the usage of CGI Programming
11	Perform data manipulation using NumPy in Anaconda framework
12	Demonstrate Data Visualization using Pandas and Matplotlib in Anaconda framework

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1	Reema Thareja, “Python Programming using problem solving approach”, First Edition, Oxford university press, India , 2019, I, II, III, IV
2.	Jake Vander Plas ,” Python Data Science Handbook Essential Tools for Working with Data”, 1st Edition, O’Reilly publishers, India, 2016, V

REFERENCES:

1	Anurag Gupta and GP Biswas, Python Programming, First Edition,Tata McGraw Hill, India,2019
2	Allen B.Downey," Think Python : How to Think Like a Computer Scientist ",2nd Edition, O'Reilly publishers, India,2016
3	Martin Brown, Python: The Complete Reference, Fourth edition,Tata McGraw Hill Education India,2018

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	use the basic concepts, functions and different data structures of Python Programming	Applying (K3)
CO2	illustrate List, Dictionaries, Tuples and Strings data structures	Applying (K3)
CO3	implement Object Oriented Programming concepts	Applying (K3)
CO4	perform data manipulation and CRUD operations using MySQL and CGI	Applying (K3)
CO5	make use of numpy and python frameworks to provide data visualization	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	1									3	2
CO2	3	2	1	1									3	2
CO3	3	2	1	1									3	2
CO4	3	2	1	1									3	2
CO5	3	2	1	1									3	2
CO6	3	2	1	1									3	2
CO7	3	2	1	1									3	2
CO8	3	2	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	**30**	**30**	**40**				**100**
CAT2	**20**	**35**	**45**				**100**
CAT3	**20**	**30**	**50**				**100**
ESE	**20**	**30**	**50**				**100**

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

20CSO03 - COMPUTATIONAL SCIENCE FOR ENGINEERS
(Offered by Department of CSE)

Programme & Branch	All BE/BTech Branches except CSE	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	OE	3	1	0	4

Preamble	This course focuses on applications of computer simulation and modeling to real world simple and complex problems.	
Unit - I	**Modeling Process**	**9+3**
Model Classifications – Steps of the Modeling Process – System Dynamics: Unconstrained Growth and Decay – Rate of Change – Differential Equation – Difference Equation – Simulation Program – Analytical Solution – Further Refinement – Unconstrained Decay – Reports – Constrained Growth: Carrying Capacity – Revised Model – Equilibrium and Stability – Drug Dosage: One-compartment Model of Single Dose and Repeated Doses – Mathematics of Repeated Doses – Sum of Finite Geometric Series – Two-compartment Model.		
Unit - II	**Force and Motion**	**9+3**
Modeling Falling and Skydiving: Acceleration, Velocity and Position – Physics Background – Friction during Fall – Modeling a Skydive – Assessment of the Skydive Model – Bungee Jumping: Physics Background – Vertical Springs – Modeling a Bungee Jump – The Pendulum Clock: Simple Pendulum – Linear Damping – Pendulum Clock – Rocket motion: Physics Background – System Dynamics Model.		
Unit - III	**System Dynamics Models**	**9+3**
Competition: Community Relations – Introduction to Competition – Modeling – Predator-Prey Model: Lotka-Volterra Model – Particular Situations – Modeling the spread of SARS: SIR Model – SARS Model – Reproductive Number – Enzyme Kinetics: Enzymatic Reactions – Differential Equations – Model – Moles vs. Molar – Results – Michaelis-Menten Equation – Modeling Inhibition.		
Unit - IV	**Data Driven Models**	**9+3**
Functions: Linear – Quadratic – Polynomial – Square Root – Exponential – Logarithmic – Logistic – Trigonometric – Empirical Models: Linear Empirical Model – Predictions – Linear Regression – Non-Linear One-term Model – Multi-term Models – Advanced Fitting with Computational Tools – Simulating with Randomness: Simulations: Disadvantages of Computational Simulations – Element of Chance – Measure of Quality – Simulation Development – Different Range of Random Numbers – Random numbers from various distributions – Rejection Method – Random Walk.		
Unit - V	**Matrix Models**	**9+3**
Matrices for Population Studies: Population Matrices and High-Performance Computing – Vectors – Vector Addition – Multiplication by Scalar – Dot Product – Matrices – Scalar Multiplication and Matrix Sums – Matrix Multiplication – Square Matrices – Matrices and Systems of Equations – Time after Time: The Problem – Age-structured Model – Leslie Matrices – Age Distribution over Time – Projected –population Growth Rate – Stage-structured Model – Algorithms – Sensitivity Analysis for Age and Stage Structured Model – Applicability of Leslie and Lefkovitch Matrices – Need for High-Performance Computing – Modeling with Markov Chains – The next Flu Pandemic.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Angela B. Shiflet, George W. Shiflet, “Introduction to Computational Science: Modeling and Simulation for the Sciences”, 2nd Edition, Princeton University Press, 2014

REFERENCE:

1.	Jerry Banks, John S. Carson, Barry L. Nelson, David M. Nicol, “Discrete-Event System Simulation: Pearson New International Edition”, 5th Edition, Pearson Education Limited,, 2013
2.	R. Panneerselvam, P. Senthilkumar, System Simulation, Modelling and Languages, PHI learning Pvt.Ltd.,, 2013

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	model system dynamics with and without constraints	Applying (K3)
CO2	determine system dynamics involved in force and motion	Applying (K3)
CO3	construct models for systems with interactions	Applying (K3)
CO4	make use of randomness and data for modeling	Applying (K3)
CO5	apply matrix theory in problem solving	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											
CO2	3	3	1											
CO3	3	2	1											
CO4	3	2	1											
CO5	3	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	10	50	40				100
CAT3	25	45	30				100
ESE	20	40	40				100

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

20CSO04 - FORMAL LANGUAGES AND AUTOMATA THEORY
(Offered by Department of CSE)

Programme & Branch	All BE/BTech Branches except CSE	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	5	OE	3	1	0	4

Preamble	The course helps the learners to know the models of computation, along with their variants in the context of formal languages and their recognizers and to familiarize students with the foundations and principles of computer science. This can be applied in designing compilers and pattern recognition system.	
Unit - I	**Finite Automata & Regular Languages**	**9+3**
Introduction to Automata Theory -Languages and Computational Problems - Finite state automata - Deterministic and Non-deterministic finite automata - Equivalence between NFA and DFA - Finite Automata with Epsilon transitions – Conversion of NFA into DFA – Equivalence and minimization of automata.		
Unit - II	**Regular Expressions and Languages**	**9+3**
Regular expression–Pattern Matching-Equivalence of finite automata and regular expressions –Proving languages not to be regular (Pumping Lemma) –Closure properties of regular languages.		
Unit - III	**Context Free Grammar and Languages**	**9+3**
Grammars - Production systems - Chomsky hierarchy - Context-Free Grammar (CFG)–Parse trees–Ambiguity in grammars and languages – Definition of the pushdown automata (PDA) – Pushdown automata –Acceptance by empty store and final state - Equivalence of pushdown automata and CFG-CFG to PDA - Deterministic Pushdown Automata.		
Unit - IV	**Context Free Languages and Turing Machines**	**9+3**
Normal forms for CFG –Chomsky Normal Form and Greibach Normal Form – Pumping lemma for CFL –Closure properties of Context Free Languages. Turing machines: Basic model – definition and representation – Instantaneous Description – Language acceptance by TM – Variants of Turing Machine –TM as Computer of Integer functions –Programming techniques for Turing machines (subroutines) - Recursively enumerable sets and recursive sets - Context sensitive languages and linear bounded automata.		
Unit - V	**Undecidability**	**9+3**
A language that is not Recursively Enumerable (RE) –An undecidable problem that is RE –Undecidable problems about Turing machine – Post's correspondence problem –Rice's theorem; decidability of membership, emptiness and equivalence problems of languages.		

Lecture:45, Tutorial :15, Total:60

TEXT BOOK:

1.	Hopcroft J.E., Motwani R. and Ullman J.D., "Introduction to Automata Theory, Languages and Computations", 3rd Edition, Pearson Education, New Delhi, 2008.

REFERENCES:

1.	Kamala Krithivasan and Rama R, "Introduction to Formal Languages, Automata Theory and Computation", First Edition, Pearson Education, 2009.
2.	Martin J., "Introduction to Languages and the Theory of Computation", 4thEdition, Tata McGraw-Hill, New Delhi, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply induction and contradiction methods for theorem proving.	Applying (K3)
CO2	design finite automata and regular expression for regular languages.	Applying (K3)
CO3	develop and normalize context free grammar for context free languages and demonstrate the recognition of context free languages using push down automata.	Applying (K3)
CO4	construct Turing Machine to accomplish specific task and argue formally about its correctness.	Applying (K3)
CO5	make use of Turing machines to distinguish decidable/ undecidable problems and compare different classes of 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											
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	10	30	60				100
CAT2	10	30	60				100
CAT3	10	30	60				100
ESE	20	20	60				100

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

20CSO05 - JAVA PROGRAMMING
(Offered by Department of CSE)

Programme & Branch	All BE/BTech Branches except CSE	Sem.	Category	L	T	P	Credit
Prerequisites	Problem solving and Programming	6	OE	2	0	2	3

Preamble	This course provides the fundamental object oriented concepts of Java programming including inheritance, exception handling, multithreading, Generics and Collections.	
Unit - I	**Classes and Objects**	**6**
History and Evolution of Java – An 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**	**6**
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**	**6**
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.		
Unit - IV	**I/O and Generics**	**6**
Enumerations – Wrappers – Auto boxing – Annotation Basics. I/O Basics – Reading and Writing Console I/O –Reading and Writing Files. Generics: Introduction – Example–Parameters – General Form – Generic Methods, Constructors and Interfaces.		
Unit - V	**String Handling and Collections**	**6**
String Handling: String constructors – operations – Character Extraction – String Comparison – Searching Strings – Modifying Strings – String Buffer. Collection Framework: Overview – Collection Interfaces – Collection Classes.		

List of Exercises / Experiments:

1.	Write java programs using operators, arrays and control statements.
2.	Develop a stack and queue data structures using classes and objects.
3.	Program to demonstrate inheritance & polymorphism.
4.	Develop an application using interfaces by accessing super class constructors and methods.
5.	Develop application using packages and exception handling.
6.	Program to demonstrate thread concepts.
7.	Write Java program to illustrate file and string manipulations.
8.	Implement Java program to illustrate collection frameworks.

Lecture:30, Practical:30, Total:60

TEXT BOOK:

1.	Herbert Schildt, "Java: The Complete Reference", 11th Edition, McGraw Hill Education, New Delhi, 2019. (units 1-5)

REFERENCE:

1.	Cay S.Horstmann, "Core Java Fundamentals", Eleventh 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	develop Java applications with I/O packages and generics concepts	Applying (K3)
CO5	apply string handling functions and collection classes and interfaces	Applying (K3)
CO6	design and develop java program using object oriented programming concepts	Applying (K3), Precision (S3)
CO7	develop application using package, multithreading concepts and generics	Applying (K3), Precision (S3)
CO8	demonstrate the various file operations, string manipulations and applications of collections classes	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											
CO2	3	2	1											
CO3	3	2	1											
CO4	3	2	1											
CO5	3	2	1											
CO6	3	2	3	2	1									
CO7	3	2	3	2	1									
CO8	3	2	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	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)**

20CSO06 - WEB ENGINEERING
(Offered by Department of CSE)

Programme & Branch	All BE/BTech Branches except CSE	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	OE	2	0	2	3

Preamble	This course provides fundamental knowledge of networks and also provides skills necessary for developing web applications.	
Unit - I	**Basics of Computer Networks**	**6**
Data Communications – Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model - Network Layer: IPv4Addresses - Address Space – Classful Addressing – Classless Addressing- DHCP - Network Address Translation (NAT) – IPv6 Addressing – Ipv6 Protocol.		
Unit - II	**HTML and CSS**	**6**
HTML 5 – Basic Tags – Input Tags – Page Structure Elements – Cascading Style Sheet: Inline Styles – Embedded Style Sheets – Conflicting Styles – Linking External Style Sheets – Positioning Elements – Background – Element Dimensions – Box Model and Text Flow – Media types and Media queries – Drop – Down Menus.		
Unit - III	**Client Side Scripting – Java Script**	**6**
Introduction – Control Statements – Functions: Function Definition – Random Number Generation: Scaling and Shifting Random Number – Displaying Random Images – Scope Rules – Global Functions – Recursion – Recursion vs Iterations. – Arrays: Declaring and Allocating Arrays – Random Image Generator using Array – Sorting and Searching Array – Java Script Objects: Introduction – Math Object – String Object – Date Object – Boolean and Number Objects – Document Objects – Document Object Model: DOM Nodes and Trees – Traversing and Modifying a DOM Tree – DOM Collections – Dynamic Style – Events – Event Handling: Load Event – Mousemove – Mouseover and Mouseout - Form Processing Events.		
Unit - IV	**Database Concepts, MySQL and WebServer**	**6**
Relational Database Concepts – Basic SQL – SELECT – INSERT – UPDATA – DELETE – MySQL – Setting Up a MySQL User Account – Creating Databases in MySQL – Web Servers – Introduction – HTTP Transactions – Multitier Application Architecture – Client-Side Scripting versus Server-Side Scripting Accessing Web Servers – XAMPP Installation – Running the Examples Using Apache HTTP Server.		
Unit - V	**Server Side Scripting PHP**	**6**
Introduction – Data Type Conversion – Operators – Arrays – Strings Comparisons – String Processing: Searching for Expressions – Representing Patterns – Finding Matches – Character Classes – Finding Multiple Instance of a Pattern – Regular Expressions – Form Processing – Database Connectivity – Session Tracking.		

List of Exercises / Experiments :

1.	Design a web page using HTML tags and host it in github repository.
2.	Design a web page with menu layout. Apply the various formatting using CSS.
3.	Design a Registration page and perform form validation using JavaScript.
4.	Write a program using PHP and HTML to create a registration form and display the details entered by the user.
5.	Create a website for student mark maintenance system using PHP and MySQL
6.	Create a website to illustrate Session Tracking in PHP.
7.	Develop and deploy online reservation system using Java script, CSS, PHP, MySQL with Session Tracking.

Lecture:30, Practical:30, Total:60

TEXT BOOK:

1.	Forouzan, Behrouz. A , "Data Communication and Networking", 5th Edition, Tata McGraw – Hill, 2013. (Unit 1)
2.	Paul Deitel, Harvey M.Deitel and Abbey Deitel, "Internet and World Wide Web - How To Program", 5th Edition, Prentice Hall, 2011. (Unit 2-5)

REFERENCE:

1.	Xavier C, "World Wide Web Design with HTML", 2nd Edition, Tata McGraw Hill, New Delhi, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply the fundamental concepts of computer networking and design a LAN	Applying (K3)
CO2	design static web pages using HTML and CSS	Applying (K3)
CO3	develop interactive web pages using JavaScript	Applying (K3)
CO4	apply SQL Queries to create and manipulate relational databases	Applying (K3)
CO5	develop web application using PHP with database connectivity and session tracking	Applying (K3)
CO6	develop interactive web pages using HTML, CSS, JavaScript	Applying (K3), Precision (S3)
CO7	design and validate HTML form data using JavaScript	Applying (K3), Precision (S3)
CO8	develop a web application to maintain information in a database using server-side scripting	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											
CO2	3	2	1											
CO3	3	2	1											
CO4	3	2	1											
CO5	3	2	1											
CO6	3	2	1	1	1									
CO7	3	2	1	1	1									
CO8	3	2	1	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	20	50	30				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)**

20CSO07 - NATURE INSPIRED OPTIMIZATION TECHNIQUES
(Offered by Department of CSE)

Programme & Branch	All BE/BTech Branches except CSE	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	OE	3	0	0	3

Preamble	This course provides an introduction to nature inspired techniques and applications.	
Unit - I	**Introduction**	**9**

Philosophy of Natural Computing - Three Branches: A Brief Overview - Conceptualization -Individuals- Entities and agents - Parallelism and Distributivity - Interactivity – Adaptation - Feedback-Self-Organization-Complexity- Emergence and Reductionism- Bottom-up Vs Top-Down - Determination- Chaos and Fractals.

Unit - II	**Computing Inspired By Nature**	**9**

Evolutionary Computing- Hill Climbing and Simulated Annealing- Evolutionary biology - Darwin's Dangerous Idea- Genetics Principles- Standard Evolutionary Algorithm - Genetic Algorithms - Selection-Crossover- Mutation- Neurocomputing- Artificial neurons - network architectures- learning approaches - Hebbian learning- Single layer perceptron- Multi-layer perceptron - Self organization maps- discrete Hopfield network.

Unit - III	**Swarm Intelligence**	**9**

Introduction - Ant Colonies- Ant Foraging Behavior- Ant Colony Optimization- Simple ACO and scope of ACO algorithms - Ant Clustering Algorithm (ACA)- Swarm Robotics- Foraging for food- Social Adaptation of Knowledge - Particle Swarm Optimization (PSO) - Scope of PSO- social systems to particle swarm.

Unit - IV	**Immuno Computing**	**9**

Introduction- Immune System - Physiology and main components- Pattern Recognition and Binding -adaptive immune response- Self/Non-self discrimination- Immune Network Theory- Danger Theory- artificial immune systems- Evaluating Interaction - Immune Algorithms- Bone Marrow Models - Negative selection algorithms- Clonal selection and affinity maturation- Artificial Immune Networks.

Unit - V	**Computing With New Natural Materials**	**9**

DNA Computing - Basic concepts - DNA Molecule - Filtering models- Adleman's experiment - Test tube programming language- Formal models - Universal DNA Computers - Scope of DNA Computing - From Classical to DNA Computing - Quantum computing- Introduction- basic concepts from quantum theory- principles from quantum mechanics.

Total: 45

TEXT BOOK:

1. Leandro Nunes de Castro, "Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 1st Edition, 2007.

REFERENCE:

1. Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", MIT Press, Cambridge, 1st Edition, 2008.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply fundamental concepts in Nature Inspired Systems to solve computational problems.	Applying (K3)
CO2	manipulate the evolutionary and neuro Computing techniques inspired by nature.	Applying (K3)
CO3	implement collective intelligence of biological systems to computing.	Applying (K3)
CO4	develop immune systems behavior to computing and optimization.	Applying (K3)
CO5	make use of the characteristics of DNA computing and Quantum Computing.	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	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)**

20CSO08- FUNDAMENTALS OF INTERNET OF THINGS
(Offered by Department of CSE)

Programme& Branch	All BE/BTech Branches except CSE and IT	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	8	OE	3	0	0	3

Preamble	The course focuses on the fundamentals of IoT and also discusses developing real time IoT applications.	
Unit - I	**Introduction to Internet of Things**	**9**
Definition and Characteristics of IoT – Physical design of IoT – Logical Design of IoT: IoT Functional Blocks – IoT Communication models and APIs – IoT Enabling Technologies –IoT Levels and Deployment Templates.		
Unit - II	**IoT Design Methodology**	**9**
M2M – Difference between M2M &IoT – Software Defined Networks – Network function Virtualization – IoT Platform Design Methodologies – Domain Specific IoT – Home Automation – Smart Agriculture-Weather Monitoring.		
Unit - III	**Python Packages for IoT and Introduction to Raspberry Pi**	**9**
JSON – XML – HTTPLib and URLLib – SMTPLib, Introduction to Raspberry Pi -pin configurations – Interfaces (Serial, SPI, 12C Programming) – Python program with Raspberry Pi –controlling output – reading input from pins		
Unit - IV	**Developing simple IoT applications using Raspberry Pi**	**9**
LED controlling - Traffic Light controller – integrating sensors (temperature sensor, Ultrasonic sensor etc.) – Developing web application to control IoT device – uploading the sensor values onto the cloud for analysis – Sending SMS – Sending images and video via mail.		
Unit - V	**IoT Use cases**	**9**
Smart and Connected Cities – An IoT Strategy for Smarter Cities – Architecture – Use cases: Street Lighting – Smart Parking – Smart Traffic – Smart Home.		
		Total:45

TEXT BOOK:

1. ArshdeepBahga and Vijay Madisetti, “Internet of Things - A Hands-on Approach”, Universities Press, 1st Edition, 2015. for Units 1, 2, 3,4
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things”, Cisco Press, 1st Edition, 2017 (Unit 5).

REFERENCE:

1. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	explain the physical/ logical design of IoT and choose an appropriate IoT level for the given applications and examine them	Analyzing (K4)
CO2:	summarize the fundamental concepts of M2M, role of SDN and NFV in IoT and develop design methodologies for a given application	Applying (K3)
CO3:	outline the concepts of Python with regard to Internet of Things and develop simple programs using Python	Applying (K3)
CO4:	develop an IoT applications using Raspberry Pi and Python	Applying (K3)
CO5:	describe the role of Internet of Things in different domains and build simple applications related to Smart cities	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	3	2									
CO2	3	2	1									
CO3	3	2	1		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	20	30	35	15			100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	20	25	40	15			100

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

20CSO09- MACHINE TRANSLATION
(Offered by Department of CSE)

Programme & Branch	All BE/BTech Branches except CSE	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	8	OE	3	0	0	3

Preamble	The course helps the learners to know the basic concepts of neural networks and design of machine translation models with the core aspects of training and decoding. This helps in building a state -of -the- art model in machine translation.	
Unit - I	**Introduction**	**9**
The Translation Problem: Goals of Translation – Ambiguity – Linguistic view – Data view. Uses of Machine Translation: Information Access – Aiding Human Values – Communication – NLP Pipelines - Multimodal Translation. History: Neural Networks – Machine Translation. Evaluation: Task based Evaluation – Human Assessments – Automatic Metrics – Metrics Research.		
Unit - II	**Basics of Machine Translation models**	**9**
Neural Networks: Linear models – Multiple Layers – Nonlinearity – Inference – Back-Propagation Training – Exploiting Parallel Processing. Computation Graphics: Neural Network as Computation Graphs – Gradient Computations. Neural Language Models: Feed-Forward Language Models – Word Embeddings – Noise Contrastive Estimation –Recurrent Neural Language Models – LSTM Models – Gate Recurrent Units.		
Unit - III	**Translation and Decoding of Models**	**9**
Translation: Encoder-Decoder Approach – Adding an Alignment Model – Training. Decoding: Beam Search – Ensemble Decoding – Ranking – Optimization Decoding – Direct Decoding.		
Unit - IV	**Design of the Machine Translation Model**	**9**
Machine Learning Tricks: Failures – Ensuring Randomness – Adjusting Learning Rate – Avoiding Local Optima – Addressing Vanishing and Exploding Gradients – Sentence Level Optimization. Alternate Architecture: Components of NN – Attention Models-Convolutional Machine Translation and Neural Networks with Attention – Self-Attention: Transformer. Revisiting Words: Word Embeddings – Large Vocabularies-Character Based Models.		
Unit - V	**Adaptation and Structure of Models**	**9**
Adaptation: Domains – Mixture Models – Sub Sampling – Fine-Tuning -Using Monolingual Data – Multiple Language Pairs – Training on Related Tasks. Linguistic Structure: Guided Alignment Training – Modeling Coverage- Additional Linguistic Annotation.		

Total:45

TEXT BOOK:

1.	Philipp Koehn, “Neural Machine Translation”, Cambridge University Press, 2020.

REFERENCES:

1.	Yorick Wilks ,”Machine Translation: Its Scope and Limits”, Springer; 1st ed. 2010
2	Philipp Koehn,” Statistical Machine Translation”, Cambridge University Press; 1st edition 2009

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the basic concepts of Neural Networks, the goals of translation models and apply in human assessments	Applying (K3)
CO2	apply basic Neural Network concepts to build translation models	Applying (K3)
CO3	make use of encoding and decoding approach in Machine Translation	Applying (K3)
CO4	design architecture for Machine Translation models with Neural Network components	Applying (K3)
CO5	perform analysis on the adaptation of models with different domains and structure	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	30	50	20				100
CAT2	30	50	20				100
CAT3	25	50	25				100
ESE	35	45	20				100

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

20CSO10 - FUNDAMENTALS OF BLOCKCHAIN
(Offered by Department of CSE)

Programme & Branch	All BE/BTech Branches except CSE	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	8	OE	3	0	0	3

Preamble	This course provides technical fundamentals of Blockchain, practical implications, and hands on development aspects of Blockchain applications.	
Unit - I	**Introduction**	**9**
History – blockchain introduction – Centralized vs. Decentralized Systems – Layers of Blockchain – Importance – Blockchain Uses and Use Cases – Laying the Blockchain Foundation – Cryptography.		
Unit - II	**Working of Blockchain**	**9**
Game Theory – Prisoner's Dilemma – Byzantine Generals' Problem – The Blockchain – Merkle Trees – Properties of Blockchain Solutions – Blockchain Transactions – Distributed consensus mechanisms – Blockchain applications – Scaling blockchain.		
Unit - III	**Bitcoin**	**9**
The History of Money – Working with Bitcoins – The Bitcoin Blockchain – The Bitcoin Network – Bitcoin Scripts – Full Nodes vs. SPVs – Bitcoin Wallets.		
Unit - IV	**Ethereum and Introduction to Hyperledger**	**9**
Bitcoin to Ethereum – Ethereum Blockchain – Ethereum Smart Contracts – Ethereum Virtual Machine and Code Execution – Ethereum Ecosystem – Swarm – Whisper – DApp – Development components – Hyperledger: Introduction – Projects**.** Fabric – Sawtooth lake – Iroha – Blockchain explorer – Fabric chaintool – Fabric SDK Py-Corda.		
Unit - V	**Blockchain Application Development**	**9**
Decentralized Applications – Blockchain Application Development – Interacting with Bitcoin Blockchain – Sending Transactions – Creating a Smart Contract – Executing Smart Contract Functions – Public vs. Private Blockchains – Decentralized Application Architecture – Building an Ethereum DApp.		

Total:45

TEXT BOOK:

1. Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, "Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions", APress, 1st Edition, 2018.

REFERENCE:

1. Brenn Hill, Samanyu Chopra, Paul Valencourt, "Blockchain Quick Reference: A guide to exploring decentralized blockchain application development", Packt publishing, 1st Edition, 2018.
2. Imran Bashir, "Mastering Blockchain Distributed ledgers, decentralization and smart contracts Explained", Packt Publishing, 1st Edition, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explore the history, background, and theoretical aspects of blockchain and apply in real case scenarios	Applying (K3)
CO2	demonstrate core components and working of blockchain	Applying (K3)
CO3	outline Bitcoin's technical concepts and apply it for realcase scenarios	Applying (K3)
CO4	adapt Ethereum blockchain for different use cases	Applying (K3)
CO5	demonstrate the end-to-end development of a decentralized 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											
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	50	50	20				100
CAT2	30	50	20				100
CAT3	30	50	20				100
ESE	30	40	30				100

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

20CSO11 – PROGRAMMING WITH JAVA
(Offered by Department of CSE)

Programme & Branch	**All BE/BTech Branches except CSE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Problem Solving and Programming**	**5**	**OE**	**3**	**0**	**2**	**4**

Preamble	This course provides the fundamental object oriented concepts of Java programming including inheritance, exception handling, multithreading, Generics and Collections.	
Unit - I	**Classes and Objects**	**9**
History and Evolution of Java – An 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.		
Unit - IV	**I/O and Generics**	**9**
Enumerations – Wrappers – Auto boxing – Annotation Basics. I/O Basics – Reading and Writing Console I/O –Reading and Writing Files. Generics: Introduction – Example–Parameters – General Form – Generic Methods, Constructors and Interfaces.		
Unit - V	**String Handling and Collections**	**9**
String Handling: String constructors – operations – Character Extraction – String Comparison – Searching Strings – Modifying Strings – String Buffer. Collection Framework: Overview – Collection Interfaces – Collection Classes.		

List of Exercises / Experiments:

1.	Write java programs using operators, arrays and control statements.
2.	Develop a stack and queue data structures using classes and objects.
3.	Program to demonstrate inheritance
4.	Write a program to implement static and dynamic polymorphism
5.	Develop an application using interfaces by accessing super class constructors and methods.
6.	Develop application using packages and exception handling.
7.	Program to demonstrate thread concepts.
8.	Use read and write I/O consoles to perform file operations
9.	Write Java program to illustrate file and string manipulations.
10.	Implement Java program to illustrate collection frameworks.

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Herbert Schildt, "Java: The Complete Reference", 11th Edition, McGraw Hill Education, New Delhi, 2019. (units 1-5)

REFERENCE:

1.	Cay S.Horstmann, "Core Java Fundamentals", Eleventh 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	develop Java applications with I/O packages and generics concepts	Applying (K3)
CO5	apply string handling functions and collection classes and interfaces	Applying (K3)
CO6	design and develop java program using object oriented programming concepts	Applying (K3), Precision (S3)
CO7	develop application using package, multithreading concepts and generics	Applying (K3), Precision (S3)
CO8	demonstrate the various file operations, string manipulations and applications of collections classes	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											
CO2	3	2	1											
CO3	3	2	1											
CO4	3	2	1											
CO5	3	2	1											
CO6	3	2	3	2	1									
CO7	3	2	3	2	1									
CO8	3	2	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	10	40	50				100
CAT3	10	40	50				100
ESE	10	40	50				100

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

20CSO12 – INTRODUCTION TO WEB ENGINEERING
(Offered by Department of CSE)

Programme & Branch	**All BE/BTech Branches except CSE**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**OE**	**3**	**0**	**2**	**4**

Preamble	This course provides fundamental knowledge of networks and also provides skills necessary for developing web applications.	
Unit - I	**Basics of Computer Networks**	**9**
Data Communications – Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model - Network Layer: IPv4Addresses - Address Space – Classful Addressing – Classless Addressing- DHCP - Network Address Translation (NAT) – IPv6 Addressing – Ipv6 Protocol.		
Unit - II	**HTML and CSS**	**9**
HTML 5 – Basic Tags – Input Tags – Page Structure Elements – Cascading Style Sheet: Inline Styles – Embedded Style Sheets – Conflicting Styles – Linking External Style Sheets – Positioning Elements – Background – Element Dimensions – Box Model and Text Flow – Media types and Media queries – Drop – Down Menus.		
Unit - III	**Client Side Scripting – Java Script**	**9**
Introduction – Control Statements – Functions: Function Definition – Random Number Generation: Scaling and Shifting Random Number – Displaying Random Images – Scope Rules – Global Functions – Recursion – Recursion vs Iterations. – Arrays: Declaring and Allocating Arrays – Random Image Generator using Array – Sorting and Searching Array – Java Script Objects: Introduction – Math Object – String Object – Date Object – Boolean and Number Objects – Document Objects – Document Object Model: DOM Nodes and Trees – Traversing and Modifying a DOM Tree – DOM Collections – Dynamic Style – Events – Event Handling: Load Event – Mousemove – Mouseover and Mouseout - Form Processing Events.		
Unit - IV	**Database Concepts, MySQL and WebServer**	**9**
Relational Database Concepts – Basic SQL – SELECT – INSERT – UPDATA – DELETE – MySQL – Setting Up a MySQL User Account – Creating Databases in MySQL – Web Servers – Introduction – HTTP Transactions – Multitier Application Architecture – Client-Side Scripting versus Server-Side Scripting Accessing Web Servers – XAMPP Installation – Running the Examples Using Apache HTTP Server.		
Unit - V	**Server Side Scripting PHP**	**9**
Introduction – Data Type Conversion – Operators – Arrays – Strings Comparisons – String Processing: Searching for Expressions – Representing Patterns – Finding Matches – Character Classes – Finding Multiple Instance of a Pattern – Regular Expressions – Form Processing – Database Connectivity – Session Tracking.		

List of Exercises / Experiments :

1.	Design a web page using HTML tags and host it in github repository.
2.	Design a web page with menu layout and apply the various formatting using CSS.
3.	Design multiple webpages using external CSS
4.	Develop a simple calculator using javascript.
5..	Design a Registration page and perform form validation using JavaScript.
6.	Write a program using PHP and HTML to create a registration form and display the details entered by the user.
7.	Create and manipulate data in database using MySQL
8.	Create a website for student mark maintenance system using PHP and MySQL
9.	Create a website to illustrate Session Tracking in PHP.
10.	Develop and deploy online reservation system using Java script, CSS, PHP, MySQL with Session Tracking.

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Forouzan, Behrouz. A , "Data Communication and Networking", 5th Edition, Tata McGraw – Hill, 2013. (Unit 1)
2.	Paul Deitel, Harvey M.Deitel and Abbey Deitel, "Internet and World Wide Web - How To Program", 5th Edition, Prentice Hall, 2011. (Unit 2-5)

REFERENCE:

1.	Xavier C, "World Wide Web Design with HTML", 2nd Edition, Tata McGraw Hill, New Delhi, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply the fundamental concepts of computer networking and design a LAN	Applying (K3)
CO2	design static web pages using HTML and CSS	Applying (K3)
CO3	develop interactive web pages using JavaScript	Applying (K3)
CO4	apply SQL Queries to create and manipulate relational databases	Applying (K3)
CO5	develop web application using PHP with database connectivity and session tracking	Applying (K3)
CO6	develop interactive web pages using HTML, CSS, JavaScript	Applying (K3), Precision (S3)
CO7	design and validate HTML form data using JavaScript	Applying (K3), Precision (S3)
CO8	develop a web application to maintain information in a database using server-side scripting	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											
CO2	3	2	1											
CO3	3	2	1											
CO4	3	2	1											
CO5	3	2	1											
CO6	3	2	1	1	1									
CO7	3	2	1	1	1									
CO8	3	2	1	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	20	50	30				100
CAT2	20	50	30				100
CAT3	20	50	30				100
ESE	10	50	40				100

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

20GEO01 – GERMAN LANGUAGE LEVEL 1

(Offered by Department of Electronics and Communication Engineering)

Programme& Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	**Basics of Language**	**4,5,6,8**	**HS**	**4**	**0**	**0**	**4**

Preamble	To acquire the vocabulary as per the Common European framework of German language A1 level competence. This course will help to assimilate the basic grammar structures and gain vocabulary to understand and reciprocate in daily life situations on a broader sense. A thorough learner will be able to gain a comprehensive understanding of the German grammar and confidently articulate in day today situations.	
Unit - I	**Contacts (Kontakte):**	**12**
Understanding Letters, simple instructions, speaking about language learning, finding specific information in text, Acknowledging the theme and understanding conversations, Making appointments. Grammar – Preposition with Dative, Articles in Dative and Accusative possessive articles.		
Unit - II	**Accommodation (Die Wohnung):**	**12**
Understanding Accommodation advertisements, describing accommodation and directions, responding to an invitation, Expressing feelings, Colours. Grammar – Adjective with to be verb, Adjective with *sehr/zu*, Adjective with Accusative, prepositions with Dative		
Unit - III	**Working Environment Communication (ArbeitenSie):**	**12**
Daily Schedule, speaking about past, understanding Job openings advertisements, Opinions, Telephonic conversations, Speaking about Jobs. Grammar – Perfect tense, Participle II – regular and irregular verbs, Conjunctions – *und, oder, aber*.		
Unit - IV	**Clothes and Style (Kleidung und mode) :**	**12**
Clothes, Chats on shopping clothes, reporting on past, Orienting oneself in Supermarkets, Information and research about Berlin. Grammar – Interrogative articles and Demonstrative articles, Partizip II – separable and non-separable verbs, Personal pronouns in Dative, Verbs with Dative.		
Unit - V	**Health and Vacation (Gesundheit und Urlaub):**	**12**
Personal information, Human Body parts, Sports, Understanding instructions and prompts, health tips. Grammar – Imperative with *du/Ihr*, Modal verbs – sollen, müssen, nichtdürfen, dürfen. Suggestions for travel, Path, Postcards, weather, Travel reports, Problems in hotel, Tourist destinations. Grammar – Pronoun: *man*, Question words – *Wer, Wen, Was, Wem*, Adverbs – *Zuerst, dann, Später, ZumSchl*		

Total:60

TEXT BOOK:

1.	“Stefanie Dengler, Paul Rusch, Helen Schmitz, TanjaSieber, “Netzwerk Deutsch alsFremdsprache A1–ursbuch, Arbeitsbuch und Glossar with 2 CDs”, Goyal Publishers, Delhi, 2015.

REFERENCES:

1.	https://ocw.mit.edu – Massachusetts Institute of Technology Open Courseware Refer: German 1 for undergraduate students
2.	https://www.dw.com/en/learn-german - Deutsche Welle , Geramany’s International Broadcaster

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understanding letters and simple texts	Remembering (K1)
CO2	assimilating vocabulary on accommodation and invitation	Understanding (K2)
CO3	comprehend concept of time, telephonic conversation and job-related information	Understanding (K2)
CO4	understanding how to do shopping in a German store	Understanding (K2)
CO5	understanding body parts and how to plan personal travel	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	1	3		3		
CO2								1	1	3		3		
CO3								1	1	3		3		
CO4								1	1	3		3		
CO5								1	1	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	25	75					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

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

20GEO02 – JAPANESE LANGUAGE LEVEL 1
(Offered by Department of Electronics and Communication Engineering)

Programme& Branch	All BE/BTech Engineering & Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Basics of Language	4/5/6/8	HS	4	0	0	4

Preamble	To understand the basics of Japanese language which provides understanding of Hiragana, Katakana and 110 Kanjis and provides the ability to understand basic conversations and also enables one to request other person and also understand Casual form	
Unit - I	**Introduction to groups of verbs:**	**12**
tai form-Verb groups-te form-Give and ask permission to do an action-Present continuous form-Restrict other person from doing an action-nouns-Basic Questions		
Unit - II	**Introduction to Casual Form:**	**12**
nai form-Dictionary form-ta form-Polite style and Casual style differences-Conversation in plain style-Place of usage of Polite style and Casual style		
Unit - III	**Express opinions and thoughts:**	**12**
Introduction to new particle-Express someone one's thought-Convey the message of one person to another-Ask someone if something is right -Noun modifications		
Unit - IV	**Introduction to If clause and Kanjis:**	**12**
If clause tara form-Express gratitude for an action done by other person-Hypothetical situation-Particles to use in case of Motion verbs-110 Kanjis		
Unit - V	**Introduction to Counters:**	**12**
How to use numbers-How to use quantifiers-Past form of adjectives and Nouns-Way to say preference-Way of expression degrees of an action-Other necessary particles-How to use numbers-How to use quantifiers-Past form of adjectives		

Total:60

TEXT BOOK:

1.	"MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1.	MargheritaPezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2.	Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	read and understand typical expression in Hiragana and Katakana	Remembering (K1)
CO2	understand Polite form and Casual form of Japanese	Understanding (K2)
CO3	comprehend personal communication and express greetings	Understanding (K2)
CO4	understand the Kanjis in Japanese Script	Understanding (K2)
CO5	comprehend concept of time, counters and job-related information	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	1	3		3		
CO2								1	1	3		3		
CO3								1	1	3		3		
CO4								1	1	3		3		
CO5								1	1	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	25	75					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

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

20GEO03 - DESIGN THINKING FOR ENGINEERS

Programme& Branch	B.E./B.Tech – all branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	GE	3	1	0	4

Preamble	This course introduces systematic process of thinking to empower the traditional thinker to develop new, innovative solutions to the problem.	
Unit - I	**Introduction and Explore Phase**	**9+3**
Introduction – Need for design thinking – Design and Business – The Design Process – Design Brief –Visualization – Four Questions, Ten Tools – Explore – STEEP Analysis – Strategic Priorities – Activity System – Stakeholder Mapping – Opportunity Framing.		
Unit - II	**Empathize Phase**	**9+3**
Visualization –Journey Mapping –Value Chain Analysis –Mind Mapping–Empathize– Methods and tools -Observations–Deep user Interview- Need Finding–User Personas –Team building activity.		
Unit - III	**Experiment Phase**	**9+3**
Brainstorming–reasons for brainstorming- Zen of brainstorming –Brainstorming Activity-Concept Development–Experiment–Ideation–different ways of ideation-Prototyping –Idea Refinement.		
Unit - IV	**Engage Phase**	**9+3**
Assumption Testing – Need for assumption testing- steps - Rapid Prototyping – forms of prototyping- Engage – Storyboarding.-purpose and case study		
Unit - V	**Evolve Phase**	**9+3**
Customer Co-Creation Learning Launch– Leading Growth and Innovation– Evolve–Concept Synthesis – Strategic Requirements – Evolved Activity Systems – Quick Wins.		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Jeanne Liedtka and Tim Ogilvie, “Designing for Growth: A Design Thinking Tool Kit for Managers”, Columbia University Press, 1st Edition, 2011.(First Half Units 1-5)
2.	Lee Chong Hwa “Design Thinking The Guidebook”, Design Thinking Master Trainers of Bhutan, 1st Edition, 2017. (Second Half Units 1-5)

REFERENCES:

1,	Jeanne Liedtka, Tim Ogilvie, and Rachel Brozenske, "The Designing for Growth Field Book: A Step-by-Step Project Guide", Columbia University Press,2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	outline the basic concepts of design thinking	Understanding (K2)
CO2	make use of the mind mapping process for designing any system	Applying (K3)
CO3	develop many creative ideas through structured brainstorming sessions.	Applying (K3)
CO4	develop rapid prototypes to bring the ideas into reality	Applying (K3)
CO5	plan the implementation of the any system considering the real time feedback	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	1	1										
CO2	3	2	1	1										
CO3	3	2	1	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	10	70	20				100
CAT2	10	30	60				100
CAT3	10	20	70				100
ESE	10	20	70				100

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

20GEO04 - INNOVATION AND BUSINESS MODEL DEVELOPMENT

(Offered by Department of Mechatronics Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	8	OE	3	0	0	3

Preamble	This course will inspire the students to think innovation concepts and ideas for business model developments.	
Unit - I	**Innovation and Design Thinking:**	**9**
Innovation and Creativity– Types of innovation – challenges in innovation- steps in innovation management- 7 concerns of design. Design Thinking and Entrepreneurship – Design Thinking Stages: Empathize – Define – Ideate – Prototype – Test. Design thinking tools: Analogies – Brainstorming – Mind mapping		
Unit - II	**User Study and Contextual Enquiry:**	**9**
Explanatory research – primary and secondary data – classification of secondary data – sources of secondary data – qualitative research – focus groups – depth interviews – analysis of qualitative data – survey methods – observations- Process of identifying customer needs –organize needs into a hierarchy –establish relative importance of the needs- Establish target specifications		
Unit - III	**Product Design:**	**9**
Techniques and tools for concept generation, concept evaluation – Product architecture –Minimum Viable Product (MVP)- Product prototyping – tools and techniques– overview of processes and materials – evaluation tools and techniques for user-product interaction		
Unit - IV	**Business Model Canvas (BMC):**	**9**
Lean Canvas and BMC - difference and building blocks- BMC: Patterns – Design – Strategy – Process–Business model failures: Reasons and remedies		
Unit - V	**IPR and Commercialization:**	**9**
Need for Intellectual Property- Basic concepts - Different Types of IPs: Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design– Patent Licensing - Technology Commercialization – Innovation Marketing		

Total:45

TEXT BOOK:

1.	Rishikesha T.Krishnan, “8 Steps To Innovation: Going From Jugaad To Excellence”, Collins India, 2013.

REFERENCES:

1.	Peter Drucker, “Innovation and Entrepreneurship”, Routledge CRC Press, London, 2014.
2.	Eppinger, S.D. and Ulrich, K.T. “Product design and development”, 7th Edition, McGraw-Hill Higher Education, 2020.
3.	Alexander Osterwalder, “Business model generation: A handbook for visionaries, game changers, and challengers”, 1st Edition, John Wiley and Sons; 2010.
4.	Indian Innovators Association, “Patent IPR Licensing – Technology Commercialization – Innovation Marketing: Guide Book for Researchers, Innovators”, Notion Press, Chennai, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand innovation need and design thinking phases	Understanding (K2)
CO2	identify, screen and analyse ideas for new products based on customer needs	Analysing (K4)
CO3	develop and analyse the product concepts based on the customer needs and presents the overall architecture of the product.	Analysing (K4)
CO4	predict a structured business model for MVP	Applying (K3)
CO5	practice the procedures for protection of their ideas' IPR	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			2						3	2	2
CO2	3	3	3	3	2	2	2	2	3	3	3	3	2	2
CO3	2	2	3	3	3	3	3	3	3	3	3	3	2	2
CO4				3	2	2	2	3	3	3	3	3	2	2
CO5				3	2	2		3	2	3	3	3	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	30	40	10			100
CAT2	20	30	40	20			100
CAT3	30	30	40				100
ESE	20	30	30	20			100

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

20GEO05 - GERMAN LANGUAGE LEVEL 2

(Offered by Department of Electronics and Communication Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	German Language Level 1	**4/5/6/8**	**HS**	**4**	**0**	**0**	**4**

Preamble	This course aims to help the learner to acquire the vocabulary as per the Common European framework of German language A1 level competence. This course will help to assimilate the basic grammar structures and gain vocabulary to understand and reciprocate in daily life situations on a broader sense. A thorough learner will be able to gain a comprehensive understanding of the German grammar and confidently articulate in day today situations.	
Unit - I	**Contacts(Kontakte):**	**12**
Understanding Letters, simple instructions, speaking about language learning, finding specific information in text, Acknowledging the theme and understanding conversations, Making appointments. Grammar – Preposition with Dative, Articles in Dative and Accusative possessive articles.		
Unit - II	**Accomodation(Die Wohnung):**	**12**
Understanding Accommodation advertisements, describing accommodation and directions, responding to an invitation, Expressing feelings, Colours. Grammar – Adjective with to be verb, Adjective with *sehr/zu*, Adjective with Accusative, prepositions with Dative		
Unit - III	**Are you Working?(Arbeiten Sie):**	**12**
Daily Schedule, speaking about past, understanding Job openings advertisements, Opinions, Telephonic conversations, Speakin about Jobs. Grammar – Perfect tense, Participle II – regular and irregular verbs, Conjunctions – *und, oder, aber*.		
Unit - IV	**Clothes and Style(Kleidung und mode):**	**12**
Clothes, Chats on shopping clothes, reporting on past, Orienting oneself in Supermarkets, Information and research about Berlin. Grammar – Interrogative articles and Demonstrative articles, Partizip II – separable and non-separable verbs, Personal pronouns in Dative, Verbs with Dative		
Unit - V	**Health and Vacation(Gesundheit und Urlaub):**	**12**
Personal information, Human Body parts, Sports, Understanding instructions and prompts, health tips. Grammar – Imperative with *du/Ihr*, Modal verbs – sollen, müssen, nicht dürfen, dürfen. Suggestions for travel, Path, Postcards, weather, Travel reports, Problems in hotel, Tourist destinations. Grammar – Pronoun: *man*, Question words – *Wer, Wen, Was, Wem*, Adverbs – *Zuerst, dann, Später, Zum Schl*		

Total: 60

TEXT BOOK:

1	Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, "Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch und Glossar with 2 CDs", Goyal Publishers, Delhi, 2015.

REFERENCES:

1	https://ocw.mit.edu – Massachusetts Institute of Technology Open Courseware
2	https://www.dw.com/en/learn-german - Deutsche Welle , Geramany's International Broadcaster

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand letters and simple texts	Remembering (K1)
CO2	assimilate vocabulary on Accommodation and invitation	Understanding (K2)
CO3	comprehend concept of time, telephonic conversation and job-related information	Understanding (K2)
CO4	understand how to do shopping in a German store	Understanding (K2)
CO5	understand body parts and how to plan personal travel	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	1	3		3		
CO2								1	1	3		3		
CO3								1	1	3		3		
CO4								1	1	3		3		
CO5								1	1	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	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

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

20GEO06 - GERMAN LANGUAGE LEVEL 3

(Offered by Department of Electronics and Communication Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	German Language Level 2	4/5/6/8	HS	3	0	0	3

Preamble	This course provides enriching information about various everyday situations in personal and professional life and enhances the vocabulary and speaking ability to respond to and also seek information in those situations. It also equips one to express opinions and negotiate appointments. With diligent learning one can capture all basic grammatical structure to answer confidently in everyday situations.	
Unit - I	**All about food (Rund Ums Essen):**	**9**
Understand information about person, Speak about food, Introduce self and others, Understand and explain a picture base story, To justify something, To speak about feelings, To express opinions, To answer questions on a text, To describe a restaurant. Grammar: Possessive Articles in Dative, Yes/No questions, Reflexive verbs, Sentence with 'weil'		
Unit - II	**School days (Nach der Schulzeit):**	**9**
Understand School reports, Speak and write comments about schooldays, To speak about habits, Understand and provide City-Tipps, To Understand School types in Germany and speak about it. Grammar: Modal verbs in Past tense, Positional Verbs, Two-way prepositions in Dativ and Akkusativ.		
Unit - III	**Media in everyday life (Medien in Alltag):**	**9**
To speak about advantages and disadvantages of Media, formulate comparisons, Express your own opinion, Talk about Movies, Understand and Write Movie reviews. Grammar: Comparative degree, Comparative Sentences with 'Als' and 'Wie', Subordinate clause with 'dass', Superlative degree.		
Unit - IV	**Feelings and expressions (Gefühle):**	**9**
Express thanks and congratulations, Talk about feelings, To understand information about festivals and speak about it, To describe a city, Express joy and regrets, Understand and write Blog entries, Write appropriate heading. Grammar: Subordinate Clause with 'Wenn', Adjectives to be used along with definite articles.		
Unit - V	**Profession and Travel (Beruf und Reisen):**	**9**
To have a conversation at ticket counter, To talk about leisure activities, To gather information from Texts, Introduce people, Express career preferences, Ideate the dream job, To prepare and make telephone calls, To understand text about Workplace. Ask for information, Express uncertainty, Understand and give directions, Understand a newspaper article, Say your own opinion, Talk about the way to work, Describe a statistic, Understand information about a trip, Talk about travel. Grammar: Adjective to be used along with indefinite articles, Prepositions, verb – 'werden', Subordinate clause – indirect questions, All units will include elements for reading, writing, speaking and listening.		

Total: 45

TEXT BOOK:

1.	Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, "Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch und Glossar with 2 CDs", Goyal Publishers, Delhi, 2015.

REFERENCES:

1.	Rosa-Maria Dallapiazza , Eduard von Jan, Till Schonherr, "Tangram 2 (German)" , Goyal Publishers, Delhi, 2011.
2.	https://www.dw.com/en/learn-german - Deutsche Welle , Geramany's International Broadcaster

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand German food style, restaurant and be able express oneself.	Remembering (K1)
CO2	understand German school system and discuss about habits and provide City-Tipps.	Understanding (K2)
CO3	analyze and compare media in everyday life.	Understanding (K2)
CO4	express feelings, describe a city and write blog entries.	Understanding (K2)
CO5	seek and provide information in a professional setup, give directions to others and talk about travel.	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	1	3		3		
CO2								1	1	3		3		
CO3								1	1	3		3		
CO4								1	1	3		3		
CO5								1	1	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	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

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

20GEO07 - GERMAN LANGUAGE LEVEL 4

(Offered by Department of Electronics and Communication Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	German Language Level 3	4/5/6/8	HS	3	0	0	3

Preamble	This course imparts knowledge about interacting with external world, understanding various cultural aspects, behaviour and addressing relationships in personal and professional front. It helps one to understand reports from various media and at work. Enhance learner's grammatical exposure and cover the core basic grammatical concepts which would lay the foundation to have a better hold of the language. With focused learning one should be able to read and respond to reports, write simple formal and informal letters and text messages and be able to engage in simple conversations in known situations.	
Unit - I	**Learning (Lernen):**	**9**
Understanding and describing learning problems, Understanding and giving advice, Giving reasons, Understanding reports about everyday work life, Talking about everyday working life, Understanding a radio report, Understanding and making a mini-presentation. Grammar: Conjunctions- denn,weil, Konjuntiv II: Sollte(suggestions), Genitive, Temporal prepositions – bis, über + Akkusativ,ab+dativ		
Unit - II	**Athletic (Sportlich):**	**9**
Expressing enthusiasm, hope, disappointment, Understanding and writing fan comments, Formulating follow-ups, Making suggestions and reacting, Making an appointment, Understanding a report about an excursion, Understanding difficult texts, Introducing a tourist attraction. Grammar: Conjunctions – deshalb, trotzdem, Verbs with Dativ and Akkusativ		
Unit - III	**Living Together (Zusammen Leben):**	**9**
To complain, apologize & give in, As for something, Understand experience reports, Report on the past, Talk about pets, Respond to information, Write and correct a story. Grammatik: Konjunctiv II- könnte, Subordinate clauses – als and Wenn.		
Unit – IV	**Good Entertainment (Gute Unterhaltung):**	**9**
Talk about music style, Buy concert tickets, Introduce a musician / band, Understand newspaper reports, Give more detailed information about a person, Understand information about painting, Understand description of a picture, Describe a picture. Grammatik: Interrogative Articles: Was fuer eine? , Pronouns – man/jemand/niemand and alles/etwas/nichts , Relative sentences in Nominativ.		
Unit - V	**Passage of time and Culture (Zeitablauf & Kultur):**	**9**
Talk about wishes, Express wishes, Give Suggestions, Understand a conversation, Plan something together, To ask others something, Understand a text, Exchange information, Talk about proverbs, write a story. Understand information about other cultures, Discuss about behavior, Express intentions, Use the appropriate salutation, Understand tips in a text, Talk about forms of addressing others, Give more information, Discuss about clichés and write about them. All units will include elements for reading, writing, speaking and listening. Grammatik: Konjunctiv II (Wishes, Suggestions), Verbs with prepositions, W- questions with prepositions, Relative sentences in Akkusativ, Subordinate clauses with damit and Um…Zu.		

Total: 45

TEXT BOOK:

1. Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, "Netzwerk Deutsch als Fremdsprache A1–ursbuch, Arbeitsbuch", Goyal Publishers, Delhi, 2015.

REFERENCES:

1. Rosa-Maria Dallapiazza, Eduard von Jan, Till Schonherr, "Tangram 2 (German)", Goyal Publishers, Delhi, 2011.
2. https://www.dw.com/en/learn-german - Deutsche Welle, Geramany's International Broadcaster

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	leverage learning in Workplace, understanding reports and make presentation.	Remembering (K1)
CO2	reciprocate to different situations, make appointment and understand texts.	Understanding (K2)
CO3	handle relationships and respond appropriately to exchange information	Understanding (K2)
CO4	familiarize to various channels of entertainment	Understanding (K2)
CO5	know about various cultural aspects, usage of proverbs and cliches.	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	1	3		3		
CO2								1	1	3		3		
CO3								1	1	3		3		
CO4								1	1	3		3		
CO5								1	1	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	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

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

20GEO08 - JAPANESE LANGUAGE LEVEL 2

(Offered by Department of Electronics and Communication Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	**Japanese Language Level 1**	**4/5/6/8**	**HS**	**4**	**0**	**0**	**4**

Preamble	The basic level of Japanese which provides understanding of Hiragana, Katakana and 110 Kanjis and provides the ability to understand basic conversations and also enables one to request other person and also understand Casual form	
Unit - I	**Introduction to groups of verbs:**	**12**
tai form-Verb groups-te form-Give and ask permission to do an action-Present continuous form-Restrict other person from doing an action-nouns-Basic Questions		
Unit - II	**Introduction to Casual Form:**	**12**
nai form-Dictionary form-ta form-Polite style and Casual style differences-Conversation in plain style-Place of usage of Polite style and Casual style		
Unit - III	**Express opinions and thoughts:**	**12**
Introduction to new particle-Express someone one's thought-Convey the message of one person to another-Ask someone if something is right -Noun modifications		
Unit - IV	**Introduction to If clause and remaining Kanjis:**	**12**
If clause tara form-Express gratitude for an action done by other person-Hypothetical situation-Particles to use in case of Motion verbs-50 Kanjis		
Unit - V	**Introduction to giving and receiving with te form and "when, even if" usages:**	**12**
Providing to and getting from differences - Understanding of situations and framing sentences using when and even if..etc.		

Total: 60

TEXT BOOK:

1.	"MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1.	Margherita Pezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2.	Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	differentiate groups of verbs and its forms	Remembering (K1)
CO2	understand Polite form and Casual form of Japanese	Understanding (K2)
CO3	comprehend personal communication and express greetings	Understanding (K2)
CO4	understand the Kanjis in Japanese Script and If clause	Understanding (K2)
CO5	comprehend concept of “even if”, “when” and job-related information	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	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	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	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

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

20GEO09 - JAPANESE LANGUAGE LEVEL 3

(Offered by Department of Electronics and Communication Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	**Japanese Language Level 2**	**4/5/6/8**	**HS**	**3**	**0**	**0**	**3**

Preamble	The intermediate level of Japanese which provides understanding of all forms ofverbs, adverbs, conjunctions, etc. which includes 150 Kanji's and provides the ability to comprehend conversations encountered in daily life	
Unit - I	**Introduction to Potential verbs:**	**9**
Causes and Reasons-Favouring Expressions-Expressing a State-Potential Verb Sentences-Simultaneous actions-Verb Groups-te Form-Customary Actions-Nouns-Basic Questions and Kanji's.		
Unit - II	**Introduction to Transitive and Intransitive verbs:**	**9**
Consequence of verbs- Embarrassment about Facts- Consequence of Verbs with an Intentions-Affirmative Sentences-Conjunctions-Basic Questions and kanji's.		
Unit - III	**Introduction to Volitional forms:**	**9**
Expressions of Speakers Intention-Expressing Suggestion or Advice-Usage of Adverbs and Quantifiers-Basic Questions and kanji's.		
Unit - IV	**Introduction to Imperative and Prohibitive verbs:**	**9**
Commanding person- Interrogatives-Expressions of Third Person-Actions and its Occurrence - Possibilities of an Action-Changing of States Basic Questions and Kanji's.		
Unit - V	**Introduction to Conditional form and Passive verbs:**	**9**
Description of Requirement and Speaker's Judgement, HabitualActions, Directions and suggestions-Passive forms of Verbs-Basic Questions and Kanji's.		

Total: 45

TEXT BOOK:

1.	"MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1.	Margherita Pezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2.	Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	read and understand BasicVocabularies.	Remembering (K1)
CO2	understand Conversations used in daily life.	Understanding (K2)
CO3	comprehend personal communication and express greetings.	Understanding (K2)
CO4	understand the Kanji's in Japanese Script.	Understanding (K2)
CO5	comprehend Coherent conversations in everyday situations.	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	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	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	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

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

20GEO10 - JAPANESE LANGUAGE LEVEL 4

(Offered by Department of Electronics and Communication Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Japanese Language Level 3	4/5/6/8	HS	3	0	0	3

Preamble	The intermediate level of Japanese provides understanding of expressions of verbs, its pattern, Relationships which also includes 150 Kanji's and also provides the ability to understand relationship among the people.	
Unit - I	**Introduction to Reasoning:**	**9**
Causes and Sequences-Causes and Effects-Interrogative Patterns-Adjective as a Noun -Basic Questions and Kanji's.		
Unit - II	**Introduction to Exchanging of things:**	**9**
Expressions for Giving and Receiving of Things-Polite Expression of Request-Indicating a Purpose of Actions-Basic Quantifiers-Basic Questions and kanji's.		
Unit - III	**Introduction to States of an Action:**	**9**
Sentence Pattern to Indicate Appearance-Degree of Action and State-Adjectives as Adverbs- Convey information -Basic Questions and kanji's.		
Unit - IV	**Introduction to Causative Verbs:**	**9**
Causative Forms of Verbs-Asking Opportunity to do something-Hypothetical Questions-Judgement and Course of an actions-Basic Questions and Kanji's.		
Unit - V	**Introduction to Relationship in Social Status:**	**9**
Honorific expressions- Respectful expressions- Humble expressions-Polite expressions-Basic Questions and Kanji's.		

Total: 45

TEXT BOOK:

1.	"MINNA NO NIHONGO–Japanese for Everyone", 2nd Edition, Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2017.

REFERENCES:

1.	Margherita Pezzopane, "Try N5", 2nd Edition, Tankobon Softcover, Japan, 2017.
2.	Sayaka Kurashina, "Japanese Word Speedmaster", 2nd Edition, Tankobon Softcover, Japan, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	read and Understand Relationship of a Person.	Remembering (K1)
CO2	understand Conversations Used in Everyday Activities.	Understanding (K2)
CO3	comprehend Contents at Near Natural Speed.	Understanding (K2)
CO4	understand the Kanji's in Japanese Script.	Understanding (K2)
CO5	comprehend Orally Presented Materials.	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	2	3		3		
CO2								1	2	3		3		
CO3								1	2	3		3		
CO4								1	2	3		3		
CO5								1	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	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

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

20GEO11 - NCC Studies(Army Wing) – I

(Offered by Department of Electrical and Electronics Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	5 / 6	OE	3	0	2	4

Preamble	This course is designed especially for NCC Cadets. This course will help develop character, camaraderie, discipline, secular outlook, the spirit of adventure, sportsman spirit and ideals of selfless service amongst cadets by working in teams, learning military subjects including weapon training.	
Unit - I	**NCC Organisation and National Integration:**	**9**
NCC Organisation – History of NCC- NCC Organisation- NCC Training- NCC Uniform – Promotion of NCC cadets – Aim and advantages of NCC Training- NCC badges of Rank- Honours and Awards – Incentives for NCC cadets by central and state govt. National Integration- Unity in diversity- contribution of youth in nation building- national integration council- Images and Slogans on National Integration.		
Unit - II	**Basic physical Training and Drill:**	**9**
Basic physical Training – various exercises for fitness(with Demonstration)-Food – Hygiene and Cleanliness. Drill- Words of commands- position and commands- sizing and forming- saluting- marching- turning on the march and wheeling- saluting on the march- side pace, pace forward and to the rear- marking time- Drill with arms- ceremonial drill- guard mounting.(WITH DEMONSTRATION)		
Unit - III	**Weapon Training:**	**9**
Main Parts of a Rifle- Characteristics of 5.56mm INSAS rifle- Characteristics of .22 rifle- loading and unloading – position and holding- safety precautions – range procedure- MPI and Elevation- Group and Snap shooting- Long/Short range firing(WITH PRACTICE SESSION) - Characteristics of 7.62mm SLR- LMG- carbine machine gun.		
Unit - IV	**Social Awareness and Community Development:**	**9**
Aims of Social service-Various Means and ways of social services- family planning – HIV and AIDS- Cancer its causes and preventive measures- NGO and their activities- Drug trafficking- Rural development programmes - MGNREGA-SGSY-JGSY-NSAP-PMGSY-Terrorism and counter terrorism- Corruption – female foeticide -dowry –child abuse-RTI Act- RTE Act- Protection of children from sexual offences act- civic sense and responsibility		
Unit - V	**Specialized Subject (ARMY):**	**9**
Basic structure of Armed Forces- Military History – War heroes- battles of Indo-Pak war- Param Vir Chakra- Career in the Defence forces- Service tests and interviews-Fieldcraft and Battlecraft-Basics of Map reading including practical.		

Lecture :45, Practical:30, Total:75

TEXT BOOK:

1.	"National Cadet Corps- A Concise handbook of NCC Cadets", Ramesh Publishing House, New Delhi, 2014.

REFERENCES:

1.	"Cadets Handbook – Common Subjects SD/SW", published by DG NCC, New Delhi.
2.	"Cadets Handbook- Specialized Subjects SD/SW", published by DG NCC, New Delhi.
3.	"NCC OTA Precise", published by DG NCC, New Delhi.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	display sense of patriotism, secular values and shall be transformed into motivated youth who will contribute towards nation building through national unity and social cohesion.	Applying (K3)
CO2	demonstrate Health Exercises, the sense of discipline, improve bearing, smartness, turnout, develop the quality of immediate and implicit obedience of orders..	Applying (K3)
CO3	basic knowledge of weapons and their use and handling.	Applying (K3)
CO4	understanding about social evils and shall inculcate sense of whistle blowing against such evils and ways to eradicate such evils	Applying (K3)
CO5	acquaint, expose & provide knowledge about Army/Navy/ Air force and to acquire information about expansion of Armed Forces, service subjects and important battles.	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	3	3				
CO2					3									
CO3	3	2	1	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	-	-	-	-	-	-	-
CAT2	-	-	-	-	-	-	-
CAT3	-	-	-	-	-	-	-
ESE	The examination and award of marks will be done by the Ministry of Defence, Government of India which includes all K1 to K6 knowledge levels. The maximum marks for the End Semester Examination is 500 marks. It will be converted to 100 marks.						

20GEO12 - NCC STUDIES (AIR WING) – I
(Offered by Department of Information Technology)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5 / 6	OE	3	0	2	4

Preamble	This course is designed especially for NCC Cadets. This course will help develop character , camaraderie, discipline, secular outlook, the spirit of adventure, sportsman spirit and ideals of selfless service amongst cadets by working in teams, honing qualities such as self-discipline, self-confidence, self-reliance and dignity of labour in the cadets.	
Unit – I	**NCC Organization and National Integration:**	**9**
NCC Organization – History of NCC- NCC Organization- NCC Training- NCC Uniform – Promotion of NCC cadets – Aim and advantages of NCC Training- NCC badges of Rank- Honors' and Awards – Incentives for NCC cadets by central and state govt. History and Organization of IAF-Indo-Pak War-1971-Operation Safed Sagar. National Integration- Unity in diversity- contribution of youth in nation building- national integration council- Images and Slogans on National Integration.		
Unit – II	**Drill and Weapon Training:**	**9**
Drill- Words of commands- position and commands- sizing and forming- saluting- marching- turning on the march and wheeling- saluting on the march- side pace, pace forward and to the rear- marking time- Drill with arms- ceremonial drill- guard mounting.(WITH DEMONSTRATION). Main Parts of a Rifle- Characteristics of .22 rifle- loading and unloading – position and holding- safety precautions – range procedure- MPI and Elevation- Group and Snap shooting- Long/Short range firing (WITH PRACTICE SESSION).		
Unit – III	**Principles of Flight:**	**9**
Laws of motion-Forces acting on aircraft–Bernoulli's theorem-Stalling-Primary control surfaces – secondary control surfaces-Aircraft recognition.		
Unit - IV	**Aero Engines:**	**9**
Introduction of Aero engine-Types of engine-piston engine-jet engines-Turboprop engines-Basic Flight Instruments-Modern trends.		
Unit – V	**Aero Modeling:**	**9**
History of aero modeling-Materials used in Aero-modeling-Types of Aero-models – Static Models-Gliders-Control line models-Radio Control Models-Building and Flying of Aero-models.		

Lecture :45, Practical30, Total:75

TEXT BOOK:

1	"National Cadet Corps- A Concise handbook of NCC Cadets" by Ramesh Publishing House, New Delhi,2014.

REFERENCES:

1	"Cadets Handbook – Common Subjects SD/SW" by DG NCC, New Delhi.
2	"Cadets Handbook – Specialised Subjects SD/SW" by DG NCC, New Delhi.
3	"NCC OTA Precise" by DGNCC, New Delhi.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	display sense of patriotism, secular values and shall be transformed into motivated youth who will carry out nation building through national unity and social cohesion.	Applying (K3)
CO2	demonstrate the sense of discipline with smartness and have basic knowledge of weapons and their use and handling	Applying (K3)
CO3	illustrate various forces and moments acting on aircraft	Applying (K3)
CO4	outline the concepts of aircraft engine and rocket propulsion	Applying (K3)
CO5	design, build and fly chuck gliders/model airplanes and display static models.	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	3	3				
CO2					3									
CO3	3	2	1	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	-	-	-	-	-	-	-
CAT2	-	-	-	-	-	-	-
CAT3	-	-	-	-	-	-	-
ESE	The examination and award of marks will be done by the Ministry of Defence, Government of India which includes all K1 to K6 knowledge levels. The maximum marks for the End Semester Examination is 500 marks. It will be converted to 100 marks.						

20GEO13 - FRENCH LANGUAGE LEVEL 1

Programme & Branch	**All Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Fundamentals of French Language**	**5/6/7/8**	**HS**	**3**	**1**	**0**	**4**

Preamble	This course provides a foundation of the French language as well as an understanding of the French culture and lifestyle of France and other French-speaking nations. The student will be learning how to introduce him/herself and acquire basic everyday vocabulary. By following the structured curriculum and practicing the same as per the learning process, one can comprehend the structure of sentences and respond to basic communications.	
Unit - I	**Introduction:**	**12**
French and French culture, alphabets, pronunciation, accents, rules, and terms for pronunciation (mas-fem),Salutations, numbers.		
Unit - II	**Daily Life:**	**12**
Subject Pronoun, Francophonie's, adjectives – colors, week, months, seasons.		
Unit - III	**Articles and Verbs:**	**12**
Articles - Indefinite, definite, partitive, and contracted, (examples), introductions to verbs, 1st group of verb		
Unit - IV	**In the City:**	**12**
2nd group of verbs, irregular verbs (avoir, etre, faire …..) present yourself & negative sentences. (faire and Jouer verb with the expressions)		
Unit - V	**Food and Culture:**	**12**
Prepositions – preposition of places (country, cities and etc), Imperative mode, invitations, culture – food (wine, cheese ….) Future (recent future)		

Total:60

TEXT BOOK:

1.	A1 – saison

REFERENCES:

1.	Apprenons les francais – 0 and 1
2.	Grammaire – langue et de civilization francaises – Mauger G
3.	.Les idees – 0 and 1

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand the grammatical structure of the language and introduce self to others.	Remembering (K1)
CO2	understand basic verbs and appropriate vocabulary.	Understanding (K2)
CO3	ask for directions and arrange for transportation, etc,as needed.	Understanding (K2)
CO4	understand the food habits of France and ask for appointments	Understanding (K2)
CO5	learn to socialize in French-speaking countries	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	2	3		3		2
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	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	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

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

20GEO14 - FRENCH LANGUAGE LEVEL 2

Programme & Branch	All Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Fundamentals of French Language	5/6/7/8	HS	3	1	0	4

Preamble	This course is designed to assist students in developing vocabulary in accordance with the Common European Framework of Reference for Languages at the A2 level. This course will aid in the integration of basic grammar structures as well as the acquisition of vocabulary necessary to comprehend and respond in everyday circumstances. The learner will be able to develop a thorough comprehension of French grammar and confidently express themselves in everyday circumstances.	
Unit - I	**French and You:**	**12**
Habits, Strengths & Weakness, Recommendations, Sentiments, Motivations, about favorite films and Types of screens in the movie world, Verbs (Regulars and irregulars), Reflexive Verbs, Prepositions		
Unit - II	**Eat and Repeat:**	**12**
Favorite foods, Recopies, Types of meals, Describing House and Kitchen, Presentation of the recipe, Comparatives, Possessive pronouns, Present continuous tense, Simple conditional form		
Unit - III	**Vacation:**	**12**
Invitations, presentation, Greetings, Goodbyes, Activities on vacation, past experiences, Describing favorite place, Recommendations on various tours, Past perfect, Past imperfect tense		
Unit - IV	**Likes and Views:**	**12**
Favorite persons & things, Giving advice, Experience, Moods, Illness, Discomforts, Symptoms, Roleplay (Doctor & Patient, Guide & Tourist, Pharmacist & Patient), Past perfect, Past indefinite, Imperative		
Unit - V	**Then and Now:**	**12**
Habits, customs, circumstances of the past and present, Debates on past and present situations and feelings. Past imperfect tense, Past perfect and Present comparatives.		

Total:60

TEXTBOOK:

1.	A2 – Saison

REFERENCES:

1.	Apprenons les francais – 0 and 1
2.	Grammaire – langue et de civilization francaises – Mauger G
3.	.Les idees – 0 and 1

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the French language in deep and its usage	Remembering (K1)
CO2	preparation of their Favorite recipes, Know the Objects used in Kitchen and house.	Understanding (K2)
CO3	converse about their vacation, their Favorite Destination	Understanding (K2)
CO4	understand complex verbs and be able to communicate about their past experiences	Understanding (K2)
CO5	know the difference between Past and Present and Compare them.	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	2	3		3		2
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	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	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

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

20GEO15 - FRENCH LANGUAGE LEVEL 3

Programme& Branch	All Engineering courses	Sem.	Category	L	T	P	Credit
Prerequisites	**Fundamentals of French Language**	**5/6/7/8**	**HS**	**3**	**0**	**0**	**3**

Preamble	This course gives knowledge regarding a variety of personal and professional circumstances, as well as improving vocabulary and speaking abilities to reply to and seek information in those settings. It also gives you the ability to articulate yourself and arrange appointments.With perseverance, one can master all of the essential grammatical structures needed to respond confidently in everyday circumstances. It almost gives you an idea of how Natives communicate.	
Unit - I	**Start Over:**	**9**
Use of periphrases, Discuss a day in life, work, problems in the world, Predictions about the future (actions and situations), Hypothetical situations, Imperfect and future tense.		
Unit - II	**Prohibitions and More:**	**9**
Prohibitions, Obligations, Habits to change, social customs, Use of the subjunctive, Describe synopsis of Movie and its relation to real life, Debate on books vs movies, usage of connectors, Object Direct and Indirect.		
Unit - III	**Let's be Creative:**	**9**
Write a letter by describing the problem, talk about desires and Necessities, propose solutions, Recommendations and Suggestions, Create an Advertisement, Give Instructions, Imperative negative, Use of Object Direct, and Indirect.		
Unit - IV	**Travel and Communication:**	**9**
Talk about Tours, Types of tourism and communication, Send messages, petitions, Talk to people on the telephone, Roleplay (Tourists and Guide, Tourists and Travel agents), Past Pluscumperfect, All Past tenses.		
Unit - V	**Let's Talk:**	**9**
Expression of Interests, Sentiments, Feelings, Sensations, Manias etc. Certain suggestions to make a better future, the use of superlatives, Exclamatory phrases, subjunctives.		

Total:45

TEXT BOOK:

1.	B1 – Saison

REFERENCES:

1.	Apprenons les francais – 0 and 1
2.	Grammaire – langue et de civilization francaises – Mauger G
3.	.Les idees – 0 and 1

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	learn on Future tense.	Remembering (K1)
CO2	understand Permissions and Prohibitions.	Understanding (K2)
CO3	know about Letter writing, Creating Ads, Expressing Desires, and Instructing Others.	Understanding (K2)
CO4	understand rules for travel and Enhancing communications.	Understanding (K2)
CO5	express the feelings and emotions using advanced grammar	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	2	3		3		2
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	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	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

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

20GEO16 - SPANISH LANGUAGE LEVEL 1

Programme & Branch	**All Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Fundamentals of Spanish Language**	**5/6/7/8**	**HS**	**3**	**1**	**0**	**4**

Preamble	This course provides a foundation of the Spanish language as well as an understanding of the Spanish culture and lifestyle of Spain and other Spanish-speaking nations. The student will be learning how to introduce him/herself and acquire basic everyday vocabulary. By following the structured curriculum and practicing the same as per the learning process, one can comprehend the structure of sentences and respond to basic communications.	
Unit - I	**Greetings and Good byes (Los Saludos y Despidirse):**	**12**
Greetings,Self-Introduction , Formal and Informal ways of introducing oneself and others, Alphabets& Numbers, Countries and Languages Spoken, Parts of Grammar – Noun, Personal Pronoun, Describe surroundings and its vocabulary		
Unit - II	**Vida Cotidiana (Daily Life):**	**12**
Time of the day, Days of the week, Months of the year, Seasons, Verb (To be, To Have), Adverbs, Likes and Dislikes, Personality and physical description, simple sentences		
Unit - III	**Friends and Family (Amigos y La Familia):**	**12**
Vocabulary of family, Animals, Professions, Parts of the body, Opinions on family cultures, Articles – Definite and Indefinite, Hobbies, Regular and Irregular verbs.		
Unit - IV	**In the City (En la Cuidad):**	**12**
Buildings in the city, Name of the places, asking for directions, Helping each other, Description of house and its components, Modes of Transport, Grammar - Possessive articles, prepositions		
Unit - V	**Food and Culture(La comida y cultura):**	**12**
Food (types and varieties) , shopping, ordering at a restaurant, inviting to parties, Roleplay (as diner and customer, salesman and customer…etc.) Past tense (all three tenses-Past Participle, Indefinite past and past imperfect- (to be and to have)		

Total:60

TEXT BOOK:

1.	Chicos Chicas Libro de Alumno nivel 1, Ma Angeles Palomino , edelsa, GRUPO DIDASCALIA, S.A., plaza cuidad de salta,3-28043 MADRID(ESPANA).

REFERENCES:

1.	https://nuevadelhi.cervantes.es/en/spanish_courses/students/spanish_general_courses/spanish_courses_level_a1.htm

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the grammatical structure of the language and introduce self to others.	Remembering (K1)
CO2	understand basic verbs and appropriate vocabulary.	Understanding (K2)
CO3	ask for directions and arrange for transportation, etc, as needed.	Understanding (K2)
CO4	understand the food habits of Spain and Latin countries and ask for appointments	Understanding (K2)
CO5	learn to socialize in Spanish speaking countries	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	2	3		3		2
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	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	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

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

20GEO17 - SPANISH LANGUAGE LEVEL 2

Programme & Branch	All Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	**Fundamentals of Spanish Language**	**5/6/7/8**	**HS**	**3**	**1**	**0**	**4**

Preamble	This course aims to help the Learner to acquire the vocabulary as per the framework of Spanish language A2 level competence. This course will help to assimilate the basic grammar structures and gain vocabulary to understand and reciprocate in daily life situations on a broader sense. A thorough learner will be able to gain a comprehensive understanding of the Spanish grammar and confidently articulate in day today situations.	
Unit - I	**Spanish and You (El Español y tú):**	**12**
Habits, Strengths & Weakness, Recommendations, Sentiments, Motivations, About favorite films and Types of screens in the movie world, Verbs(Regulars and irregulars), Reflexive Verbs, Prepositions		
Unit - II	**Eat and Repeat (Comer y repetir):**	**12**
Favorite foods, Recipies, Types of meals, Describing House and Kitchen, Presentation of recipe, Comparatives, Possessive pronouns, Present continuous tense, Simple conditional form		
Unit - III	**Its Vacation Time (Tiempo de vacaciones):**	**12**
Invitations, presentation, Greetings, Goodbyes, Activities on vacation, past experiences, Describing favorite place, Recommendations on various tours, Past perfect, Past imperfect tense, Usage of Todavia or No		
Unit - IV	**Likes and Views (Gustasyvistas):**	**12**
Favorite persons & things, Giving advices, Experience, Moods, Illness, Discomforts, Symptoms, Roleplay (Doctor & Patient, Guide & Tourist, Pharmacist & Patient), Past perfect, Past indefinite, Imperative		
Unit - V	**Then** and Now(Antes y Ahora):	**12**
Habits, customs, circumstances of the past and present, Debates on past and present situations and feelings. Past imperfect tense, Past perfect and Present comparatives.		

Total:60

TEXT BOOK:

1.	AULA INTERNACIONAL 2 (A2), Jaime Corpas, Agusin Garmendia, Nuria Sanchez, Carmen Soriano Goyal Publishers and Distributors Pvt LTD, 86, UB Jawahar Nagar, Kamla Nagar, Delhi-110007.

REFERENCES:

1.	https://nuevadelhi.cervantes.es/en/spanish_courses/students/spanish_general_courses/spanish_courses_level_a1.htm

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the Spanish language in deep and its usage	Remembering (K1)
CO2	preparation of their Favorite recipes, Know the Objects used in Kitchen and house.	Understanding (K2)
CO3	converse about their vacation, their Favorite Destination	Understanding (K2)
CO4	understand complex verbs and be able to communicate about their past experiences	Understanding (K2)
CO5	know the difference between Past and Present and Comparing them.	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	2	3		3		2
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	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	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

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

20GEO18 - SPANISH LANGUAGE LEVEL 3

Programme & Branch	All Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Fundamentals of Spanish Language	5/6/7/8	HS	3	0	0	3

Preamble	This course provides enriching information about various everyday situations in personal and professional life and enhances the vocabulary and speaking ability to respond to and also seek information in those situations. It also equips one to express opinions and negotiate appointments. With diligent learning one can capture all basic grammatical structure to answer confidently in everyday situations. It almost gives a basic idea on how Natives speak.	
Unit - I	**Start Over(Volver a Empezar):**	**9**
Use of periphrases, Discuss a day in life, work, problems in the world, Predictions about future (actions and situations),Hypothetical situations, Imperfect and future tense.		
Unit - II	**Prohibitions and More(Prohibiciones y mas):**	**9**
Prohibitions, Obligations, Habits to change, social customs, Use of subjunctive, Describe synopsis of Movie and its relation to real life, Debate on books vs movies, usage of connectors, Object Direct and Indirect.		
Unit - III	**Let's be Creative (Seamos creatives):**	**9**
Write a letter by describing the problem,talk about desires and Necessities, propose solutions, Recommendations and Suggestions, Create an Advertisement, Give Instructions, Imperative negative, Use of Object Direct and Indirect.		
Unit - IV	**Travel and Communication (Viajar y comunicar):**	**9**
Talk about Tours, Types of tourism and communication, Send messages, petitions, Talk to people on telephone, Role play(Tourists and Guide, Tourists and Travel agents), Past Pluscumperfect, All Past tenses.		
Unit - V	**Let's Talk(Hablemos):**	**9**
Expression of Interests, Sentiments, Feelings, Sensations, Manias etc. Certain suggestions to make a better future, use of superlatives, Exclamatory phrases, subjunctive.		

Total:45

TEXT BOOK:

1.	AULA INTERNACIONAL 3 (B1) [Paperback] Jaime Corpas, Agusin Garmendia, Nuria Sanchez, Carmen Soriano Goyal Publishers and Distributors Pvt LTD, 86, UB Jawahar Nagar, Kamla Nagar, Delhi-110007.

REFERENCES:

1.	https://nuevadelhi.cervantes.es/en/spanish_courses/students/spanish_general_courses/spanish_courses_level_a1.htm

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	learn on Future tense.	Remembering (K1)
CO2	understand about Permissions and Prohibitions.	Understanding (K2)
CO3	know about Letter writing, Creating Ads, Expressing Desires and Instructing Others.	Understanding (K2)
CO4	understand rules for travel and Enhance communications.	Understanding (K2)
CO5	express the feelings and emotions using advanced grammar	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	2	3		3		2
CO2								1	2	3		3		2
CO3								1	2	3		3		2
CO4								1	2	3		3		2
CO5								1	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	75	25					100
CAT2	25	75					100
CAT3	25	75					100
ESE	25	75					100

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

20GEO19 - ENTREPRENEURSHIP DEVELOPMENT

(Offered by Department of Mechatronics Engineering)

Programme & Branch	All BE/BTech Engineering and Technology Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Economics and Management for Engineers	6	EC	3	0	0	3

Preamble	The purpose of this course to create entrepreneurial awareness among engineering students.	
Unit - I	**Entrepreneurship Concepts:**	**9**
Entrepreneurship & Entrepreneur- Role in Economic Development - Factors affecting Entrepreneurship- Creativity and Innovation - Entrepreneurship vs Intrapreneurship- Entrepreneurial Motivation factors – Types of Entrepreneurship & Entrepreneurs - Characteristics of Entrepreneurs - Entrepreneurship Development in India		
Unit - II	**Entrepreneurial Ventures and opportunity assessment:**	**9**
New venture creation – Bootstrapping, Minipreneurship, Start-ups, Acquiring, Franchising & Social venturing - Venture development stages - Models of market opportunity- Opportunity assessment: Critical Factors In Opportunity Assessment, Idea vs Opportunity, Evaluation process, Global opportunities for entrepreneurs.		
Unit - III	**Business Plan:**	**9**
Designing Business Model- Business Model Canvas- Objectives of a Business Plan - Business Planning Process – Structure of a Business Plan – Technical, Marketing, Financial Feasibility assessment - Competitive analysis - Common errors in Business Plan formulation - Presentation of the Business Plan: The 'Pitch'- case studies		
Unit - IV	**Financing and accounting:**	**9**
Forms of entrepreneurial capital – Sources of Financial capital: debt financing- Commercial banks and other sources, equity financing: Initial Public offering (IPO), Private placement - Venture capitalists - Angel investors-New forms of financing: Impact investors, Micro-financing, Peer-to-Peer Lending, Crowd funding - Natural capital. Preparing Financial Budget, Break even analysis, Taxation-Direct and indirect taxes, Insolvency and Bankruptcy.		
Unit - V	**Small Business Management:**	**9**
Definition of Small Scale Industries: Strengths and Weaknesses, Sickness in Small Enterprises: Symptoms -Causes and remedies- Indian Startup Ecosystem – Institutions supporting small business enterprises, Business Incubators – Government Policy for Small Scale Enterprises - Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger, FDI and Sub-Contracting		

Total:45

TEXT BOOK:

1.	Donald F. Kuratko,"Entrepreneurship: Theory, Process, Practice", 11th Edition, Cengage Learning, Boston, 2020.

REFERENCES:

1.	Robert D. Hisrich, Michael P. Peters & Dean A. Shepherd, Sabyasachi Sinha "Entrepreneurship", 11th Edition, McGraw Hill, Noida, 2020.
2.	Charantimath Poornima .M, "Entrepreneurship Development and Small Business Enterprises", 3rd Edition, Pearson Education, Noida, 2018.
3.	Gordon E & Natarajan K, "Entrepreneurship Development", 6th Edition, Himalaya Publishing House, Mumbai, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the importance of entrepreneurship and demonstrate the traits of an entrepreneur	Applying (K3)
CO2	identify suitable entrepreneurial ventures and business opportunity	Applying (K3)
CO3	assess the components of business plan	Analyzing (K4)
CO4	appraise the sources of finance and interpret accounting statements	Applying (K3)
CO5	interpret the causes of sickness of small scale enterprises and its remedies	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	2	1	1		3	2		1
CO2	1	2	2	2		2	2	1	1		3	2		2
CO3	2	2	2	2	2	2	2	2	2	2	3	2		1
CO4	1	1	2	1		2	1	1	1	2	3	2		1
CO5	1	1	2	1		2	1	1	1	2	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	30	30	20			100
CAT3	30	30	40				100
ESE	20	30	40	10			100

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

20MAO01 - MATHEMATICAL FOUNDATIONS FOR MACHINE LEARNING

(Common to all Engineering and Technology Branches)

Programme & Branch	All Engineering and Technology branches	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**4**	**OE**	**3**	**1**	**0**	**4**

Preamble	To impart the basic knowledge in linear algebra, decomposition of matrices, continuous optimization, linear regression and support vector machines which provide the foundations for machine learning and deep learning.	
Unit - I	**Vector Spaces:**	**9+3**
Definition – Subspaces – Linear dependence and independence – Basis and dimension – Row space, Column space and Null Space – Rank and nullity.		
Unit - II	**Linear Transformations:**	**9+3**
Introduction – Kernel and range – Matrices of linear transformations – Change of basis – Rank and nullity.		
Unit - III	**Inner Product Spaces:**	**9+3**
Norms – Inner products – Length and Distance – Angle and Orthogonality – Orthonormal Basis – Gram-Schmidt Process – QR-Decomposition – Orthogonal Projection – Rotations.		
Unit - IV	**Matrix Decomposition and Continuous Optimization:**	**9+3**
Matrix Decomposition: Cholesky decomposition – Singular Value Decomposition. Continuous Optimization: Introduction – Unconstrained Optimization – Gradient Descent method – Constrained Optimization – Lagrange Multipliers method – Convex Optimization.		
Unit - V	**Linear regression and Support Vector Machines:**	**9+3**
Linear Regression: Parameter Estimation – Maximum Likelihood estimation – Bayesian linear regression. Support Vector Machines: Introduction – Linear and Non-linear Support vector machine – Margin and support vectors – Hard and Soft margins in Support vector machines – Kernels – Primal support vector machine – Dual support vector machine.		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Howard Anton and Chris Rorres, “Elementary Linear Algebra”, 11th Edition, John Wiley & Sons, New Delhi, 2014 for Units I, II & III.
2.	M. P. Deisenroth, A. A. Faisal, and C. S. Ong, “Mathematics for Machine Learning”, 1st Edition Cambridge University Press, 2019 for Units IV & V.

REFERENCES:

1.	David C. Lay, Steven R. Lay, Judith McDonald, "Linear Algebra and its Applications", 5th Edition, Pearson Education, New Delhi, 2016.
2.	EthemAlpaydin, “Introduction to Machine Learning (Adaptive Computation and Machine Learning series)”, 4th Edition, MIT Press, USA, 2020.
3.	R. O. Duda, E. Hart, and D.G. Stork, "Pattern classification", 2nd Edition, John Wiley & Sons,2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the concepts of vector spaces.	Understanding (K2)
CO2	apply the concepts of linear mappings in machine learning.	Applying (K3)
CO3	understand the concept of inner product space and decompose the given matrix by means of orthonormal vectors.	Understanding (K2)
CO4	apply the knowledge of factorisation of matrices and optimization techniques in clustering and classification of data.	Applying (K3)
CO5	describe the concepts of parameter estimation and support vector machine.	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	1												
CO2	3	1												
CO3	3	2												
CO4	3	3		1	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	50	40				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	5	25	70				100

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

20MAO02 - GRAPH THEORY AND ITS APPLICATIONS

(Common to all Engineering and Technology branches)

Programme & Branch	All Engineering and Technology branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	4	OE	3	1	0	4

Preamble	To develop rigorous logical thinking and analytical skills by graph theoretic concepts which helps for solving real time engineering problems in networks, computer architecture, compiling techniques, model checking, artificial intelligence, software engineering, expert systems, software/hardware correctness problem.	
Unit - I	**Graphs:**	**9+3**
Introduction – Definition – Types of graphs – Degree of vertex – Walk, path and cycle – Isomorphism – Connected graph – Hamiltonian graph – Euler graph – Digraph – Representations of graphs: Adjacency matrix – Incidence matrix.		
Unit - II	**Trees:**	**9+3**
Introduction – Properties of trees – Pendant vertices in a tree – Distances and centers in a tree – Rooted and binary trees – Spanning tree – Construction of spanning tree: BFS algorithm – DFS algorithm – Finding all spanning trees of a graph – Fundamental circuits.		
Unit - III	**Graph Coloring:**	**9+3**
Introduction – Properties of trees – Pendant vertices in a tree – Distances and centers in a tree – Rooted and binary trees – Spanning tree – Construction of spanning tree: BFS algorithm – DFS algorithm – Finding all spanning trees of a graph – Fundamental circuits.		
Unit - IV	**Network Flows and Applications:**	**9+3**
Flows and cuts in networks - Max-flow Min-cut Theorem – Transport networks –Residual capacity and Residual network – Ford-Fulkerson Algorithm – Edmonds-Karp Algorithm – Maximal Flow Applications: Multiple sources and sinks – Maximum Bipartite matching.		
Unit - V	**Graph Theoretic Algorithms:**	**9+3**
Shortest paths – Shortest path algorithms: Dijkstra's algorithm – Warshall's algorithm – The Chinese Postman Problem – Fleury's Algorithm – Travelling salesman problem – Minimum Spanning tree – Minimal spanning tree algorithms: Prim's algorithm – Krushkal's algorithm – Optimal assignment – Kuhn and Munkres algorithm.		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1. NarsinghDeo, "Graph Theory with Applications to Engineering and Computer Science", 1st Edition, Dover Publications, New York, 2016, for Units I, II & III.
2. S. Saha Ray, "Graph Theory with Algorithms and Its Applications in Applied Science and Technology", 1st Edition, Springer, London, 2013, for Units IV & V.

REFERENCES:

1. Douglas B West, "Introduction to Graph Theory", 2nd Edition, Pearson Education, New Delhi, 2002.
2. Jonathan L. Gross and Jay Yellen, "Graph Theory and its Applications", 2nd Edition, CRC Press, New York, 2006.
3. J.A.Bondy and U.S.R. Murty ,Graph Theory and Applications , 5th Edition, Elsevier Science Publishing Co., Inc., New York,1982.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand basic graph theoretic concepts.	Understanding (K2)
CO2	intrepret the concepts the concepts of tress and its types.	Applying (K3)
CO3	compute the Chromatic partition, Chromatic polynomial and Matching of a given graph.	Applying (K3)
CO4	identify the maximal flow in network by means of algorithms.	Applying (K3)
CO5	apply various graph theoretic algorithms to communication and network 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											
CO2	3	1												
CO3	3	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	10	50	40				100
CAT2	10	30	60				100
CAT3	10	20	70				100
ESE	10	35	55				100

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

20MAO03 - DATA ANALYTICS USING R PROGRAMMING
(Common to all Engineering and Technology Branches)

Programme & Branch	**All Engineering and Technology branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**0**	**0**	**3**

Preamble	To impart the basic knowledge in R and develop skills to apply the knowledge of R programming to statistical measures, data handling, probability, testing of hypothesis and design of experiments.	
Unit - I	**Introduction to R:**	**9**
Overview of R programming – Need for R – Installing R – Environment setup with R Studio – Packages: Installing packages – Running and manipulating packages – Basic objects: Vectors – Matrix – Array – Lists – Factors – Data frames.		
Unit - II	**R Programming Structures and Functions:**	**9**
Basic expressions: Arithmetic expressions – Control Statements: if and if-else statements –– switch statement – Loops: for loop – while loop – Function: Creating a function – calling a function – Default value for function arguments – Logical functions – Math functions – Statistical functions – Apply-family functions – Getting started with strings – Formatting data and time.		
Unit - III	**Descriptive Statistics:**	**9**
Summary command – Summarizing samples – cumulative statistics – summary statistics for data frames – summary tables – Linear Modeling: Simple linear regression – Multiple regression – Curvilinear regression – Plotting linear models and curve fitting.		
Unit - IV	**Working with data:**	**9**
Reading and writing data: Text-format in a file – Excel worksheets – Native data files – built-in datasets. Visualizing data: Scatter plots – line plots – bar charts – pie charts – Cleveland dot charts –Histogram and density plots – Box-whisker plots.		
Unit - V	**Probability Distributions, Testing of hypothesis and ANOVA:**	**9**
Probability Distributions: Binomial Distribution – Poisson Distribution – Normal Distribution. Testing of Hypothesis and ANOVA: Student's t-test – Non-Parametric tests: Wilcoxon U-test – Paired t and U-tests – Correlation and covariance – Tests for association – Analysis of variance: One-way ANOVA – Two-way ANOVA.		

Total: 45

TEXT BOOK:

1.	Kun Ren, "Learning R Programming", 1st Edition, Packt Publishing Ltd, UK, 2016, for Units I, II.
2.	Mark Gardener, "Beginning R-The Statistical Programming Language",1st Edition, John Wiley & Sons Inc., USA, 2012 for Units III, IV & V.

REFERENCES:

1.	Seema Acharya, "Data Analytics using R", 1st Edition, McGraw Hill Education, Chennai, 2018.
2.	Norman Matloff, "The Art of R Programming", 1st Edition, No Starch Press, San Francisco, 2011.
3.	Paul Teetor, "R Cookbook", 1st Edition, O'Reilly Media, USA, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the basics of fundamentals of R.	Understanding (K2)
CO2	understand the concepts of decision, looping structures and functions.	Understanding (K2)
CO3	apply R programming to descriptive statistics.	Applying (K3)
CO4	apply the libraries for data manipulation and data visualization in R.	Applying (K3)
CO5	use R studio to identify the probability and test statistical hypothesis.	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	1	1											
CO2	3	1	1		2									
CO3	3	2	2	2	2									
CO4	3	3	2	3	2									
CO5	3	2	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	10	40	50				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)**

20MAO04 - NUMBER THEORY AND CRYPTOGRAPHY

(Common to all Engineering and Technology branches)

Programme & Branch	**All Engineering and Technology branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**0**	**0**	**3**

Preamble	To provide the skills for applying various number theoretic algorithms, congruences, primality tests in cryptography and network security and impart knowledge of basic cryptographic techniques.	
Unit - I	**Divisibility Theory and Canonical Decompositions:**	**9**
Division algorithm- Base-b representations – number patterns – Prime and composite numbers – Fibonacci and Lucas numbers – Fermat numbers – GCD – Euclidean Algorithm – Fundamental theorem of Arithmetic – LCM.		
Unit - II	**Theory of Congruences:**	**9**
Basic concepts – Properties of congruences – Linear congruences – Solution of congruences – Fermat's Little theorem – Euler's theorem – Chinese remainder theorem.		
Unit - III	**Number Theoretic Functions:**	**9**
Introduction – Functions τ and σ – Mobius function – Greatest integer function – Euer's Phi function – Euler's theorem – Properties of Euler's function – Applications to Cryptography.		
Unit - IV	**Primality testing and Factorization:**	**9**
Primality testing: Fermat's pseudo primality test – Solvay-Strassen test – Miller-Rabin test – Fibonacci test – Lucas test – Integer factorization: Trial division – Pollard's Rho method – Quadratic sieve method.		
Unit - V	**Classical Cryptographic Techniques:**	**9**
Introduction – Substitution techniques – Transposition techniques – Encryption and decryption – Symmetric and asymmetric key cryptography – Steganography.		

Total: 45

TEXT BOOK:

1.	Thomas Koshy, "Elementary Number Theory with Applications", 2nd Edition, Academic Press, Elsevier, USA, 2007, for Units I,II,III.
2.	William Stallings, "Cryptography and Network Security: Principles and Practice", 7th Edition, Pearson Education, New Delhi, 2019, for Units IV,V.

REFERENCES:

1.	Ivan Niven, Herbert S. Zukerman, Hugh L. Montgomery, "An Introduction to the Theory of Numbers", Reprint Edition, John Wiley & Sons, New Delhi, 2008.
2.	Bernard Menezes, "Cryptography and Network Security", Cengage Learning India, 1st Edition, New Delhi, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the concepts of divisibility and canonical decompositions	Understanding (K2)
CO2	obtain the knowledge in theory of congruences and solution of linear congruences.	Understanding (K2)
CO3	use different number theoretic function suitably in cryptography.	Applying (K3)
CO4	apply Primality test and factorisation algorithms to network security problems.	Applying (K3)
CO5	apply the suitable cryptographic techniques to handle real time security issues.	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												
CO2	3	1												
CO3	3	1												
CO4	3	2	1		2									
CO5	3	2	1		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	30	60				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)**

20MAO05 -ADVANCED LINEAR ALGEBRA

(Common to all Engineering and Technology branches)

Programme & Branch	All Engineering and Technology branches	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**8**	**OE**	**3**	**0**	**0**	**3**

Preamble	To provide the skills for solving linear equations, decomposition of matrices and linear transformations in real time engineering problems and impart knowledge of vector spaces.	
Unit - I	**Linear Equations:**	**9**
System of linear equations – Row reduction and echelon forms – Vector equations – Matrix equations – Solution sets of linear systems – Applications of Linear systems: Matrix operations – inverse of a matrix, Matrix factorization – Applications to computer graphics.		
Unit - II	**Vector Spaces:**	**9**
Definition – Subspaces – Linear independence – Basis and dimension – Row space, Column space and Null Space – Rank and nullity.		
Unit - III	**Inner Product Spaces:**	**9**
Inner products – Angle and Orthogonality in inner product spaces – Orthonormal Bases – Gram-Schmidt Process – QR-Decomposition – Orthogonal Projection – Least square technique.		
Unit - IV	**Linear Transformations:**	**9**
General linear transformation – Kernel and range – Matrices of linear transformations – Change of basis – Rank and nullity.		
Unit - V	**Quadratic form and Matrix Decomposition:**	**9**
Quadratic forms – Quadratic surfaces – Hermitian, Unitary and Normal matrices – LU decomposition – Singular value decomposition.		

Total: 45

TEXT BOOK:

1.	Howard Anton and Chris Rorres, “Elementary Linear Algebra”, 11th Edition, John Wiley & Sons, New Delhi, 2014.

REFERENCES:

1.	David C. Lay, Steven R. Lay, Judith McDonald, "Linear Algebra and its Applications", 5th Edition, Pearson Education, New Delhi, 2016.
2.	Gareth Williams, “Linear Algebra with Applications”, 9th Edition, Jones & Bartlett Publishers, Canada, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply the concepts of matrices and vectors in solving the system of linear equations.	Applying (K3)
CO2	understand the concept of vector spaces.	Understanding (K2)
CO3	apply the concept of inner product spaces in orthogonalization.	Applying (K3)
CO4	apply the concepts of linear transformation to engineering problems	Applying (K3)
CO5	apply the knowledge of quadratic forms and matrix decompositions in practical 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											
CO2	3	1												
CO3	3	1	1											
CO4	3	2	1											
CO5	3	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	10	20	70				100
CAT2	10	40	50				100
CAT3	10	20	70				100
ESE	10	30	60				100

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

20MAO06 - OPTIMIZATION TECHNIQUES

(Common to all Engineering and Technology branches)

Programme & Branch	All Engineering and Technology branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	8	OE	3	0	0	3

Preamble	To provide the skills for solving the real time engineering problems involving linear and non-linear problems and also impart knowledge in project management and game theoretic concepts.	
Unit - I	**Linear Programming:**	**9**
Introduction – Formulation of Linear Programming Problem – Basic assumptions – Limitations of Linear Programming models – Standard form of LPP – Graphical Method – Simplex Method – Artificial variable techniques – Big M Method.		
Unit - II	**Transportation and Assignment problems:**	**9**
Transportation problem: Mathematical Formulation of Transportation Problem – Initial basic feasible solution – North West Corner Method – Least Cost Method – Vogel's approximation method – Optimal solution – MODI Method – Degeneracy – Unbalanced transportation problem – Maximization transportation problem. Assignment Problem: Mathematical model of Assignment problem – Hungarian Method – Unbalanced assignment problem.		
Unit - III	**Theory of Games:**	**9**
Two-person zero-sum game – Pure strategies - Game with mixed strategies – Rules of Dominance – Solution methods: Algebraic method – Matrix method – Graphical method.		
Unit - IV	**Network Scheduling:**	**9**
Basic Concept of network Scheduling – Construction of network diagram – Critical path method – Programme evaluation and review technique – Project crashing – Time-cost trade-off procedure.		
Unit - V	**Non-Linear Programming:**	**9**
Formulation of non–linear programming problem – Constrained optimization with equality constraints – Kuhn-Tucker conditions – Constrained optimization with inequality constraints.		

Total: 45

TEXT BOOK:

1.	Hamdy A. Taha, "Operations Research: An Introduction", 10th Edition, Dorling Kindersley, Pvt. Ltd, Uttar Pradesh, 2016.

REFERENCES:

1.	Sharma J.K, "Operations Research – Theory and Applications", 4th Edition, Macmillan Publishers India Ltd, New Delhi, 2009.
2.	Gupta P.K. and Hira D.S., "Operations Research: An Introduction", 6th Edition, S.Chand and Co. Ltd., New Delhi, 2008.
3.	KantiSwarup, Gupta P.K. and Man Mohan, "Operation Research", 14th Edition, Sultan Chand & Sons, New Delhi, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	solve linear programming problems.	Applying (K3)
CO2	apply transportation algorithms in engineering problems	Applying (K3)
CO3	use assignment and game theory concepts in practical situations	Applying (K3)
CO4	handle the problems of Project Management using CPM and PERT	Applying (K3)
CO5	solve various types of Non-linear Programming 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											
CO2	3	1	1											
CO3	3	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	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)**

20PHO01 - THIN FILM TECHNOLOGY

(Common to all Engineering and Technology branches)

Programme & Branch	All BE / BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**4**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course aims to impart the essential knowledge on deposition, characterization and application of thin films in various engineering fields, and also provides motivation towards innovations.	
Unit - I	**Theories and models of thin film growth:**	**9+3**
Introduction - Theories of thin film nucleation: Impingement, Adsorption and Thermal accommodation - The capillarity model - The atomistic models - Structural consequences of thin film nucleation - The four stages of film Growth - The incorporation of defects during growth.		
Unit - II	**Vacuum technology:**	**9+3**
Principle and working of vacuum pumps: Roots vacuum pump, Rotary pump, Diffusion pump, Turbo molecular pump, Cryogenic pump, Ion pump, Ti-sublimation pump - Measurement of Pressure: Bayet-Albert gauge, Pirani and Penning gauge - Cold cathode and hot cathode ionization gauges - Pressure controlling system (qualitative).		
Unit - III	**Deposition of thin films - Physical methods:**	**9+3**
Thermal evaporation – Electron beam evaporation – Pulsed laser deposition – Ion plating – DC sputtering – RF sputtering – Magnetron sputtering – Reactive sputtering - Molecular beam epitaxy - Demonstration of deposition of thin films by RF sputtering.		
Unit - IV	**Deposition of thin films – Chemical methods:**	**9+3**
Chemical vapor deposition – Sol-gel method - Chemical bath deposition - Hydro thermal methods – Electroplating deposition - Electroless deposition - Spray Pyrolysis - Spin coating.		
Unit - V	**Characterization and Applications of thin films:**	**9+3**
Characterization: X-ray diffraction, Energy dispersive X-ray analysis, Atomic probe microscopy, Scanning Tunneling Microscope, X-ray Photoemission Spectroscopy, UV-vis spectroscopy and Four probe resistivity – Applications (qualitative): Thin film solar cells, Thin film gas sensors, Thin films for information storage and Optical coatings.		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Maissel L.I. and Glang R, Hand book of Thin Film Technology, Reprint, McGraw Hill Inc., New York, 1970 for Units I, II, III & IV.
2	Sam Zhang, Lin Li and Ashok Kumar, Materials Characterization Techniques, 1st edition, CRC Press, Boca Raton, 2008, for Unit V.

REFERENCES:

1.	Ohring M, Material Science of Thin Films, 2nd Edition, Academic Press, New Jersey, 2001
2.	Goswami A, Thin Film Fundamentals, Reprint, New Age International (P) Ltd, New Delhi, 2003
3.	Chopra K. L, Thin Film Phenomena, Illustrated, McGraw Hill Inc., New York, 1969

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Utilize the appropriate theory and models to comprehend the thin film growth process.	Applying (K3)
CO2	Apply the principle of vacuum pump to explain select methods to create vacuum and to make use of the principle of vacuum gauge to explain the measurement of vacuum by select methods.	Applying (K3)
CO3	Describe the deposition of thin films by select physical methods using the principle of working of respective methods.	Applying (K3)
CO4	Explain the deposition of thin films by select chemical methods using the principle of working of respective methods.	Applying (K3)
CO5	Make use of select characterization techniques to comprehend the properties of thin films and also to illustrate the various device applications of thin films.	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	25	35	40				100
CAT2	25	35	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)**

20PHO02- HIGH ENERGY STORAGE DEVICES
(Common to all Engineering and Technology branches)

Programme & Branch	All BE / BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	OE	3	1	0	4

Preamble	This course aims to impart the essential knowledge on the fundamental principles and application areas of proven technologies and materials for energy storage solutions, together with an overview of development trends in this engineering field.	
Unit - I	**Introduction to Energy Storage:**	**9+3**
An overview of energy storage systems (qualitative): Thermal Energy Storage, Mechanical Energy Storage, Chemical Energy Storage, Electrical Energy Storage, Electrochemical Energy Storage, Electrostatic Energy Storage, Magnetic Energy Storage and Optical Energy Storage – General criteria of energy storage systems - Conventional batteries: fundamentals and applications - Grid connected and Off grid energy storage systems and requirements.		
Unit - II	**Thermal storage and Mechanical Storage:**	**9+3**
Thermal storage: Thermal properties of materials, Principle of operations, Efficiency factors, Large scale and Medium scale operations - Merits and demerits of thermal storage system - Recent development in thermal storage systems. Mechanical Storage: Types of mechanical storage systems, Principle of operations, Emerging advances and technologies in mechanical storage systems - Flywheel.		
Unit - III	**Magnetic storage, Electro-optic and Optical storage:**	**9+3**
Magnetic storage: Principle of operation, Emerging challenges and a review on devices and technology. Electro-optic and Optical storage: Principles of operation, Device fabrication, Emerging devices and Upcoming technologies.		
Unit - IV	**Electrochemical Storage:**	**9+3**
Materials, Principle of Operation, Positive electrode materials, negative electrode materials, electrolytes. Li-ion batteries: Principle of operation, Battery components, design of Electrodes, Cell and battery fabrications - Building block cells - Battery modules and packs - Li-polymer batteries – Applications - Future developments: Sodium-battery, Magnesium battery, Aluminum battery and Silicon battery.		
Unit - V	**Fuel Cells, Hydrogen storage and Super capacitors:**	**9+3**
Fuel Cells: Introduction to fuel cells, PEM (polymer electrolyte membrane), Hydrogen PEM fuel cell, Direct Methanol fuel cell, Alkaline fuel cells and Solid oxide fuel cells. Hydrogen storage systems: Solid state hydrogen storage tanks, Gas phase hydrogen storage tanks, Cryogenic hydrogen storage tanks, and Liquid phase hydrogen storage tanks. Super capacitors: Features of super capacitors, Basic principle of operation, Performance and technologies of super capacitors.		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Robert A. Huggins, Energy Storage, Springer, 2010, (Unit I – V)
2	Ehsani, Y. Gao, S. Gay, A. Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles, CRC Press, New York, 2005 (Unit 1- V)

REFERENCES:

1.	Yuping Wu, Lithium-Ion Batteries: Fundamentals and Applications(Electrochemical Energy Storage and Conversion), CRC Press, United Kingdom, 2015
2.	Trevor M. Letcher, Storing Energy: with Special Reference to Renewable Energy Sources, Elsevier, 2016
3.	D. Linden and T. S. Reddy, Handbook of Batteries, McGraw Hill, Newyork, 2002

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Utilize the appropriate concepts and models to comprehend the basics of energy storage systems.	Applying (K3)
CO2	Apply the principle of thermal and mechanical storage systems to explain the working and the recent advancements in thermal and mechanical storage systems.	Applying (K3)
CO3	Ultilize the principle of operation of magnetic storage systems, electro-optic and optical storage systems to illustrate the respective device fabrication techniques.	Applying (K3)
CO4	Explain the principle of operation of electrochemical storage device and materials used, and to elucidate the construction and working of various types of high energy storage batteries.	Applying (K3)
CO5	Make use of various techniques to construct different types of fuel cells and to explain the advanced techniques involved in hydrogen storage systems and also to explain the principle and working of super capacitors.	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	25	35	40				100
CAT2	25	35	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)**

20PHO03 - STRUCTURAL AND OPTICAL CHARACTERIZATION OF MATERIALS
(Common to all Engineering and Technology branches)

Programme & Branch	All BE / BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	OE	3	0	0	3

Preamble	This course aims to impart the essential knowledge on the characterization of materials using X-ray diffraction, Raman spectroscopy, UV-visible spectroscopy, Electron microscopy and Scanning tunneling microscopy and their application in various engineering fields, and also provides motivation towards innovations.	
Unit - I	**Introduction to Characterization Techniques and X-Ray Diffraction:**	**9**
Importance of materials characterization - Classification of characterization techniques - Crystalline materials - Reciprocal lattice - Theory of X-ray diffraction - Powder and Single crystal X-ray diffraction: Instrumentation (qualitative), XRD pattern, Systematic procedure for structure determination (qualitative), Crystallite size determination, Strain calculation - Applications of X ray diffraction measurements.		
Unit - II	**Electron Microscopy:**	**9**
Need of electron microscopy - Electron specimen interaction: Emission of secondary electrons, Backscattered electrons, Characteristic X-rays, Transmitted electrons, Specimen interaction volume - Resolution - Scanning electron microscope and Transmission electron microscope: Schematic diagram, Short details of each component and working – Field emission scanning electron microscope – Different types of filaments - Wavelength dispersive x-ray analysis – Three parameter equation for quantitative composition analysis.		
Unit - III	**Scanning Tunneling Microscopy:**	**9**
Introduction to quantum mechanical tunneling - Basic principles of scanning tunneling microscopy - Two modes of scanning - Interpreting scanning tunneling microscopic images -Applications of scanning tunneling microscopy.		
Unit - IV	**Raman Spectroscopy:**	**9**
Introduction – Pure rotational Raman spectra – Vibrational Raman spectra – Polarization of light and Raman effect – Structure determination – Instrumentation – Near-Infra-Red FT Raman Spectroscopy.		
Unit - V	**Ultra Violet &Visible Spectroscopy:**	**9**
Regions of UV-Visible radiation - Colour and light absorption - The chromophore concept - Beer's and Lambert's laws – Theory of electronic transition - Frank Condon principle – Instrumentation and Working of UV vis spectrometer - Applications of UV visible spectroscopy.		

Total: 45

TEXT BOOK:

1.	Cullity B. D. and Stock S. R, Elements of X-ray diffraction, 3rd Edition, Pearson Education, India, 2003 (Unit I)
2	Banwell C. N, McCash E. M, Choudhury H. K, Fundamentals of Molecular Spectroscopy, 5th Edition, Tata McGraw-Hill Publ., New Delhi, 2013 (Unit II-V)

REFERENCES:

1.	Holt D. B. and Joy D. C, SEM micro characterization of semiconductors, 1st Edition, Academic Press, New Delhi, 1989
2.	Willard H. H., Merritt L. L., John A Dean, and Settle Jr. F. A, Instrumental methods of Analysis 7th Edition, Wadsworth Publishing Company, United States, 1988
3.	Elton N. Kaufman, Characterization of Materials (Volume1&2), 2nd, Wiley-Interscience, New Jersey, 2012

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Apply the concept of X-ray diffraction to determine the crystal structure and related structural parameters of materials.	Applying (K3)
CO2	Determine the micro-structural parameters of materials and to perform surface analysis of materials using the concept of matter waves and electron microscopy.	Applying (K3)
CO3	Utilize the concept and phenomenon of quantum mechanical tunneling to interpret the surface image recorded at atomic level using scanning tunneling microscopy.	Applying (K3)
CO4	Make use of the concept of Raman effect and Raman spectroscopy to determine the crystal structure and related structural parameters of materials.	Applying (K3)
CO5	Apply the theory of UV-Vis spectroscopy to comprehend the working of UV-Vis spectrophotometer.	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	25	35	40				100
CAT3	30	30	40				100
ESE	20	40	40				100

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

20CYO01 - INSTRUMENTAL METHODS OF ANALYSIS
(Common to all Engineering and Technology branches)

Programme & Branch	**All BE / BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	**OE**	**3**	**1**	**0**	**4**

Preamble	Instrumental methods of analysis aim to prepare the students to have all-encompassing knowledge of spectral methods in order to identify the molecules and reaction mechanism for the process to enhance application towards the industries.	
Unit - I	**Absorption and Emission Spectroscopy:**	**9+3**
Basic concepts of Absorption and Emission Spectroscopy – representation of spectra – basic elements of practical spectroscopy – signal to noise ratio - techniques for signal to noise enhancement – resolving power – Fourier transform spectroscopy – evaluation of results – basic principles, instrumentation and applications of Atomic Absorption, Atomic Fluorescence and Atomic Emission Spectroscopy.		
Unit - II	**IR, Raman, and NMR Spectroscopy:**	**9+3**
Infrared spectroscopy – correlation of IR Spectra with molecular structure, instrumentation, samplings technique and quantitative analysis. Raman Spectroscopy – Classical and Quantum theory instrumentation, Structural analysis and quantitative analysis. Nuclear magnetic resonance spectroscopy – basic principles – pulsed Fourier transform NMR spectrometer – elucidation of NMR spectra and quantitative analysis.		
Unit - III	**Surface Studies:**	**9+3**
Surface Study – X-Ray Emission Spectroscopy (XES), X- Ray Photo Electron Spectroscopy (XPS) - Auger Emission Spectroscopy (AES) - Transmission Electron Microscopy (TEM) - Scanning Electron Microscopy (SEM) - Surface Tunneling Microscopy (STEM) - Atomic Force Microscopy (AFM).		
Unit - IV	**Mass spectroscopy:**	**9+3**
Mass spectroscopy – Ionization methods in mass spectroscopy – mass analyzer – ion collection systems - correlation of molecular spectra with molecular structure. Instrumentation design and application of Fourier transform mass spectroscopy (FT-MS) and Ion microprobe mass analyzer (IMMA).		
Unit - V	**Thermal analysis:**	**9+3**
Thermal analysis: principles and instrumentations and applications of thermogravimetry (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC), evolved gas detection, thermo mechanical analysis and Thermometric titration.		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Chatwal. G. R., Anand, Sham K., “Instrumental Methods of Chemical Analysis” 5th Edition, Himalaya Publishing House, 2019.

REFERENCES:

1.	B.K. Sharma, Instrumental Method of Chemical Analysis, Krishna Prakashan Media (P) Ltd. 2019.
2.	Willard,H.H, Merritt,L.L, Dean,J.A, and Settle, F.A, “Instrumental methods of analysis” CBS Publishers & Distributors, 7 Ed, 2004.
3.	Kaur. H, “Instrumental Methods of Chemical Analysis”, XII Edition, Pragati prakashan, Meerat, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	illustrate the basics of spectroscopy to understand the instrumentation of various spectral techniques	Understanding (K2)
CO2	apply the IR, Raman and NMR for quantitative analysis of the sample.	Applying (K3)
CO3	apply the various techniques for the better understanding of surface morphology	Applying (K3)
CO4	explain the principle, instrumentation of mass spectroscopy for the analysis of organic sample	Understanding (K2)
CO5	illustrate the thermal analysis for the identification of thermal stability of the compounds	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	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)**

20CYO02 - CORROSION SCIENCE AND ENGINEERING
(Common to all Engineering and Technology branches)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	OE	3	1	0	4

Preamble	Corrosion science and engineering aims to equip the students to have a wide-range knowledge of corrosion and prevention methods in order to meet the industrial needs.	
Unit – I	**Corrosion and its Units**	**9+3**
Localized corrosion: electro chemical mechanism Vs. chemical mechanism - emf Series and Galvanic series – Galvanic Corrosion – Area effect in anodic and cathodic metal coatings – prediction using emf Series and Galvanic series - pilling Bedworth's ratio and it consequences (Problems) – units corrosion rate – mdd (milligrams per square decimeter per day), mmpy (Millie miles per year) and mpy (Mils per year) –- Importance of corrosion prevention in various industries: direct and indirect effects of corrosion		
Unit - II	**Thermodynamics of corrosion**	**9+3**
Electrode Potentials, Electrical Double Layer, Gouy−Chapman Model, Stern Model, Bockris – Devanathan−Müller Model - Free energy and oxidation potential criterion of corrosion (Problems) - Basis of Pourbaix Diagrams - Pourbaix diagrams of Water, Magnesium, Aluminium and Iron – Their and limitations–Methods of Determining Corrosion Rates - Weight Loss Method, Weight Gain Method and Chemical Analysis of Solution.		
Unit - III	**Types of Corrosion**	**9+3**
Introduction - (i) Crevice - differential aeration corrosion, (ii) pitting – mechanism, factors (iii) intergrannular- chromium depletion theory, weld decay and knife line attack, (iv) stress - SCC mechanism, and fatique- Cavitation damage – Fretting damage, (v) stray current corrosion - causes and its control.		
Unit - IV	**Kinetics of Corrosion**	**9+3**
Electrochemical Polarization – Evan's diagram – Activation polarization – Concentration polarization - Mixed potential theory(Wagner and Traud) – application of mixed potential theory – effect of Metal in acid solution – Cathodic protection of iron in acid solution – effect of cathodic reaction – effect of cathodic area – Passivity – Flade potential – Theories of Passivity - Adsorption theory – Oxide film theory – Film sequence theory.		
Unit – V	**Prevention of Corrosion**	**9+3**
Inhibitors – types of inhibitors, chemisorption of inhibitors, effect of concentration, effect of molecular structure, V.P. inhibitors – Prevention of corrosion at the design stage and in service conditions – control of catastrophic oxidation and Hydrogen disease – Langelier saturation Index and its uses - Corrosion prevention by surface coatings – Phosphating and its uses -Principles and procedures of cathodic protection: Sacrificial anodes and external cathodic current impression		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	E. McCafferty, Introduction to Corrosion Science, 2^{nd} Edition, Springer, 2017.

REFERENCES:

1.	R. Winston, Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering, Revie 4^{th} Edition, Wiley publisher, 2008.
2.	Fontanna, "Corrosion Engineering", (Materials Science and Metallurgy series), McGraw Hill international Ed., 2005.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	illustrate the mechanism, expression of rate of corrosion and importance of corrosion studies to familiarize for industrial needs.	Understanding (K2)
CO2	demonstrate the thermodynamics and kinetics of different models of corrosion with respect to the environment	Applying (K3)
CO3	organize the various types of corrosion to understand the corrosion problems	Applying (K3)
CO4	utilize the theories corrosion to interpret with the real time applications	Applying (K3)
CO5	summarize the corrosion prevention methods to avoid corrosion related issues	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	1												
CO2	3	2	1	1										
CO3	3	2	1	1										
CO4	3	2	1	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)**

20CYO03 - CHEMISTRY OF COSMETICS IN DAILY LIFE
(Common to all Engineering and Technology branches)

Programme& Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	OE	3	1	0	4

Preamble	This course aims to provide knowledge for engineering students on chemistry of cosmetics.	
Unit 1	**Formulation of Cosmetic Product**	**9+3**
Introduction - basic sciences of cleansing – Surfactant and adsorption, Surfactant Micelles, Surfactants and Cleansing, Surfactants and Foam (foam formation, stability, drainage, Rupture and Collapse and defoaming) - Polymers in Cosmetics - Polymer Solubility and Compatibility, polymer conformation - Basics of Dispersions - Electrical Charges Associated With Surfaces and Barriers – Basics of emulsion (stability, Ostwald Ripening, Prevention of Creaming and Sedimentation).		
Unit 2	**Structuring Materials for cosmetics**	**9+3**
Introduction - Water/Hydrophilic Base Materials, Oleaginous/Hydrophobic Base Materials and Amphiphilic Substances - Adding Functions and Effects - Materials That Add or Improve Functional Value, Emotional Value and Materials for Quality Control - Precautions on Cosmetic Ingredients - Future Challenges in Cosmetics Material Development.		
Unit 3	**Polymers in Cosmetic Products**	**9+3**
Polymers that modify surfaces - Film-forming polymers in cosmetics and personal care products - Hair-conditioning polymers - Polymers for the treatment of skin - Polymers as controlled release matrices - Dendritic polymers - Polymeric antimicrobials and bacteriostats.		
Unit 4	**Powders and Fragrance in Cosmetics**	**9+3**
Inorganic Pigments – extender pigment, coloured pigment, white pigment, pearlescent Pigments – organic pigments - extender pigment, coloured pigment. Fragrance – Introduction – natural products – aroma chemicals - fragrance creation and duplication - fragrance applications - encapsulation and controlled release – malodor - natural, green, organic, and sustainable fragrances.		
Unit 5	**Preparation of Cosmetics**	**9+3**
Brief introduction of the following cosmetic preparation and a detailed study on their quality control: shampoo, tooth paste, skin powder, skin creams, hair creams, nail polish, after shave lotion, bath and toiletries, lipstick and hair dyes, perfumes, depilatories.		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Kazutami Sakamoto, Robert Y. Lochhead, Howard I. Maibach, Yuji Yamashita, Cosmetic Science and Technology: Theoretical Principles and Applications, Elsevier, 2017, for Units- I, II, III, IV, V.
2.	Gaurav Kumar Sharma, JayeshGadiya, MeenakshiDhanawat A text book of cosmetic formulation, 2018, for Unit V.

REFERENCES:

1.	R.K. Nema, K.S. Rathore , B.K. Dubey, Textbook of Cosmetics, CBS Publishers and Distributors, 2017.
2.	Bruno Burlando, Elisa Bottini-Massa, LuisellaVerotta, Laura Cornara, Herbal Principles in Cosmetics: Properties and Mechanisms of Action, CRC Press, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	outline the formulation of cosmetics products	Understanding (K2)
CO2	identify the structuring materials form cosmetics	Applying (K3)
CO3	interpret the polymers in cosmetics	Understanding (K2)
CO4	develop knowledge about Powders and Fragrance in Cosmetics	Applying (K3)
CO5	apply the preparation methodology of cosmetics to explain the preparation and quality control of different cosmetic products used in day to day life.	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	1												
CO2	3	2	1											
CO3	3	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	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)**

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20CYO04 - CHEMISTRY OF NUTRITION FOR WOMEN HEALTH
(Common to all Engineering and Technology branches)

Programme& Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course aims to provide knowledge for engineering students on components of health and fitness and the role of nutrition for women health.	
Unit - I	**Nutrition**	**9+3**
Energy- Functions, sources and concept of energy balance, Functions, Recommended Dietary Allowances, dietary sources, effects of deficiency and/ or excess consumption on health of the following nutrients: • Carbohydrates and dietary fibre, Lipids, Proteins, Fat soluble vitamins-A, D,E and K, Water soluble vitamins – Thiamin, Riboflavin, Niacin, Pyridoxine, Folate, Vitamin B12 and Vitamin C, Minerals – Calcium, Iron, Zinc and Iodine		
Unit - II	**Role of women in national development**	**9+3**
Women in family and community: Demographic changes menarche, marriage, fertility, morbidity, mortality, life expectancy, sex ratio, aging, widowhood. Women in society: Women's role, their resources, and contribution to family, and effect of nutritional status.		
Unit - III	**Women and health**	**9+3**
Disease pattern and reproductive health- Menopause – Hypothyroid- PCOD-Diabetes - Policies and programs for promoting maternal and child nutrition and health - Concept of small family - Methods of family planning - Merits and demerits.		
Unit - IV	**Nutrition during Lactation and for Infants**	**9+3**
Physiology and psychology of lactation, hormonal control, composition of colostrums and breast milk, nutritional requirements of a nursing mother, advantages of breast feeding, food and nutritional requirements for infants, weaning and supplementary foods for infants and immunization.		
Unit - V	**Physical fitness and nutrition**	**9+3**
Significance of physical fitness and nutrition in the prevention and management of weight control, obesity, diabetes mellitus, CV disorders, bone health and cancer - Nutrition and exercise regimes for pre and postnatal fitness - Nutritional and exercise regimes for management of obesity - Critical review of various dietary regimes for weight and fat reduction. Prevention of weight cycling.		

Lecture:45,Tutorial:15, Total: 60

TEXT BOOK:

1.	Srilakshmi, B., Nutrition Science, New Age International (P) Ltd., New Delhi, 2017 for Units- I, IV, V.
2.	Arpita Verma, Women's Health and Nutrition: Role of State and Voluntary Organizations, Rawat Publishers, 2017, for Units II, III, IV.

REFERENCES:

1.	Shubhangini A Joshi , Nutrition and Dietetics, TataMacGraw Hill, 2010.
2.	Rujuta Diwekar, Women and The Weight Loss Tamasha, Westland ltd, 2010.
3.	Swaminathan, M., Advanced Textbook on Food and Nutrition, Vol. 1, Second Edition, Bangalore Printing and Publishing Co. Ltd., Bangalore, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Make use of the knowledge of dietary sources in day to day life	Applying (K3)
CO2	Interpret the various role of women in society	Understanding (K2)
CO3	Explain the disease pattern and policies towards women health	Understanding (K2)
CO4	Develop knowledge about nutrition during lactation and for infants	Applying (K3)
CO5	Utilize the knowledge of physical fitness and nutrition towards achieving a good health	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	1												
CO3	3	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	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)**

20CYO05 - CHEMISTRY CONCEPTS FOR COMPETITIVE EXAMINATIONS
(Common to all Engineering and Technology branches)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	OE	3	0	0	3

Preamble	This course aims to refresh the knowledge of chemistry required for competitive examinations and equip the students with a capacity to solve the problems in chemistry while participating various competitive examinations including TNFUSRC-FORESTER (paper-II: General science-chemistry), UPSC-IAS (prelims: General science-chemistry), GATE (thermodynamics concept for chemical & mechanical engineering).	
Unit – I	**Periodic Classification of Elements:**	**9**
Mendeleev's periodic table-Law and classification of elements- Modern periodic law-Modern periodic table and its characteristics - Periodic properties – important aspects of s, p & d block elements -Reactivity series and Uses - Alloys-Uses of Alloys- Properties of nano metals and oxides.		
Unit – II	**Chemical Equations and Bonding:**	**9**
Chemical Equations: Types of ions and radicals- oxidation and reduction-redox reactions - Balancing ionic equations. **Chemical Bonding:** Octet rule -Types of Chemical bond -Formation of Ionic and Covalent bond- Common Properties of ionic and covalent compounds- Differences between Ionic and covalent Compounds-Coordinate covalent bond- Coordination compounds – nomenclature and isomerism. Application in analytical chemistry.		
Unit – III	**Acids, Bases, Salts and Metallurgy:**	**9**
Acid- base theory – Bronsted- Lowry theory- conjugate acid-base- Lewis concept- HSAB- applications- pH scale- Importance of pH in everyday life-Salts-Classification of salts-Uses of salts. **Metallurgy:** Introduction-Terminologies in metallurgy-Differences between Minerals and Ores-Occurrence of metals- Metallurgy of Aluminum, Copper and Iron.		
Unit – IV	**Carbon and its Compounds:**	**9**
Introduction-Compounds of carbon-Modern definition of organic chemistry- Bonding in carbon and its compounds-Allotropy-Physical nature of carbon and its compounds-Chemical properties of carbon compounds-Homologous Series-Hydrocarbons and their Types- Functional groups- Classification of organic compounds based on functional group-Ethanol-Ethanoic acid.		
Unit – V	**Thermodynamics:**	**9**
Introduction- Some important terms in thermodynamics-thermodynamic system, process, properties and energy- First law of thermodynamics: Mathematical expression and interpretation- Applications of First law of thermodynamics-Molar heat capacity-Reversible isothermal expansion/compression of an ideal gas-Adiabatic expansion of an ideal gas-Isobaric and Isochoric Processes in Ideal Gases- Second laws of thermodynamics: Entropy- Entropy change for isolated system (system and surroundings)- Entropy change for system only (Ideal Gas)- Entropy change for mixing of ideal gases-Entropy of physical changes- Entropy of chemical changes-Maxwell Relations.		

Total: 45

TEXT BOOK:

1.	Steven S. Zumdahl, Susan A. Zumdahl and Donald J. DeCoste , "Chemistry", 10th Edition, Cengage Learning, 2018, for Units-I, II, III, IV.
2.	Wiley editorial board. "Wiley Engineering Chemistry". 2nd Edition, Wiley India Pvt. Ltd, New Delhi, Reprint 2019, for Units- I, II, III, V.

REFERENCES:

1.	B.R. Puri, L.R. Sharma, Principles of Inorganic Chemistry, 33rd Edition, Vishal Publishing Co., 2020.
2.	Paula Bruise, "Organic Chemistry", 6th Edition, 8th Edition, Pearson Education, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply the basic concept of periodic classification of elements to explain the periodic properties and reactivity series of s, p & d block elements.	Applying (K3)
CO2	utilize the concepts of chemical equation and bonding to solve the problems in balancing ionic equation and differentiate ionic and covalent compounds.	Applying (K3)
CO3	apply the concept of acid, base, salts and metallurgy to explain HSAB concepts, Importance of pH in everyday life, classification of salts and metallurgy of Al, Cu & Fe.	Applying (K3)
CO4	make use of the concept of carbon its compounds to explain bonding and classification of carbon compounds.	Applying (K3)
CO5	utilize the important terms and concepts of thermodynamics to explain the first law and second law of thermodynamics with examples.	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	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)**

20CYO06 - WASTE AND HAZARDOUS WASTE MANAGEMENT

(Common to all Engineering and Technology branches)

Programme & Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	OE	3	0	0	3

Preamble	Waste and Hazardous waste management aims to equip the students to have a wide-range of knowledge on waste management.	
Unit - I	**SOLID WASTE MANAGEMENT**	**9**
Solid wastes: definition, sources, types, composition of solid waste- Solid waste management system: collection, separation, processing and transformation of solid waste – combustion, aerobic composting, vermicomposting, pyrolysis, landfill-classification, types, methods and control of leachate in landfills. Recycling of material found in municipal solid waste- recycling of paper and cardboard, recycling of plastics, recycling of glass.		
Unit - II	**HAZARDOUS WASTE MANAGEMENT**	**9**
Hazardous wastes: definition, nature and sources of hazardous waste, classification and characteristics of hazardous waste-chemical class of hazardous waste, segregation of waste-generation, treatment and disposal-waste reduction, waste minimization-recycling-chemical treatment: acid base neutralization, chemical precipitation, oxidation/reduction, hydrolysis, electrolysis, chemical extraction and leaching, ion exchange, photolytic reaction- thermal treatment methods: incineration – biodegradation of hazardous waste: aerobic, anaerobic, reductive dehalogenations-land treatment and composting.		
Unit - III	**E- WASTE & BIOMEDICAL WASTE MANAGEMENT**	**9**
E-Waste Management: Definition, sources, classification, collection, segregation, treatment and disposal. **Biomedical Waste Management :** Introduction-definition –components of biomedical waste-waste generation –waste identification and waste control-waste storage-labeling and color coding-handling and transportation-waste treatment and disposal- autoclave, hydroclave , microwave treatments- chemical disinfection – sanitary and secure landfill.		
Unit - IV	**POLLUTION FROM MAJOR INDUSTRIES AND MANAGEMENT**	**9**
Introduction- sources and characteristics - waste treatment flow sheets for selected industries such as Textiles, Tanneries, Pharmaceuticals, Sugar, Petroleum refinery, fertilizer, dairy industries.		
Unit - V	**SOLID WASTE MANAGEMENT LEGISLATION**	**9**
Solid waste management plan - Solid Waste (Management and Handling) Rules - Biomedical Waste (Management and Handling) Rules- Plastic Waste Management Rules - E-Waste Management Rules - Hazardous and Other Wastes (Management and Transboundary Movement) Rules - Construction and Demolition Waste Management Rules..		

Total: 45

TEXT BOOK:

1.	George Tchobanoglous, Hillary Theisen, Samuel a Vigil, Integrated solid waste management (Engineering principle and management issues) McGraw hill Education (India) Pvt. Ltd., 2015, for Unit-I, II, V.
2.	SC Bhatia, Handbook of Industrial pollution and control (Volume-1), CBS publisher and distributers, New delhi, 2002 for Units - II, III, IV & V.

REFERENCES:

1.	Manual on Municipal Solid waste management, Central public Health and Environmental Engineering Organization (CPHEEO), Govt. of India, May 2000.
2.	Michael D. LaGrega, Phillip L. Buckingham, Jeffrey C. Evans, Hazardous waste management, MEDTEC, 2015.
3.	Majeti Narasimha Vara Prasad, Meththika Vithanage, Anwesha Borthakur, “Handbook of Electronic Waste Management: International Best Practices and Case Studies” 1st Edition, Butterworth-Heinemann, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply the technical points that are required to set up a solid waste management system.	Applying (K3)
CO2	select the various disposal methods of hazardous wastes like radioactive wastes	Understanding (K2)
CO3	organize the appropriate method for managing e-waste and biomedical waste	Applying (K3)
CO4	identify to plan minimization of industrial wastes	Applying (K3)
CO5	relate the legal legislation to solid waste management.	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			3							
CO2	2	1					3							
CO3	3	2	1	1			3							
CO4	3	2	1	1			3							
CO5	2	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	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)**

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE-638060
(AUTONOMOUS)
BOARD OF COMPUTER SCIENCE AND ENGINEERING

DEGREE & PROGRAMME : BE & CSE
HONOURS DEGREE TITLE: Data Science

The following courses are identified to earn additional 18 credits to get a Honours degree with specialization in **Data Science**

S.No	Course Code	Course Title	Credits	Prerequisites	Semester
1.	20CSH01	Data Preparation and Analysis	4	Nil	5
2.	20CSH02	Statistical Learning	4	Nil	5
3.	20CSH03	Text and Speech Analytics	4	Nil	6
4.	20CSH04	Image and Video Analytics	3	Nil	6
5.	20CSH05	Real-Time Analytics	3	Nil	7
		TOTAL	**18**		

20CSH01 - DATA PREPARATION AND ANALYSIS							
(Common to CSE, IT and CSD branches)							
Programme & Branch	**B.E. – Computer Science and Engineering, Computer Science and Design & BTech – Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5/6/7**	**HN**	**3**	**1**	**0**	**4**

Preamble	This course provides various techniques to prepare data for analysis, perform exploratory data analysis, and develop meaningful data visualizations.	
Unit – I	**Data Gathering and Preparation**	**9+3**
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	**Data Cleaning**	**9+3**
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	**Exploratory Analysis**	**9+3**
Understanding Relationships: Visualizing Relationships Between Variables -Calculating Metrics About Relationships. Identifying and Understanding Groups: Clustering - Association Rules - Learning Decision Trees from Data.		
Unit – IV	**Prediction and Data Wrangling**	**9+3**
Building Models from Data: Linear Regression - Logistic Regression - k- Nearest Neighbours - Classification and Regression Trees - Other Approaches. Data Wrangling: Hierarchical Indexing - Combining and Merging Datasets - Reshaping and Pivoting.		
Unit – V	**Visualization and Data Aggregation**	**9+3**
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, Tutorial:15 Total:60

TEXT BOOK:

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.(Unit 1,2,3,4)
2.	Wes McKinney, “Python for Data Analysis”, 2nd Edition, O'Reilly Media Publication, 2017. (Unit 5)

REFERENCES:

1.	Jake Vander Plas, "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.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret various types of data by gathering from different sources and prepare for processing	Applying (K3)
CO2	apply various methods of data cleaning for a given set of data	Applying (K3)
CO3	use different exploratory analysis methods	Applying (K3)
CO4	build models on real time data	Applying (K3)
CO5	use recent visualization methods for visualizing data in various real life 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	2		2								3	2
CO2	3	2	2		2								3	2
CO3	3	2	2		2								3	2
CO4	3	2	2		2								3	2
CO5	3	2	2		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	20	50	30				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)

20CSH02 - STATISTICAL LEARNING							
(Common to CSE, IT and CSD branches)							
Programme & Branch	**B.E. – Computer Science and Engineering, Computer Science and Design & BTech – Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5/6/7**	**HN**	**3**	**1**	**0**	**4**

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+3**
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+3**
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+3**
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+3**
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+3**
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		
		Lecture:45, Tutorial:15 Total:60

TEXT BOOK:

1.	James G, Witten D, Hastie T, Tibshirani R, "An Introduction to Statistical Learning with Applications in R", 1st edition, Springer, 2017.

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.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand the basics of statistical methods and use it in R	Applying (K3)
CO2	apply statistical methods for linear regression models	Applying (K3)
CO3	interpret resampling methods and linear model selection process	Applying (K3)
CO4	use data to make work with nonlinear models and tree based methods	Applying (K3)
CO5	apply support vector machine and unsupervised methods for real datasets	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								3	2
CO2	3	2	2		2								3	2
CO3	3	2	2		2								3	2
CO4	3	2	2		2								3	2
CO5	3	2	2		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	20	50	30				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)

20CSH03 - TEXT AND SPEECH ANALYTICS							
(Common to CSE, IT and CSD branches)							
Programme & Branch	**B.E. – Computer Science and Engineering, Computer Science and Design & BTech – Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5/6/7**	**HN**	**3**	**1**	**0**	**4**

Preamble	This course explores text extraction, text data analysis and speech processing and modeling	
Unit – I	**Text Extraction**	**9+3**
Introduction- Rapid automatic keyword extraction: candidate keywords - keyword scores - adjoining keywords - extracted keywords - Benchmark evaluation: precision and recall – efficiency – stop list generation - Evaluation on new articles.		
Unit – II	**Anomaly and Trend Detection**	**9+3**
Text visualization techniques: Visualization in text analysis - Tag clouds - authorship and change tracking - Data Exploration and the search for novel patterns - sentiment tracking, visual analytics and Future Len - scenario discovery - adaptive threshold setting for novelty mining: Introduction - adaptive threshold for anomaly -Experimental study detection - Experimental study.		
Unit – III	**Text Streams**	**9+3**
Events and trends in text streams: Introduction - Text streams - Feature extraction and data reduction - Event detection - Trend detection - Event and trend descriptions - Embedding semantics in LDA topic models: Introduction - vector space modeling - latent semantic analysis - probabilistic latent semantic analysis - Latent Dirichlet allocation - embedding external semantics from Wikipedia - data-driven semantic embedding		
Unit – IV	**Speech processing**	**9+3**
Phonetics - Articulatory Phonetics - Phonological Categories - Acoustic Phonetics and Signals - Speech Synthesis - Text Normalization - Phonetic and Acoustic Analysis - Diphone Waveform synthesis – Evaluation - Automatic Speech Recognition - Architecture - Hidden Markov Model to Speech - MFCC vectors - Acoustic Likelihood Computation - Evaluation. Triphones - Discriminative Training - Modeling Variation. Computational Phonology - Finite-State Phonology - Computational Optimality Theory - Syllabification - Learning Phonology and Morphology.		
Unit – V	**Speech modeling**	**9+3**
Hidden Markov Models: Markov Processes - HMMs - Evaluation, Optimal State Sequence - Viterbi Search, Baum-Welch Parameter Re-estimation - Implementation issues.		
		Lecture :45 ;Tutorial:15 Total:60

TEXT BOOK:

1.	Michael W. Berry & Jacob Kogan,"Text Mining Applications and Theory", Wiley publications, 2010. (Units I,II,III)
2.	Jurafsky and Martin, “Speech and Language Processing”, Pearson Prentice Hall, Second Edition,2008(Units IV,V)

REFERENCES:

1.	Aggarwal, Charu C., and Cheng Xiang Zhai, eds., “Mining text data”, Springer Science & Business Media, 2012.
2.	Miner, Gary, et al., “Practical text mining and statistical analysis for non-structured text data applications”, Academic Press, 2012.
3.	Lawrence Rabinerand Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Education,2003

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	explore various text extraction techniques	Applying (K3)
CO2	apply visualization techniques and perform anomaly & trend detection	Applying (K3)
CO3	perform event operations in Text streams	Applying (K3)
CO4	identify the different linguistic components of natural language	Applying (K3)
CO5	decide on the appropriate modeling technique necessary for a given language and 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	2		2								3	2
CO2	3	2	2		2								3	2
CO3	3	2	2		2								3	2
CO4	3	2	2		2								3	2
CO5	3	2	2		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	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)

<table>
<tr><td colspan="8">20CSH04 - IMAGE AND VIDEO ANALYTICS</td></tr>
<tr><td colspan="8">(Common to CSE, IT and CSD branches)</td></tr>
<tr><td>Programme & Branch</td><td>B.E. – Computer Science and Engineering, Computer Science and Design & BTech – Information Technology</td><td>Sem.</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>Credit</td></tr>
<tr><td>Prerequisites</td><td>Nil</td><td>5/6/7</td><td>HN</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Preamble</td><td colspan="7">This course aims to provide a broad view on processing and analyzing images and video.</td></tr>
<tr><td>Unit – I</td><td colspan="6">Introduction</td><td>9</td></tr>
<tr><td colspan="8">Deep Neural Networks – Introduction to Tensor flow – Keras Deep Learning library – OpenCV Library - Hand Written Number Recognition with Keras and OpenCV</td></tr>
<tr><td>Unit – II</td><td colspan="6">Convolutional Neural Network for Computer Vision</td><td>9</td></tr>
<tr><td colspan="8">Convolution Neural Network – CNN architectures and drawbacks of DNN- convolution and pooling operations in tensor flow – training and evaluating CNN – model performance optimization – ImageNet – LeNet – AlexNet – VGGNet – GoogleLENet - TesNet.</td></tr>
<tr><td>Unit – III</td><td colspan="6">Feature extraction, object detection and segmentation</td><td>9</td></tr>
<tr><td colspan="8">Feature extraction approach – transfer learning example – multi-task learning – Auto encoders of CNN – difference between object detection and image classification - Traditional, non CNN approaches to object detection - R-CNN – Regions with CNN features - Fast R-CNN – fast region-based CNN - Faster R-CNN – faster region proposal network-based CNN -Mask R-CNN – Instance segmentation with CNN</td></tr>
<tr><td>Unit – IV</td><td colspan="6">Generative Models</td><td>9</td></tr>
<tr><td colspan="8">Pix2pix - Image-to-Image translation - GAN – code example – feature matching – applications of generative models – neural artistic style transfer – generative adversarial networks – visual dialogue model.</td></tr>
<tr><td>Unit – V</td><td colspan="6">Video Classification</td><td>9</td></tr>
<tr><td colspan="8">Understanding and classifying videos – exploring video classification dataset – splitting videos in to frames – approaches for classifying videos – extending image based approaches to videos: Regressing the human pose- segmenting videos – generating videos.</td></tr>
<tr><td colspan="8" align="right">Total:45</td></tr>
</table>

TEXT BOOK:	
1.	Mohit Sewak, Md. Rezaul Karim and Pradeep Pujari, “Practical Convolutional Neural Networks, Packt Publishing, 2018, (Unit I,II,III)
2.	Rajalingappaa Shanmugamani, “Deep Learning for Computer Vision”, Packt Publishing, 2018, (Unit IV,V)
REFERENCES/ MANUAL / SOFTWARE:	
1.	D. L. Baggio et al., “Mastering OpenCV with Practical Computer Vision Projects”, Packt Publishing, 2012.
2.	Jan Erik Solem, “Programming Computer Vision with Python: Tools and algorithms for analyzing images”, O'Reilly Media, 2012.
3.	Windows/Linux

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Make use of the basic concepts of image processing and its libraries	Applying (K3)
CO2	Interpret the various CNN models used for image analytics	Applying (K3)
CO3	Apply the various levels of segmentation and interpret the results for object detection and feature extraction.	Applying (K3)
CO4	Make use of the GAN model to solve the real world problems.	Applying (K3)
CO5	Predict the more reliable video analytic solutions for real time 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		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

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	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)

20CSH05 - REAL TIME ANALYTICS							
(Common to CSE, IT and CSD branches)							
Programme & Branch	**B.E. – Computer Science and Engineering, Computer Science and Design & BTech – Information Technology**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5/6/7**	**HN**	**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 BOOK:

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.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	describe the concepts of streaming data and analyze various architectures for streaming data	Applying (K3)
CO2	make use of processing and storage techniques to build real time analytics applications	Applying (K3)
CO3	apply visualization and aggregation techniques for real time analytics	Applying (K3)
CO4	employ statistical approximation and sketching techniques for solving the real world problems	Applying (K3)
CO5	develop models and use it for forecasting and monitoring to solve real time 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										3	2
CO2	3	2	1		2								3	1
CO3	3	2	1										3	1
CO4	3	2	1										3	1
CO5	3	2	1		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	10	40	50				100
CAT2	15	35	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)