KONGU ENGINEERING COLLEGE

(Autonomous Institution Affiliated to Anna University, Chennai)

PERUNDURAI ERODE – 638 060

TAMILNADU INDIA

Estd : 1984

REGULATIONS, CURRICULUM & SYLLABI - 2020

(CHOICE BASED CREDIT SYSTEM & OUTCOME BASED EDUCATION)

(For the students admitted from 2021 - 2022)

BACHELOR OF TECHNOLOGY DEGREE

IN

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

DEPARTMENT OF ARTIFICIAL INTELLIGENCE

KONGU
Assuring the Best

INDEX

KONGU ENGINEERING COLLEGE
PERUNDURAI ERODE – 638 060
(Autonomous)

INSTITUTE VISION

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

INSTITUTE MISSION

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

QUALITY POLICY

We are committed to

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

DEPARTMENT OF ARTIFICIAL INTELLIGENCE

VISION

To be a centre of excellence in the broad field of Artificial Intelligence by focusing knowledge-centric education, innovation and cutting-edge research to address the needs of industry and society.

MISSION

Department of Artificial Intelligence is committed to:

MS1: To develop technocrats with strong core capabilities in Artificial Intelligence by continuously enhancing teaching and learning with state-of-the-art technologies.

MS2: To provide high-quality, value-based education to gain competence in Artificial Intelligence and allied areas in terms of research and innovation activities for societal benefits.

MS3: To promote students' professional growth by instilling ethical and leadership skills with industry support.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of Artificial Intelligence and Machine Learning will:

PEO1: Demonstrate explorative and analytical abilities and develop solutions for real world challenges learned in Artificial Intelligence and Machine Learning.

PEO2: Conduct research and build intelligent systems in the areas such as machine learning, deep learning, computer vision, natural language processing and contribute to developing knowledge in the field of Artificial Intelligence and Machine Learning.

PEO3: Exhibit professional and ethical mentality and address challenges with social awareness, demonstrates cooperation, communication and leadership skills.

MAPPING OF MISSION STATEMENTS (MS) WITH PEOs

MS\PEO	PEO1	PEO2	PEO3
MS1	3	2	2
MS2	3	3	2
MS3	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

PROGRAM OUTCOMES (POs)

Graduates of Artificial Intelligence and Machine Learning 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 Artificial Intelligence and Machine Learning will**:**

PSO1 **Foundations of Artificial Intelligence and Machine Learning:** Demonstrate an understanding of human cognition, machine learning and data engineering in order to develop intelligent systems.

PSO2 **Building Intelligent Systems:** Interpret, analyze, design and implement Artificial Intelligence driven solutions using learning algorithms and methodologies to serve society.

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	3	3	-	-	2	-	-	-	-	-	2	3	2
PEO2	3	3	3	2	2	-	-	-	-	-	-	2	2	3
PEO3	-	-	-	-	-	3	2	3	3	3	2	2	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:

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

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

7.3 Theory Courses

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

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

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

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

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

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

7.4 Theory cum Practical Courses

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

7.5 Practical Courses

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

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

7.6 Project Work-II Phase-I / Project Work-II Phase-II

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

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

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

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

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

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

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

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

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

7.7 Project Work-I Phase-I / Industrial Training

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

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

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

7.8 Professional Skills Training

Phase-I training shall be conducted for minimum of 80 hours in 4^{th} semester vacation and during 5^{th} semester. Phase-II training shall be conducted for minimum of 80 hours in 5^{th} semester vacation and during 6^{th} semester. The evaluation procedure shall be approved by 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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CURRICULUM BREAKDOWN STRUCTURE										
Summary of Credit Distribution										
Category	**Semester**								**Total number of credits**	**Curriculum Content (% of total number of credits of the program)**
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
HS	**3**	**4**	**3**				**3**		**13**	**7.69**
BS	**11**	**4**	**4**						**19**	**11.24**
ES	**4**	**10**	**3**	**4**					**21**	**12.43**
PC	**4**	**4**	**14**	**14**	**15**	**11**	**4**		**66**	**39.05**
PE					**3**		**12**	**3**	**18**	**10.65**
OE				**4**	**4**	**3**		**3**	**14**	**8.28**
EC					**2**	**6**	**6**	**4**	**18**	**10.65**
Semester wise Total	**22**	**22**	**24**	**22**	**24**	**20**	**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

HUMANITIES AND SOCIAL SCIENCE INCLUDING MANAGEMENT (HS)

S. No.	Course Code	Course Name	L	T	P	C	Sem
1.	20EGT11	English Language Skills	3	0	0	3	I
2.	20EGT21	Advanced Communication Skills	3	0	0	3	II
3.	20VEC11	Yoga and Values for Holistic Development	1	0	1	1	II
4.	20EGL31	English for Workplace Communication Laboratory	0	0	2	1	III
5	20GET31	Universal Human Values	2	0	0	2	III
6	20GET71	Engineering Economics 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 Equation	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.	20MAT21	Discrete Mathematics and Linear Algebra	3	1	0	4	II
6.	20MAT35	Probability Theory and Inferential Statistics	3	1	0	4	III
Total Credits to be earned						**19**	

ENGINEERING SCIENCE (ES)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	20ALC11	Basic of Electrical and Electronic Engineering	3	0	2	4	I
2.	20ALC21	Digital Principles and Design	3	0	2	4	II
3.	20MEL11	Engineering Practices Laboratory	0	0	2	1	II
4.	20ALC22	Python Programming	3	0	2	4	II
5	20ALL22	Open Source Laboratory	0	0	2	1	II
6	20ALC31	Foundation of Artificial Intelligence and Machine Learning	2	0	2	3	III
7	20ALT42	Web Technology	3	0	0	3	IV
8	20ALL41	Web Technology Laboratory	0	0	2	1	IV
Total Credits to be earned						**21**	

PROFESSIONAL CORE (PC)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**	**Domain/ Stream**
1.	20ALT11	Problem Solving and Programming	3	0	0	3	I	SD
2.	20ALL11	Problem Solving and Programming Laboratory	0	0	2	1	I	SD
3.	20ALT21	Data Structures	3	0	0	3	II	SD
4.	20ALL21	Data Structures Laboratory	0	0	2	1	II	SD
5.	20ALC32	Design and Analysis of Algorithms	3	0	2	4	III	SD
6.	20ALT31	Computer Organization	3	0	0	3	III	AP
7.	20ALT32	Database Management Systems	3	0	0	3	III	AP
8.	20ALC33	Data Visualization	2	0	2	3	III	AI
9.	20ALL31	Database Management Systems Laboratory	0	0	2	1	III	SD
10.	20ALT41	Optimization Techniques	3	1	0	4	IV	AI
11.	20ALC41	Object Oriented Programming	2	0	2	3	IV	SD
12.	20ALT43	Operating Systems	3	0	0	3	IV	AP
13.	20ALT44	Applied Machine Learning	3	0	0	3	IV	AI
14.	20ALL42	Applied Machine Learning Laboratory	0	0	2	1	IV	AI
15.	20ALT51	Artificial Intelligence	3	0	0	3	V	AI
16.	20ALT52	Deep Learning	3	0	0	3	V	AI
17.	20ALC51	Design Patterns and Principles	3	0	2	4	V	AI
18.	20ALC52	Big Data Analytics	3	0	2	4	V	AI
19.	20ALL51	Deep Learning Laboratory	0	0	2	1	V	AI
20.	20ALT61	Artificial Intelligence and Robotics	3	0	0	3	VI	AI
21.	20ALT62	Nature Inspired Optimization Techniques	3	0	0	3	VI	AI
22.	20ALT63	Information Retrieval Techniques	3	1	0	4	VI	AI
23.	20ALL61	Artificial Intelligence and Robotics Laboratory	0	0	2	1	VI	AI
24.	20ALC71	Internet of Things and Edge Analytics	3	0	2	4	VII	AI
Total Credits to be earned						**66**		

PROFESSIONAL ELECTIVE (PE)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**	**Domain/ Stream**
		Elective I						
1.	20ALE01	Theory of Computation	3	0	0	3	V	SD
2.	20ALE02	Multi-core Architecture	3	0	0	3	V	AI
3.	20ALE03	Computer Networks	3	0	0	3	V	NS
4.	20ALE04	Soft Computing Techniques	3	0	0	3	V	SD
		Elective II						
5.	20ALE05	Wireless and Sensor Networks	3	0	0	3	VII	NS
6.	20ALE06	Cloud Computing	2	0	2	3	VII	NS
7.	20ALE07	Web Mining	3	0	0	3	VII	AI
8.	20ALE08	Modeling and Simulation	3	0	0	3	VII	AI
9.	20GEE01	Fundamentals of Research	3	0	0	3	VII	GE
		Elective III						
10.	20ALE09	Information Security	3	0	0	3	VII	NS
11.	20ALE10	Regression Analysis	2	0	2	3	VII	AI
12.	20ALE11	Reinforcement Learning	3	0	0	3	VII	AI
13.	20ALE12	Embedded Systems and Programming	3	0	0	3	VII	SD
14.	20ALE13	Time Series Analysis and Forecasting	2	0	2	3	VII	AI
		Elective IV						
15.	20ALE14	Parallel Computing Architecture and Programming	3	0	0	3	VII	SD
16.	20ALE15	Social Media Analytics	3	0	0	3	VII	AI
17.	20ALE16	Real Time Analytics	3	0	0	3	VII	AI
18.	20ALE17	Graph Theory and its Applications	3	0	0	3	VII	AI
		Elective V						
19.	20ALE18	Operations and Supply Chain Management	3	0	0	3	VII	AI
20.	20ALE19	Multivariate Data Analysis	3	0	0	3	VII	AI
21.	20ALE20	Cognitive Science and Analytics	3	0	0	3	VII	AI
22.	20ALE21	Text and Speech Analytics	2	0	2	3	VII	AI
		Elective VI						
23.	20ALE22	Software Defined Networks	3	0	0	3	VIII	NS

24.	20ALE23	Software Quality and Testing	3	0	0	3	VIII	SDE
25.	20ALE24	Software Project Management	3	0	0	3	VIII	SDE
26.	20ALE25	Cyber Forensics	3	0	0	3	VIII	NS
27.	20ALE26	Agile Methodologies for Software Development	3	0	0	3	VIII	SDE
Total Credits to be earned						**18**		

***** AI – Artificial Intelligence, SD-Systems Development, SDE – Software Development and Engineering, NS- Networks and Security.

EMPLOYABILITY ENHANCEMENT COURSES (EC)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**	**Domain/ Stream**
1.	20GEL51	Professional Skills Training I / Industrial Training I	-	-	-	2	V	--
2.	20GEP61	Comprehensive Test / Viva	-	-	-	2	VI	--
3.	20GEL51	Professional Skills Training II / Industrial Training II	-	-	-	2	VI	--
4.	20ALP61	Project Work I	0	0	4	2	VI	--
5.	20ALP71	Project Work II Phase I	0	0	12	6	VII	--
6.	20ALP81	Project Work II Phase II	-	-	8	4	VIII	--
Total Credits to be earned						**18**		

MANDATORY COURSES							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	20MNT11	Student Induction Programme	-	-	-	0	I
2.	20MNT31	Environmental Science	2	0	0	0	IV

OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	20ALO01	Business Intelligence	3	1	0	4	IV
2.	20ALO02	Data Exploration and Visualization Techniques	3	0	2	4	V
3.	20ALO03	Industrial Machine Learning	3	0	0	3	VI
4.	20ALO04	Machine Learning for Smart Cities	3	0	0	3	VIII
Total Credits to be earned						**14**	

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
12	20CSO01	Fundamentals of Databases	3	0	2	4	CSE
13	20CSO02	Python Programming and Frameworks	3	0	2	4	CSE
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	20PHO01	Thin Film Technology	3	1	0	4	PHY
25	20CYO01	Instrumental Methods of Analysis	3	1	0	4	CHEMIS
		SEMESTER - V					
26	20CEO02	Disaster Management	3	1	0	4	CIVIL
27	20MEO02	Design of Experiments	3	0	2	4	MECH
28	20MTO02	Factory Automation	3	0	2	4	MTS
29	20MTO03	Data Acquisition and Virtual Instrumentation	3	0	2	4	MTS
30	20AUO02	Automotive Electronics	3	0	2	4	AUTO
31	20ECO04	PCB Design and Fabrication	3	0	2	4	ECE
32	20EEO04	Energy Conservation and Management	3	1	0	4	EEE
33	20EIO02	Industrial Automation	3	1	0	4	EIE

34	20EIO03	Measurements and Instrumentation	3	1	0	4	EIE
35	20CSO03	Computational Science for Engineers	3	1	0	4	CSE
36	20CSO04	Formal Languages and Automata	3	1	0	4	CSE
37	20ITO05	Data Science	3	1	0	4	IT
38	20ITO06	Advanced Java Programming	3	1	0	4	IT
39	20CHO03	Renewable Bioenergy Resources	3	1	0	4	CHEM
40	20CHO04	Intelligent Controllers	3	1	0	4	CHEM
41	20FTO03	Processing of Milk and Milk Products	3	0	2	4	FT
42	20FTO04	Processing of Fruits and Vegetables	3	0	2	4	FT
43	20CDO02	Fundamentals of User Interactive Design	3	0	2	4	CSD
44	20ADO02	Computer Vision	3	0	2	4	AIDS
45	20PHO02	High Energy Storage Devices	3	0	0	3	PHY
46	20CYO02	Corrosion Science and Engineering	3	1	0	4	CHEMIS
47	20CYO03	Chemistry of Cosmetics in Daily Life	3	1	0	4	CHEMIS
48	20CYO04	Chemistry of Nutrition for Women Health	3	1	0	4	CHEMIS
49	20MAO01	Mathematical Foundations for Machine Learning	3	1	0	4	MATHS
50	20MAO02	Graph Theory and its Applications	3	1	0	4	MATHS
		SEMESTER - VI					
51	20CEO03	Introduction to Smart Cities	3	0	0	3	CIVIL
52	20CEO04	Environmental Health and Safety	3	0	0	3	CIVIL
53	20MEO03	Fundamentals of Ergonomics	3	0	0	3	MECH
54	20MEO04	Principles of Management and Industrial Psychology	3	0	0	3	MECH
55	20MTO04	3D Printing and Design	3	0	0	3	MTS
56	20MTO05	Drone System Technology	3	0	0	3	MTS
57	20MTO06	Virtual and Augument Reality in Industry 4.0	3	0	0	3	MTS
58	20AUO03	Vehicle Maintenance	3	0	0	3	AUTO
59	20ECO05	Electronic Hardware and Troubleshooting	2	0	2	3	ECE
60	20ECO06	Bioinspired Computing Technologies	2	0	2	3	ECE
61	20EEO05	Micro Grid and Smart Grid	3	0	0	3	EEE
62	20EEO06	E-Waste Management	3	0	0	3	EEE
63	20EIO04	Biomedical Instrumentation and Applications	3	0	0	3	EIE
64	20EIO05	PLC Programming and Its Applications	3	0	0	3	EIE
65	20EIO06	Instrumentation for Industry 4.0	3	0	0	3	EIE
66	20CSO05	Java Programming	2	0	2	3	CSE
67	20CSO06	Web Engineering	2	0	2	3	CSE
68	20CSO07	Nature Inspired Optimization Techniques	3	0	0	3	CSE
69	20ITO07	Bio Natural Language Processing	3	0	0	3	IT

70	20ITO08	Disaster Management for Information Technology	3	0	0	3	IT
71	20CHO05	Food as Medicine	3	0	0	3	CHEM
72	20CHO06	Organic Farming	3	0	0	3	CHEM
73	20FTO05	Principles of Food Safety	3	0	0	3	FT
74	20FTO06	Fundamentals of Food Packaging and Storage	3	0	0	3	FT
75	20CDO03	Introduction to Mobile Game Design	3	0	0	3	CSD
76	20ADO03	Neural Networks and Deep Learning	3	0	0	3	AIDS
77	20PHO03	Structural and Optical Characterization of Materials	3	0	0	3	PHY
78	20CYO05	Chemistry Concepts for Competitive Examinations	3	0	0	3	CHEMIS
79	20CYO06	Waste and Hazardous Waste Management	3	0	0	3	CHEMIS
80	20MAO03	Data Analytics using R Programming	3	0	2	4	MATHS
81	20MAO04	Number Theory and Cryptography	3	1	0	4	MATHS
		SEMESTER - VIII					
82	20CEO05	Infrastructure Planning and Management	3	0	0	3	CIVIL
83	20CEO06	Environmental Laws and Policy	3	0	0	3	CIVIL
84	20MEO05	Safety Measures for Engineers	3	0	0	3	MECH
85	20MEO06	Energy Conservation in Thermal Equipments	3	0	0	3	MECH
86	20MTO06	Robotics	3	0	0	3	MTS
87	20MTO07	Virtual and Augment Reality in Industry 4.0	3	0	0	3	MTS
88	20AUO04	Public Transport Management	3	0	0	3	AUTO
89	20AUO05	Autonomous Vehicles	3	0	0	3	AUTO
90	20ECO07	Optical Engineering	3	0	0	3	ECE
91	20EEO07	Electric Vehicle	3	0	0	3	EEE
92	20EIO07	Graphical Programming using Virtual Instrumentation	3	0	0	3	EIE
93	20EIO08	Testing of Materials	3	0	0	3	EIE
94	20CSO08	Fundamentals of Internet of Things	3	0	0	3	CSE
95	20CSO09	Machine Translation	3	0	0	3	CSE
96	20CSO10	Fundamentals of Block chain	3	0	0	3	CSE
97	20ITO09	Modern Application Development	3	0	0	3	IT
98	20ITO10	Object Oriented System Development using UML	3	0	0	3	IT
99	20ITO11	Reinforcement Learning	3	0	0	3	IT
100	20CHO07	Cosmetics and Personal Health Care Products	3	0	0	3	CHEM
101	20CHO08	Brewing and Alcohol Technology	3	0	0	3	CHEM
102	20FTO07	Food Ingredients	3	0	0	3	FT
103	20FTO08	Food and Nutrition	3	0	0	3	FT
104	20CDO04	Introduction to Graphics Design	3	0	0	3	CSD

105	20ADO04	Business Analytics	3	0	0	3	AIDS
106	20MAO05	Advanced Linear Algebra	3	0	0	3	MATHS
107	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	Offering Dept.	Semester
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 – BTECH - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING Total Credits: 169

Sem.	Course1	Course2	Course3	Course4	Course5	Course6	Course7	Course8	Course9	Course10	Credits
I	English Language Skills(3-0-0-3)	Matrices and Differential Equations (3-1*-2*-4)	Applied Physics(3-0-0-3)	Applied Chemistry(3-0-0-3)	Problem Solving and Programming (3-0-0-3)	Basics of Electrical and Electronics Engineering (3-0-2-4)	Problem Solving and Programming Laboratory(0-0-2-1)	Physical Sciences Laboratory I(0-0-2-1)	Student Induction Program (0-0-0-0)		**22**
II	Advance Communication Skills(3-0-0-3)	Discrete Mathematics and Linear Algebra(3-1-0-4)	Digital Principles and Design (3-0-2-4)	Data Structures(3-0-0-3)	Python Programming (3-0-2-4)	Data Structures Laboratory(0-0-2-1)	Open Source Laboratory(0-0-2-1)	Engineering Practices Laboratory(0-0-2-1)	Yoga and Values for Holistic Development(1-0-1-1)		**22**
III	Probability Theory And Inferential Statistics (3-1-0-4)	Foundations of Artificial Intelligence and Machine Learning(2-0-2-3)	Design and Analysis of Algorithms(3-0-2-4)	Computer Organization (3-0-0-3)	Database Management System(3-0-0-3)	Data Visualization (2-0-2-3)	Database Management System Laboratory(0-0-2-1)	English for Workplace Communication Laboratory(0-0-2-1)	Universal Human Values(2-0-0-2)		**24**
IV	Optimization Techniques(3-1-0-4)	Web Technology(3-0-0-3)	Object Oriented Programming (2-0-2-3)	Operating Systems(3-0-0-3)	Applied Machine Learning(3-0-0-3)	Open Elective - 1(3-1/0-0/2-4)	Web Technology Laboratory(0-0-2-1)	Applied Machine Learning Laboratory(0-0-2-1)	Environmental Science(2-0-0-0)		**22**
V	Artificial Intelligence(3-0-0-3)	Deep Learning(3-0-0-3)	Design Patterns and Principles (3-0-2-4)	Big Data Analytics (3-0-2-4)	Professional Elective -1(3-0-0-3)	Open Elective – 2(3-1/0-0/2-4)	Deep Learning Laboratory(0-0-2-1)	Professional Skills Training I / Industrial Training I (0-0-0-2)			**24**
VI	Artificial Intelligence and Robotics (3-0-0-3)	Nature Inspired Optimization Techniques (3-0-0-3)	Information Retrieval Techniques (3-1-0-4)	Open Elective - 3(2/3-0-0/2-3)	Artificial Intelligence and Robotics Laboratory(0-0-2-1)	Comprehensive Test and Viva(0-0-0-2)	Professional Skills Training II/ Industrial Training II /(0-0-0-2)	Project Work 1 (0-0-4-2)			**20**
VII	Engineering Economics and Management(3-0-0-3)	Internet of Things and Edge Analytics(3-0-2-4)	Professional Elective – 2(3-0-0-3)	Professional Elective – 3(3-0-0-3)	Professional Elective – 4(3-0-0-3)	Professional Elective – 5(3-0-0-3)	Project Work II Phase I (0-0-12-6)				**22**
VIII	Professional Elective -6(3-0-0-3)	Open Elective – 4(2/3-0-0/2-3)	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	20ALT11	Problem Solving and Programming	✓	✓	✓		✓								✓	✓
1	20ALC11	Basics of Electrical and Electronics Engineering	✓	✓	✓		✓								✓	✓
1	20ALL11	Problem Solving and Programming Laboratory	✓	✓	✓	✓	✓					✓			✓	✓
1	20PHL11	Physical Sciences Laboratory I				✓										
1	20MNT11	Student Induction Program														
2	20EGT21	Advance Communication Skills						✓			✓	✓	✓	✓		
2	20MAT21	Discrete Mathematics and Linear Algebra	✓	✓	✓	✓									✓	
2	20ALC21	Digital Principles and Design	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓	✓
2	20ALT21	Data Structures	✓	✓	✓										✓	✓
2	20ALC22	Python Programming	✓	✓	✓	✓	✓								✓	✓
2	20ALL21	Data Structures Laboratory	✓	✓	✓	✓	✓							✓	✓	✓
2	20ALL22	Open Source Laboratory	✓	✓	✓	✓	✓							✓	✓	✓
2	20MEL11	Engineering Practices Laboratory	✓	✓	✓	✓	✓				✓	✓	✓	✓		
2	20EEC11	Yoga Values for Holistic Development						✓		✓	✓			✓		
3	20MAT25	Probability Theory And Inferential Statistics	✓	✓	✓	✓									✓	
3	20ALC31	Foundations of Artificial Intelligence and Machine Learning	✓	✓	✓	✓	✓								✓	✓
3	20ALC32	Design and Analysis of Algorithms	✓	✓	✓	✓	✓								✓	✓
3	20ALT31	Computer Organization	✓	✓	✓										✓	✓
3	20ALT32	Database Management System	✓	✓	✓						✓				✓	✓
3	20ALC33	Data Visualization	✓	✓	✓	✓	✓								✓	✓
3	20ALL31	Database Management System Laboratory	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
3	20ALL32	English for Workplace Communication Laboratory									✓	✓			✓	
3	20GET31	Universal Human Values						✓		✓						
4	20ALT41	Optimization Techniques	✓	✓	✓										✓	✓
4	20ALT42	Web Technology	✓	✓	✓	✓	✓								✓	✓
4	20ALC41	Object Oriented Programming	✓	✓	✓	✓	✓								✓	✓
4	20ALT43	Operating Systems	✓	✓	✓										✓	✓
4	20ALT44	Applied Machine Learning	✓	✓	✓		✓	✓						✓	✓	✓
4	20ALL41	Web Technology Laboratory	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓
4	20ALL42	Applied Machine Learning Laboratory	✓	✓	✓	✓	✓				✓		✓		✓	✓
4	20MNT31	Environmental Science	✓	✓	✓				✓							
5	20ALT51	Artificial Intelligence	✓	✓	✓									✓	✓	✓
5	20ALT52	Deep Learning	✓	✓	✓		✓							✓	✓	✓
5	20ALC51	Design Patterns and Principles	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓	✓
5	20ALC52	Big Data Analytics	✓	✓	✓	✓	✓								✓	✓
5	20ALL51	Deep Learning Laboratory	✓	✓	✓	✓	✓							✓	✓	✓
5	20GEL51	Professional Skills Training I / Industrial Training I														
6	20ALT61	Artificial Intelligence and Robotics	✓	✓	✓										✓	✓
6	20ALT62	Nature Inspired Optimization Techniques	✓	✓	✓										✓	✓
6	20ALT63	Information Retrieval Techniques	✓	✓	✓										✓	✓
6	20ALL61	Artificial Intelligence and Robotics Laboratory	✓	✓	✓	✓	✓								✓	✓
6	20GEP61	Comprehensive Test and Viva														
6	20GEL51	Professional Skills Training II / Industrial Training II														
6	20ALP61	Project Work I														
7	20GET71	Engineering Economics and Management	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓
7	20ALC71	Internet of Things and Edge Analytics	✓	✓	✓	✓	✓	✓							✓	✓
7	20ALP71	Project Work II Phase I														

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
8	20ALP81	Project work II Phase II														

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		Professional Elective Courses														
5	20ALE01	Theory of Computation	✓	✓	✓										✓	✓
5	20ALE02	Multi-core Architecture	✓	✓	✓										✓	✓
5	20ALE03	Computer Networks	✓	✓	✓	✓									✓	✓
5	20ALE04	Soft Computing Techniques	✓	✓	✓	✓	✓	✓		✓		✓			✓	✓
7	20ALE05	Wireless and Sensor Networks	✓	✓	✓	✓									✓	✓
7	20ALE06	Cloud Computing	✓	✓	✓	✓	✓								✓	✓
7	20ALE07	Web Mining	✓	✓	✓		✓			✓					✓	✓
7	20ALE08	Modeling and Simulation	✓	✓	✓										✓	✓
7	20GEE01	Fundamentals of Research	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	20ALE09	Information Security	✓	✓	✓					✓					✓	✓
7	20ALE10	Regression Analysis	✓	✓	✓	✓	✓							✓	✓	✓
7	20ALE11	Reinforcement Learning	✓	✓	✓	✓									✓	✓
7	20ALE12	Embedded System and Programming	✓	✓	✓		✓								✓	✓
7	20ALE13	Time Series Analysis and Forecasting	✓	✓	✓	✓	✓								✓	✓
7	20ALE14	Parallel Computing Architecture and Programming	✓	✓	✓		✓								✓	✓
7	20ALE15	Social Media Analytics	✓	✓	✓										✓	✓
7	20ALE16	Real Time Analytics	✓	✓	✓	✓									✓	✓
7	20ALE17	Graph Theory and its Applications	✓	✓	✓	✓									✓	✓
7	20ALE18	Operation and Supply Chain Management	✓	✓	✓			✓						✓	✓	✓
7	20ALE19	Multivariate Data Analysis	✓	✓	✓										✓	✓
7	20ALE20	Cognitive Science and Analytics	✓	✓	✓										✓	✓
7	20ALE21	Text and Speech Analytics	✓	✓	✓										✓	✓
8	20ALE22	Software Defined Networks	✓	✓	✓		✓								✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
8	20ALE23	Software Quality and Testing	✓	✓	✓						✓	✓	✓		✓	✓
8	20ALE24	Software Project Management	✓	✓	✓						✓	✓	✓		✓	✓
8	20ALE25	Cyber Forensics	✓	✓	✓			✓		✓				✓	✓	✓
8	20ALE26	Agile Methodologies for Software Development	✓	✓	✓						✓	✓	✓		✓	✓

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	20CSO01	Fundamentals of Databases	✓	✓	✓	✓	✓									
4	20CSO02	Python Programming and Frameworks														
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	20PHO01	Thin Film Technology	✓	✓	✓											
4	20CYO01	Instrumental Methods of Analysis	✓	✓	✓	✓										
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	20CSO03	Computational Science for Engineers	✓	✓	✓											
5	20CSO04	Formal Languages and Automata	✓	✓	✓											
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	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	20CSO05	Java Programming	✓	✓	✓	✓	✓									
6	20CSO06	Web Engineering	✓	✓	✓	✓	✓									
6	20CSO07	Nature Inspired Optimization Techniques	✓	✓	✓											
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	✓	✓	✓										

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	20CSO08	Fundamentals of Internet of Things	✓	✓	✓		✓									
8	20CSO09	Machine Translation	✓	✓	✓											
8	20CSO10	Fundamentals of Blockchain	✓	✓	✓											
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	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	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		

BTECH - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING CURRICULUM - R2020
(For the students admitted in the academic year 2021-22)

SEMESTER – I									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20EGT11	English Language Skills	3	0	0	3	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
20ALT11	Problem Solving and Programming	3	0	0	3	40	60	100	PC
20ALC11	Basics of Electrical and Electronics Engineering	3	0	2	4	50	50	100	ES
Practical / Employability Enhancement									
20ALL11	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 Credits to be earned					**22**				

***Alternate Weeks**

SEMESTER – II									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20EGT21	Advanced Communication Skills	3	0	0	3	40	60	100	HS
20MAT21	Discrete Mathematics and Linear Algebra	3	1	0	4	40	60	100	BS
20ALC21	Digital Principles and Design	3	0	2	4	50	50	100	ES
20ALT21	Data Structures	3	0	0	3	40	60	100	PC
20ALC22	Python Programming	3	0	2	4	50	50	100	ES
Practical / Employability Enhancement									
20ALL21	Data Structures Laboratory	0	0	2	1	60	40	100	PC
20ALL22	Open Source Laboratory	0	0	2	1	60	40	100	ES
20MEL11	Engineering Practices Laboratory	0	0	2	1	60	40	100	ES
20VEC11	Yoga and Values for Holistic Development	1	0	1	1	100	0	100	HS
Total Credits to be earned					**22**				

*Alternate Weeks

BTECH - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING CURRICULUM - R2020

(For the students 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									
20MAT35	Probability Theory And Inferential Statistics	3	1	0	4	40	60	100	BS
20ALC31	Foundations of Artificial Intelligence and Machine Learning	2	0	2	3	50	50	100	ES
20ALC32	Design and Analysis of Algorithms	3	0	2	4	50	50	100	PC
20ALT31	Computer Organization	3	0	0	3	40	60	100	PC
20ALT32	Database Management Systems	3	0	0	3	40	60	100	PC
20ALC33	Data Visualization	2	0	2	3	50	50	100	PC
Practical / Employability Enhancement									
20ALL31	Database Management Systems Laboratory	0	0	2	1	60	40	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					**24**				

SEMESTER – IV									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20ALT41	Optimization Techniques	3	1	0	4	40	60	100	PC
20ALT42	Web Technology	3	0	0	3	40	60	100	ES
20ALC41	Object Oriented Programming	2	0	2	3	50	50	100	PC
20ALT43	Operating Systems	3	0	0	3	40	60	100	PC
20ALT44	Applied Machine Learning	3	0	0	3	40	60	100	PC
	Open Elective - I	3	1/0	0/2	4	40/ 50	60/ 50	100	OE
Practical / Employability Enhancement									
20ALL41	Web Technology Laboratory	0	0	2	1	60	40	100	ES
20ALL42	Applied Machine Learning Laboratory	0	0	2	1	60	40	100	PC
20GEL51	Professional Skills Training I / Industrial Training I *$	--	--	--	2	100	0	100	EC
Total Credits to be earned					**24**				

***Alternate Weeks**

BTECH - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING CURRICULUM - R2020
(For the students admitted in the academic year 2021-22)

SEMESTER – V									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20ALT51	Deep Learning	3	1	0	4	40	60	100	PC
20ALT52	Big Data Analytics	3	1	0	4	40	60	100	PC
20ALC51	Data Modeling and Business intelligence	3	0	2	4	50	50	100	PC
	Professional Elective –I	3	0	0	3	40	60	100	PE
	Open Elective – II	3	1/0	0/2	4	40/ 50	60/ 50	100	OE
Practical / Employability Enhancement									
20ALL51	Deep Learning Laboratory	0	0	2	1	60	40	100	PC
20ALL52	Big Data Analytics Laboratory	0	0	2	1	60	40	100	PC
20GEL61	Professional Skills Training II / Industrial Training II @	---	---	---	2	100	0	100	EC
Total Credits to be earned					**23**				

SEMESTER – VI									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
20ALT61	Information Retrieval Techniques	3	1	0	4	40	60	100	PC
20ALT62	Natural Language Processing	3	0	0	3	40	60	100	PC
20ALT63	Image and Video Analytics	3	0	0	3	40	60	100	PC
	Open Elective - 3	2/3	0	0/2	3	40/ 50	60/ 50	100	OE
Practical / Employability Enhancement									
20ALL61	Natural Language Processing Laboratory	0	0	2	1	60	40	100	PC
20ALL62	Image and Video Analytics Laboratory	0	0	2	1	60	40	100	PC
20GEP61	Comprehensive Test and Viva	---	---	---	2	100	0	100	EC
20MNT31	Environmental Science	2	0	0	0	100	0	100	MC
20ALP61	Project Work I	0	0	4	2	100	0	100	EC
Total Credits to be earned					**19**				

BTECH - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING CURRICULUM - R2020
(For the students admitted in the academic year 2021-22)

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	40	60	100	HS
20ALC71	Transfer Learning	3	0	2	4	50	50	100	PC
	Professional Elective – 2	3	0	0	3	40	60	100	PE
	Professional Elective – 3	3	0	0	3	40	60	100	PE
	Professional Elective – 4	3	0	0	3	40	60	100	PE
	Professional Elective – 5	3	0	0	3	40	60	100	PE
Practical / Employability Enhancement									
20ALP71	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									
	Professional Elective -6	3	0	0	3	40	60	100	PE
	Open Elective – 4	2/3	0	0/2	3	40	60	100	OE
Practical / Employability Enhancement									
20ALP81	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**	**Domain/ Stream**
		Semester - V					
		Elective I					
1.	20ALE01	Theory of Computation	3	0	0	3	SD
2.	20ALE02	Multi-core Architecture	3	0	0	3	AI
3.	20ALE03	Computer Networks	3	0	0	3	NS
4.	20ALE04	Soft Computing Techniques	3	0	0	3	SD
		Semester - VII					
		Elective II					
5.	20ALE05	Wireless and Sensor Networks	3	0	0	3	NS
6.	20ALE06	Agile Methodologies for Software Development	3	0	0	3	VII
7.	20ALE07	Web Mining	3	0	0	3	AI
8.	20ALE08	Modeling and Simulation	3	0	0	3	AI
9.	20GEE01	Fundamentals of Research	3	0	0	3	GE
		Elective III					
10.	20ALE09	Information Security	3	0	0	3	NS
11.	20ALE10	Regression Analysis	2	0	2	3	AI
12.	20ALE11	Reinforcement Learning	3	0	0	3	AI
13.	20ALE12	Healthcare Analytics	3	0	0	3	VII
14.	20ALE13	Time Series Analysis and Forecasting	2	0	2	3	AI
		Elective IV					
15.	20ALE14	Ethics of Artificial Intelligence	3	0	0	3	VII
16.	20ALE15	Social Media Analytics	3	0	0	3	AI
17.	20ALE16	Real Time Analytics	3	0	0	3	AI
18.	20ALE17	Graph Theory and its Applications	3	0	0	3	AI

		Elective V					
19.	20ALE18	Operations and Supply Chain Management	3	0	0	3	AI
20.	20ALE19	Multivariate Data Analysis	3	0	0	3	AI
21.	20ALE20	Cognitive Science and Analytics	3	0	0	3	AI
22.	20ALE21	Software Testing	3	0	0	3	VII
		Semester - VIII					
		Elective VI					
23.	20ALE22	Software Defined Networks	3	0	0	3	NS
24.	20ALE23	Embedded System and Programming	3	0	0	3	VIII
25.	20ALE24	Software Project Management	3	0	0	3	SDE
26.	20ALE25	Cyber Forensics	3	0	0	3	NS
27.	20ALE26	Artificial Intelligence and Robotics	3	0	0	3	VIII

OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE)

(Offered by Department of Artificial Intelligence)

S. No.	Course code	Course Name	L	T	P	C	Sem
1	20ALO01	Business Intelligence	3	1	0	4	IV
2	20ALO02	Data Exploration and Visualization Techniques	3	0	2	4	V
3	20ALO03	Industrial Machine Learning	3	0	0	3	VI
4	20ALO04	Machine Learning for Smart Cities	3	0	0	3	VIII

20EGT11 ENGLISH LANGUAGE SKILLS

(Common to all Engineering and Technology Branches)

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

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

Total: 45

TEXT BOOK:

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

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

20MAC11 - MATRICES AND DIFFERENTIAL EQUATIONS

(Common to All Engineering and Technology Branches)

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

Preamble	To provide the skills to the students for solving different real time problems by applying matrices and differential equations.	
Unit - I	**Matrices:**	**9**
Introduction – Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors (without proof) – Cayley - Hamilton theorem (Statement and applications only) – Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form – Nature of Quadratic forms - Reduction of quadratic form to canonical form by orthogonal transformation.		
Unit - II	**Ordinary Differential Equations:**	**9**
Introduction – Solutions of First order differential equations: Exact differential equations – Leibnitz's Linear Equation – Bernoulli's equation – Clairaut's equation.		
Unit - III	**Ordinary Differential Equations of Higher Order:**	**9**
Linear differential equations of second and higher order with constant coefficients - Particular Integrals for the types: e^{ax} – cosax / sinax – x^n – $e^{ax}x^n$, e^{ax}sinbx and e^{ax}cosbx – x^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. for Unit I, II, III, IV and V.

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, 2020.
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)**

20ALT11 - PROBLEM SOLVING AND PROGRAMMING

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	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, 2020.

REFERENCES:

1. Yashavant Kanetkar, "Let us C", 16th Edition, BPB Publications, 2020.
2. Reema Thareja., “Programming in C ”, 2nd Edition, Oxford University Press, New Delhi, 2020.
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)**

20ALC11 - BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	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)**

20ALL11 - PROBLEM SOLVING AND PROGRAMMING LABORATORY

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	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			1	2
CO2	3	2	1	1	1					1			1	2
CO3	3	2	1	1	1					1			1	2

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, 2020.
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)**

20MAT21 – DISCRETE MATHEMATICS AND LINEAR ALGEBRA
(Common to AIDS and AIML branches)

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	BS	3	1	0	4

Preamble	To provide in depth knowledge in various concepts of linear algebra,mathematical logic, relations and various category of functions which serves as a foundation for machine learning and data scienceand also develop skills to apply algebraic structures in coding theory.	
Unit - I	**Mathematical Logic:**	**9+3**
Propositional Calculus: Propositions – Logical connectives – Compound propositions – Conditional and biconditional propositions – Truth tables – Tautologies and contradictions – Theory of Inference – Rules of inference – Arguments – Validity of arguments. Predicate Calculus: Predicates – Statement function – Variables – Quantifiers – Universe of discourse – Theory of inference for Predicate calculus – Rules of universal specification and generalization – Rules of Existential specification and generalization.		
Unit - II	**Relations and Functions:**	**9+3**
Relations: Definition – Partial ordered relation – Poset – Hasse diagram – Lattices – Properties of lattices – Boolean algebra – Definition – Properties. Functions: Definition – Types of functions – Composition of functions – Inverse functions – Recursive functions.		
Unit - III	**Algebraic Structures:**	**9+3**
Groups and Subgroups (Definitions only) – Cosets – Lagrange's theorem – Rings andFields (Definitions and examples) – Coding Theory – Group codes – Basic notions of error correction – Error recovery in group codes (Excluding theorems in coding theory).		
Unit - IV	**Vector spaces:**	**9+3**
Real vector spaces – Subspaces – Linear combinations and Span – Linear independence – Bases and dimension –Row space, Column space andNull Space – Rank and nullity.		
Unit - V	**Inner Product Spaces:**	**9+3**
Inner products – Angle and Orthogonality in inner product spaces – Orthonormal vectors – Gram Schmidt orthonormalization process – QR decomposition – Singular value decomposition.		

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,
2. Howard Anton, Chris Rorres, "Elementary Linear Algebra", 11th Edition, John Wiley & Sons, 2014, for Units 4, 5.

REFERENCES:

1. Kenneth H. Rosen , "Discrete Mathematics and its applications", 8th Edition, Tata McGraw Hill, 2019
2. Gilbert Strang, "Introduction to Linear Algebra", 4th Edition, Wellesley-Cambridge Press, Wellesley, USA, 2016.
3. David C. Lay, Steven R. Lay, Judith McDonald, "Linear Algebra and Its Applications", 5th Edition, Pearson Education Limited, England, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply propositional and predicate logic to validate the arguments.	Applying (K3)
CO2	understand various types of relations and functions which has applications in cryptography and combinatorial optimization.	Understanding (K2)
CO3	apply the concepts of group structures in coding theory.	Applying (K3)
CO4	illustrate the concept of vector spaces commonly used in intelligent systems.	Understanding (K2)
CO5	apply the concepts of inner product spaces in orthogonalization and decomposition in data reduction.	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									1	
CO2	3	2	1										2	
CO3	3	2	1	2									2	
CO4	3	2	1										1	
CO5	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	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)**

20ALC21 - DIGITAL PRINCIPLES AND DESIGN

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	ES	3	0	2	4

Preamble	This course enables the students to gain knowledge about the basic principles of number system, Binary Codes, Boolean algebra, digital logic gates and its minimization techniques and to design different combinational and sequential logic circuits.	
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 –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 up to four variable – Don't–Care Conditions – NAND and NOR Implementation– Minimization of functions using Quine-McCluskey method.		
Unit - III	**Combinational Logic:**	**9**
Combinational Logic: Half Adder – Full Adder - Half Subtractor – Full Subtractor – Binary Adder - Subtractor – Magnitude Comparator – Decoders – Encoders – Multiplexers – Demultiplexers – Boolean Functions implementation using Multiplexers.		
Unit - IV	**Synchronous Sequential Logic:**	**9**
Sequential Logic: Introduction – Latches and Flip-flops – Analysis of clocked sequential circuits: State Equations – State Table – State Diagram – State Reduction and Assignment.-Shift Registers-Counters.		
Unit - V	**Asynchronous Sequential Logic and Programmable Logic Devices:**	**9**
Introduction to Asynchronous Sequential Circuits: Concepts of Analysis Procedure - Race conditions - types.– Programmable Logic devices: PROM – PLA – PAL.		

List of Exercises / Experiments:

1.	Verification of Boolean theorems using digital logic gates
2.	Design and implementation of combinational circuits using basic gates
3.	Design and implementation of binary adder and subtractor
4.	Design and implementation of multiplexer and de-multiplexer
5.	Design and implementation of encoder and decoder
6.	Truth table verification of flip flops
7.	Design and implementation of shift registers using suitable ICs
8.	Design and implementation of counters

Lecture: 45, Practical: 30, Total: 75

TEXT BOOK:

1.	Morris Mano M, "Digital Design", 6th Edition, Pearson Education Pvt. Ltd, New Delhi, 2020.

REFERENCES:

1.	Anandkumar A, "Fundamentals of Digital Circuits", 4th Edition, Prentice Hall of India, New Delhi, 2016.
2.	Salivahanan S &Arivazhagan S, "Digital Circuits and Design", 5th Edition, Oxford University Press, New Delhi, 2020

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	verify the Boolean Algebra	Applying (K3)
CO2	realization of Boolean Functions	Applying (K3)
CO3	apply Karnaugh map techniques for gate level logic minimization	Applying (K3)
CO4	design adders and subtractors	Applying (K3)
CO5	design multiplexers and demultiplexers	Applying (K3)
CO6	design the combinational circuits	Applying (K3)
CO7	design the sequential circuits	Applying (K3)
CO8	realize boolean functions using PLDs	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	3	2		2						1	2	2
CO2	3	2	3	2	2	2			2	2		1	3	2
CO3	3	2	3	2	2	2			2	2		1	3	2
CO4	3	2	3	2	2	2			2	2		2	3	2
CO5	3	2	3	2		2						2	3	2
CO6	3	2	3	2		2						2	3	2
CO7	3	2	3	2		2						2	3	2
CO8	3	2	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	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)**

20ALT21 - DATA STRUCTURES

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	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	**List:**	**9**
Data Structures – Abstract Data Types (ADT)–List ADT and Array Implementation – Linked List – Doubly Linked List – Circular Linked List – Applications of Linked Lists.		
Unit - II	**Stack and Queue:**	**9**
Stack ADT – Array and Linked List implementation of Stacks – Applications of Stacks – Queue ADT – Array and Linked List implementation of Queue – Circular Queue – Applications of Queue.		
Unit - III	**Trees:**	**9**
Preliminaries: Implementation of trees –Tree Traversals – 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 - IV	**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 - 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 Merge - 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.

REFERENCE:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, “Introduction to Algorithms”, 3rd Edition, McGraw Hill, 2009.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	solve problems using various implementations of linked list.	Applying (K3)
CO2	make use of ADTs like stack and queue for solving real world problems.	Applying (K3)
CO3	implement the tree structure and its operations.	Applying (K3)
CO4	apply appropriate graph algorithms for computing problems.	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	2										3	2
CO2	3	2	2										3	2
CO3	3	2	2										3	2
CO4	3	2	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	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)**

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	C Programming	2	ES	3	0	2	4

20ALC22 - PYTHON PROGRAMMING

Preamble	To provide practical exposure to basic concepts of Python Programming including object oriented programming, GUI and Web programming	
Unit – I	**Introduction**	**9**
Basic Concepts: Keywords, identifiers and variables- Data types - type casting – user input – modules – operators – Flow control statements- Strings – Calendars and clocks.		
Unit - II	**Functions and Data types:**	**9**
Functions: Basics –function arguments – modules – Recursion – Special functions. **Lists**: Creating, traversing and slicing - functions – nested lists. **Tuples:** Creating, initializing and accessing – tuple functions – swapping tuples, unpacking tuples – **Dictionaries:** Basics of Creating, initializing and accessing – dictionary functions and methods-view objects.		
Unit - III	**Object Oriented Programming:**	**9**
Concepts of OOP- OOP concepts for Python – Built in Attributes and methods –polymorphism- operator overloading - Inheritance and Namespace – Method types - Exceptions: Built-in and User defined exceptions.		
Unit - IV	**Strings, Files and Regular Expressions:**	**9**
Strings: Built-in methods for string manipulation – Case studies. Modules and Packages : import statement – creating user defined modules and packages. **Files:** File operations –Reading and Writing a file. **Regular Expressions**: match, search, sub, find all and finite functions - Case studies.		
Unit - V	**User Interface and GUI Programming:**	**9**
User Interface design: Tkinter - Events – Connecting with databases. **Web Frameworks:** - Web servers - Introduction to web server frameworks (Bottle, Django and Flask)		

Lecture: 45, Practical: 30, Total: 75

List of Exercises / Experiments:

1.	Program using user-defined functions with different types of argument passing methods
2.	Demonstrate tuple, list and dictionary operations
3.	Program to illustrate the concept of constructors
4.	Program to implement different types of inheritance
5.	Program to demonstrate the usage of exception handling
6.	Explore string manipulation functions
7.	Find the most frequent words from a given text file and copy the same into another file
8.	Perform validation of inputs using Regular Expressions
9.	Design applications using TKInter
10.	Develop web pages using Web frameworks

TEXT BOOK:

1.	Anurag Gupta, G P Biswas. Python Programming, McGraw Hill Education, 1st Edition, 2020.

REFERENCES:

1	Bill Lubanovic, —Introducing Python Modern Computing in Simple Packages, 2nd Edition, O'Reilly Media, 2019.
2.	Samuel Dauzon, Aidas Bendoraitis and Arun Ravindran. Django: Web Development with Python: Web Development with Python. Packt Publisher, 1st edition, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	apply basic constructs of Python Programming to solve simple problems	Applying (K3)
CO2:	write programs using functions and data types	Applying (K3)
CO3:	get familiar with implementation of object oriented concepts in python	Applying (K3)
CO4:	Perform string, file and Regular expression operations and process data	Applying (K3)
CO5:	use TKinter and other web frameworks for addressing solutions for various real life problems	Applying (K3)
CO6	implement basic concepts of python programming and use it to solve the given problem	Applying (K3), Precision (S3)
CO7	make use of object oriented concepts to solve real world problems	Applying (K3), Precision (S3)
CO8	develop applications using GUI and web frameworks	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	2
CO2	3	2	2		2								3	3
CO3	3	2			3								3	3
CO4	3	2			3								3	3
CO5	3	2	2		3								3	3
CO6	3	2	1	2	1								3	2
CO7	3	2	1	2	1								3	2
CO8	3	2	1	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 %
CAT 1	15	30	55				100
CAT 2	15	30	55				100
CAT 3	15	30	55				100
ESE	15	30	55				100

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

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	PC	0	0	2	1

20ALL21 - DATA STRUCTURES LABORATORY

Preamble	The 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 stack and its operations
4.	Infix to postfix conversion using stack ADT
5.	Evaluating postfix expression using stack ADT
6.	Implementation of queue and its operations
7.	Implementation of circular queue and its operations
8.	Reverse a queue using stack
9.	Implementation of binary search tree traversals
10.	Implementation of graph traversal techniques
11.	Implementation of linear and binary search algorithms
12.	Implementation of sorting algorithms

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 and non linear data structures to solve the given problem	Applying (K3), Precision (S3)
CO2	use a data structure to implement another data structure	Applying (K3), Precision (S3)
CO3	implement searching and sorting operations for 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	2	2	2	2							2	3	2
CO2	3	2	2	2	2							2	3	2
CO3	3	2	2	2	2							2	3	2

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

20ALL22 - OPEN SOURCE LABORATORY

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	ES	0	0	2	1
Preamble	This course provides knowledge about basic Linux commands, shell script programming and Internet hosting for software development and version control using Git						

List of Exercises / Experiments:

1.	Implementation of Linux Commands
2.	Implementation of Shell programming for constructs like loops and patterns
3.	Implementation of Shell programming for string operations
4.	Git Installation and Setup
5.	Experiment on basic Git Commands
6.	Creation of Git local and remote repository
7.	Creation of branches and merging branches
8.	Experiment on merge conflicts and resolution
9.	Working with multiple repositories and configuration files
10.	Experiment on Fetch, Pull, Clone and rebasing on repositories
11.	Working with Patches and Hooks
12.	Experiment on Git graph model and version tracking

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Operating System : Linux
2.	Software: GitHub Desktop
3.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explore linux commands and apply it for various operations at terminal	Applying (K3), Precision (S3)
CO2	solve the given problem using shell script	Applying (K3), Precision (S3)
CO3	explore the functionality of Git	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							2	3	2
CO2	3	2	1	2	1							2	3	2
CO3	3	2	1	2	1							2	3	2

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

20MEL11 - ENGINEERING PRACTICES LABORATORY
(Common to all Engineering and Technology Branches)

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	2	ES	0	0	2	1

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.	To prepare a leak proof sheet metal tray/box/funnel using modern power tools.
6.	Welding practice using welding simulator.
7.	Project: Preparing innovative articles using wood/sheet metal.
	PART B – ELECTRICAL AND ELECTRONICS ENGINEERING
8.	Safety Aspects of Electrical Engineering, Electrical Symbols, Components Identification, Fuse selection and installation, Circuit Breakers selection
9.	Wiring circuit for fluorescent lamp and stair case wiring
10.	Measurement of earth resistance
11.	Soldering of simple circuits and trouble shooting
12.	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	3	3	3	3	3				3	3	2	3		
CO2	3	2	1	1					3	2	2	3		
CO3	2	1							3	2	2	3		
CO4	3	2	1	1					3	3	2	3		
CO5	3	2	1	1					3	2	2	3		

Mapping of COs with POs and PSOs
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

20VEC11 - YOGA AND VALUES FOR HOLISTIC DEVELOPMENT
(Common to all Engineering and Technology Branches)

Programme& Branch	BTech. - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	HS	1	0	1	1

Preamble	ProvidingValueEducationtoimprovetheStudents"character-understanding yogic life and physical health-maintaining youthfulness- Measure and method in five aspects of life	
Unit- I	**Physical Health:**	**2**
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 – Thuvipathaasva Sanjalana asana –Astanga Namaskara - Bhujangasana - Atha Muktha Savasana – Aswa Sanjalana Asana - Pada Hasthasana – Hastha Uttanasana –Pranamasana **Pranayama:** Naddisuddi-Clearance Practice- Benefits.		
Unit- II	**Life Force:**	**2**
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:** EnrichingBio-Magnetism-Physicalbody-Sexualvitalfluid-Lifeforce-Bio-Magnetism-Mind. **Maintaining youthfulness:** Postponingold age - Transformation of food into seven components - Importance of sexual vital fluid - Measure and method in five aspects of life –Controllingundue Passion. **Kayakalpapractice:** Aswini Mudra- Ojasbreath – Benefits of Kaya Kalpa.		
Unit- III	**Mental Health:**	**2**
Mental Frequencies: Beta, Apha, Theta and Delta wave- Agna Meditation explanation - benefits. Shanti meditation: ShanthiMeditation explanation – benefits. **Thuriya Meditation:** Thuriya Meditation explanation – benefits. **Benefits of Blessing**: Self blessing(Autosuggestion)-Family blessing-Blessing the others-World blessing-Divine protection.		
Unit- IV	**Values:**	**2**
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:** Nonviolence –Service. Patriotism –Equality. Respect for parents and elders- care and protection - Respect for teacher. Punctuality- Time Management.		
Unit- V	**Morality(Virtues):**	**2**
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: 10,Practical: 10,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.

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)**

20MAT35 PROBABILITY THEORY AND INFERENTIAL STATISTICS
(Common to AIDS and AIML branches)

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	3	BS	3	1	0	4

Preamble	To impart knowledge and problem solving capability in probability and statistical concepts necessary for handling real time applications in Artificial intelligence.	
Unit - I	**Probability and Random Variables:**	**9+3**
Probability – Axioms of probability – Conditional probability – Total probability – Baye's theorem – Random variable – Discrete and Continuous random variables – Probability mass function – Probability density function – Cumulative distribution function – Moments – Moment generating functions.		
Unit - II	**Standard Probability Distributions:**	**9+3**
Discrete Distributions: Binomial distribution – Poisson distribution – Geometric distribution – Continuous Distributions: Uniform distribution – Exponential distribution – Gaussian distribution.		
Unit - III	**Correlation and Estimation Theory:**	**9+3**
Correlation and Regression: Covariance – Correlation – Karl Pearson's Coefficient of Correlation – Regression – Lines of Regression – Properties of Regression lines and coefficients. Estimation Theory: Concept of Estimation – Characteristics of estimators – Unbiasedness – Consistency –Methods for Estimation: Method of Maximum Likelihood Estimation - Method of Moments.		
Unit - IV	**Testing of Hypothesis:**	**9+3**
Introduction – Critical region and level of significance – Types of Errors – Large sample tests - 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. Jay L. Devore, "Probability and Statistics for Engineering and Sciences", 9th Edition, Cengage Learning USA, 2016.

REFERENCES:

1. Douglas C. Montgomery & George C. Runger, "Applied Statistics and Probability for Engineers ", 7th Edition, John Wiley and Sons, USA, 2020.
2. Veerarajan, T, "Probability, Statistics, Random Processes and Queuing Theory", 1st Edition, Tata McGraw-Hill, New Delhi, 2019.
3. Gupta S.C. and Kapoor V.K. "Fundamentals of Mathematical Statistics", 11th Edition, Sultan Chand and Sons, 2002.

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	utilize the concepts of correlation and point estimation in intelligent systems	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	3	1										1	
CO2	3	3	2										2	
CO3	3	3	2	3									2	
CO4	3	3	2	3									3	
CO5	3	3	2	3									3	

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	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)**

20ALC31 - FOUNDATIONS OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Python Programming	3	ES	2	0	2	3

Preamble	The course focuses on the methodology of how to translate a data driven business problem into an effective solution by using the powerful AI technologies according to the Machine Learning paradigm.	
Unit - I	**Revolution of AI and ML, Prediction using Regression:**	**6**
Introduction to Machine Learning – Machine Learning vs Classical Programming – The ability to predict – Introduction to Regression – Regression Models – Linear Regression Model and Machine Learning – Evaluating Model Quality using different metrics – Insurance cost prediction problem		
Unit - II	**Non-Linear Models and Feature Engineering:**	**6**
Non-Linear Models – Feature Engineering - Insurance cost modeling problem – Reasons for Model Errors – Rectification of Model Errors – Overfitting and Underfitting – Deriving Data to Train the Model – Train/Test Split on the Insurance Problem		
Unit - III	**Classification Problems and Confusion Matrix:**	**6**
Introduction to Classification – Approach followed by Classification Algorithms – A Visual Representation of Logistic Regression – Evaluating Classification Model Accuracy – Classification with Logistic Regression – Introduction to Confusion Matrix – Hands-on with Confusion Matrix- Importance of Class wise Accuracy.		
Unit - IV	**Decision Trees and Random Forest Classifier:**	**6**
Introduction – Decision Trees as Classifiers – Overfitting in Decision Trees – Preventing Decision Trees from Overfitting – Ensemble Models – Random Forest Classifier – Random Forests for Bank Note Classification – Controlling Overfitting in Random Forests.		
Unit - V	**Unsupervised Learning:**	**6**
Clustering – Clustering with K-means – Customer Segmentation using K-means – Collaborative Filtering – Recommender Systems –Recommender System for Book Ratings Data.		

List of Exercises / Experiments:

1.	Study tools/packages in Weka / RapidMiner / Python
2.	Perform data preprocessing tasks for the given dataset
3.	Demonstration of classification using ID3, J48 and Naïve Bayes Algorithm
4.	Demonstrate performing clustering on dataset
5.	Demonstrate performing Linear Regression and Logistic Regression on datasets
6.	Demonstrate performing k-Nearest Neighbors on dataset
7.	Explore Weka Experimenter to find the performance of classification algorithms
8.	Explore Weka knowledge flow for implementing a project

Lecture: 30, Practical: 30, Total: 60

TEXT BOOK:

1.	Sujit Bhattacharyya, Subhrajit Bhattacharyya, “Practical Handbook of Machine Learning”, Career Launcher Infrastructure Pvt Ltd and G.K. Publications Pvt Ltd, First Edition, 2021.

REFERENCES:

1.	Rajendra Akerkar, “Introduction to Artificial Intelligence”, PHI Learning Pvt Ltd, Second Edition August, 2014.
2.	Gopinath Rebala, Ajay Ravi, Sanjay Churiwala, “An Introduction to Machine Learning”, Springer Nature, Switzerland, 1st Edition, 2019.
3.	Oliver Theobald, “Machine Learning for Absolute Beginners”, Independently Published, Second Edition, 2017.

REFERENCES/MANUAL/SOFTWARE:

1.	Operating System : Linux / Windows
2.	Software: Weka / Rapid Miner / Python
3.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply regression problems for prediction	Applying (K3)
CO2	understand the metrics of the machine learning problems	Understand(K2)
CO3	apply the logistic regression model and analyze confusion matrix	Applying (K3)
CO4	apply decision tree and random forest classifiers for given problem	Applying (K3)
CO5	create model using unsupervised learning methods	Applying (K3)
CO6	exhibit proficiency to build and assess data based models using weka / Rapid Miner tools	Applying (K3), Precision (S3)
CO7	demonstrate various classification model	Applying (K3), Precision (S3)
CO8	demonstrate various clustering and regression model	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	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	2	1								3	2
CO7	3	2	1	2	1								3	2
CO8	3	2	1	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	20	70				100
ESE	15	25	60				100

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

20ALC32 - DESIGN AND ANALYSIS OF ALGORITHMS

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Data Structures	3	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 & Divide and Conquer:**	**9**
Selection 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 & Transform 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 & Greedy technique:**	**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 & Branch and Bound:**	**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 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.

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	analyze 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)

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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	2										3	2
CO4	3	2	2										3	2
CO5	3	2	2										3	2
CO6	3	2	2	2	2								3	2
CO7	3	2	2	2	2								3	2
CO8	3	2	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	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)**

20ALT31 - COMPUTER ORGANIZATION
(Common to CSE, IT, AI DS and AIML branches)

Programme& Branch	**BTech - Artificial Intelligence and Machine Learning**	**Sem**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PC**	**3**	**0**	**0**	**3**

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**
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**
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**
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**
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**
Accessing I/O Devices – Interrupts – Enabling and Disabling Interrupts – Handling Multiple Devices – Bus Structure – Bus Operation – Arbitration – Interface Circuits – Interconnection Standards : USB.		

Total: 45

TEXT BOOK:

1.	Carl Hamacher, ZvonkoVranesic, SafwatZaky and NaraigManjikian, "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	60	20				100
CAT2	20	50	30				100
CAT3	20	55	25				100

ESE	20	40	40				100

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

20ALT32 - DATABASE MANAGEMENT SYSTEMS

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	3	PC	3	0	0	3

Preamble	The course provides an emphasis on how to organize, maintain and retrieve information from a database management system more efficiently and effectively.	
Unit - I	**Data Models:**	**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 – ER 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**
Features of good relational designs – Functional dependency – Decomposition using functional dependencies – Normal Forms: 1NF, 2NF, 3NF, BCNF, 4NF, 5NF.		

Unit - IV	**Indexing and Hashing:**	**9**
Ordered indices – B tree index files – B+ Tree index files – Multiple key access – Static and Dynamic Hashing – Bitmap indices – Overview of Query Processing.		
Unit - V	**Transactions:**	**9**
Transaction concept – Transaction model –Storage structure – Transaction atomicity and durability – Isolation – Serializability– Concurrency control: Lock-based Protocols – Deadlock Handling.		

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.	Elmasri Ramez 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	determine various keys and sketch a suitable schema for a given application.	Applying (K3)
CO2	design an ER model and write SQL queries for a queries for a given scenario.	Applying (K3)
CO3	design relational database using normalization methods for a given application.	Applying (K3)
CO4	apply indexing and hashing techniques in the design of relational database.	Applying (K3)
CO5	apply the concept of concurrency control in transaction processing.	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	2						2				3	2
CO3	3	2	2						2				3	2
CO4	3	2	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	30	60				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)**

20ALC33 - DATA VISUALIZATION

Programme & Branch	**BTech - Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Python Programming**	**3**	**PC**	**2**	**0**	**2**	**3**

Preamble	This course provides practical exposure to Python Programming frameworks required for visualizing data	
Unit - I	**Numpy:**	**6**
Basics of Numpy arrays – Computation on Numpy arrays: Universal functions – Aggregations – Computation on arrays: Broadcasting – Comparisons, Masks and Boolean Logic – Fancy Indexing – Sorting arrays.		
Unit - II	**Data Manipulation with Pandas:**	**6**
Introducing Pandas Objects – Data Indexing and Selection – Operating on Data in Pandas: Index Preservation – Index Alignment – Operations between DataFrame and Series – Handling missing data – Hierarchical Indexing: Creating, Indexing, Slicing, Rearranging and Data Aggregations.		
Unit - III	**Advanced Operations with Pandas:**	**6**
Combining Datasets: Concat and Append – Combining Datasets: Merge and Join – Aggregation and Grouping – Pivot Tables – Vectorized String Operations – Working with Time Series – High-Performance Pandas:Eval() and query().		
Unit - IV	**Visualization with Matplotlib:**	**6**

Line Plots – Scatter Plots – Visualizing errors – Density and Contour Plots – Histograms, Binnings and Density – Customizing Plot Legends – Customizing Colorbars – Multiple Subplots – Text and Annotation – Customizing Ticks.		
Unit - V	**Customiizing Matplotlib and Visualization with Seaborn**	**6**
Customizing Matplotlib: Configurations and Stylesheets – Three-Dimensional Plotting in Matplotlib – Geographic data with Basemap – Visualization with Seaborn.		

List of Exercises:

1.	Perform operations on arrays using Numpy.
2.	Perform Data Manipulation using Pandas.
3.	Combine datasets using concat, append, merge and join functions
4.	Perform aggregation, grouping and vectorized string operations using Pandas
5.	Visualize data using line, scatter, density and contour plots.
6.	Perform three-dimensional plotting using Matplotlib.
7.	Visualize geographic data using Basemap.
8.	Perform data visualization using Seaborn.

Lecture: 30, Practical: 30, Total:60

TEXT BOOK:

1.	Jake VanderPlas, " Python Data Science Handbook: Essential Tools for working with Data", 1st Edition, O'Reilly Media, Inc, 2016.

REFERENCES:

1.	Dr. Ossama Embarak, " Data Analysis and Visualization using Python ", APress, 2018
2.	Wes McKinney, "Python for Data Analysis", 2nd Edition, Or'reilly, 2018.

REFERENCES/MANUAL/SOFTWARE:

1.	Operating System : Windows/Linux
2.	Software : Python
3.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	perform array operations using Numpy	Applying (K3)
CO2	manipulate data using Pandas	Applying (K3)
CO3	apply data transformations such as aggregation and grouping using Pandas	Applying (K3)
CO4	visualize data using Matplotlib	Applying (K3)
CO5	use Seaborn to perform data visualization	Applying (K3)
CO6	prepare and Manipulate data using Numpy and Pandas	Analyzing (K4) Precision (S3)
CO7	construct 2-D and 3-D plots using Matplotlib	Analyzing (K4) Precision (S3)
CO8	use Seaborn for data visualization	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	2										3	2
CO4	3	2	2										3	2
CO5	3	2	2										3	2
CO6	3	2	2	2	2								3	2
CO7	3	2	2	2	2								3	2
CO8	3	2	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	40	50				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)**

20ALL31 - DATABASE MANAGEMENT SYSTEMS LABORATORY

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	3	PC	0	0	2	1
Preamble	The course explores the features of database management systems and how to interface with front end tools.						

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 concept 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.	Embed SQL queries in high level languages.
11.	Mini project on Application Development using Oracle/ SQL SERVER / MYSQL.

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Front End: Microsoft .NET Framework SDK v2.0, Java etc.,
2.	Back End : ORACLE / MYSQL
3.	Manuals: https://docs.oracle.com/cd/E11882_01/server.112/e41085.pdf
4.	Laboratory Manual

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

Mapping of COs with POs and PSOs

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

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

20ALL32 - ENGLISH FOR WORKPLACE COMMUNICATION LABORATORY
(Common to all Engineering and Technology Branches)

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

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

List of Exercises / Experiments:

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

Total: 30

TEXT BOOK:

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

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

20GET31 - UNIVERSAL HUMAN VALUES
(Common to all Engineering and Technology Branches)

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	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 Professional 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: 45

TEXT BOOK:

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

REFERENCES:

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

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

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

20ALT41 - OPTIMIZATION TECHNIQUES

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	4	PC	3	1	0	4

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+3**
Introduction – Formulation of Linear Programming Problem – Standard form of LPP – Solution of LPP: Graphical Method – Simplex Method – Artificial variable techniques – Big M Method.		
Unit - II	**Transportation and Assignment problems:**	**9+3**
Transportation problem: Mathematical Formulation of Transportation Problem – Initial basic feasible solution – North West Corner Method – Vogel's approximation method – Optimal solution – MODI Method – Degeneracy – Unbalanced transportation problem. Assignment Problem: Mathematical model of Assignment problem – Hungarian Method – Unbalanced assignment problem.		
Unit - III	**Theory of Games:**	**9+3**
Introduction – Basic Terminology – Two-Person zero sum games – Pure strategies (Games with saddle point) – Mixed Strategies (Games without saddle points) – Rule of Dominance – Solution of Mixed Strategy games:– Matrix method (upto 3 × 3 games) – Algebraic method (2 × n, m × 2 games) - Graphical method (2 × n, m × 2 games).		
Unit - IV	**Network and Project Scheduling:**	**9+3**
Introduction – Basic terminology – Rules of Network construction - Fulkerson's Rule for numbering of events – Construction of network – Critical path method – Programme Evaluation and Review Technique - Cost analysis in networks – Project crashing.		
Unit - V	**Non-Linear Programming:**	**9+3**
Introduction – Mathematical formulation of Non-linear programing problems – Non-linear programing problem with equality constraints – Lagrange multipliers method – Non-linear programing problem with inequality constraint – Kuhn Tucker conditions.		

Total: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1. Gupta P.K. and Hira D.S., "Operations Research: An Introduction", 7th Revised Edition, S.Chand and Co. Ltd., New Delhi, 2014.

REFERENCES:

1. Sharma J.K, "Operations Research – Theory and Applications", 6th Edition, Trinity Press, India, New Delhi, 2017.
2. Hamdy A. Taha, "Operations Research: An Introduction", 10th Edition, Pearson Education India, 2016.
3. Kanti Swarup, 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	formulate and solve linear programming problems.	Applying (K3)
CO2	apply transportation and assignment algorithms in engineering problems.	Applying (K3)
CO3	use game theory concepts in practical situations	Applying (K3)
CO4	apply the concepts of CPM and PERT in scheduling the project networks.	Applying (K3)
CO5	optimize the Non-linear Programming problems involving various types of constraints.	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	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)**

20ALT42 - WEB TECHNOLOGY

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Object Oriented Programming	4	ES	3	0	0	3

Preamble	This course provides an introduction to HTML, CSS, Bootstrap, Client-Side JS and Server-Side JS Framework. The course also addresses the web application development using React JS	
Unit - I	**UI Design:**	**9**
Introduction – Basic tags – HTML5 Forms Element – Page Structured Elements – Media Tags. Cascading Style Sheet: Types of CSS – Positioning Elements – Backgrounds – Box Model – Dropdown Menus. Responsive Web Design: Introduction – Bootstrap – Grid basics – Nav – Nav Bar – List – Drop down – Tables – Button –Images – Forms-Input – Input Groups.		
Unit - II	**JavaScript:**	**9**
Introduction – Operators – Control Structures: Selection- Repetition- Functions: Function Definition – Scope Rules – Recursion. Array: Declaration – Initialization – Growing Arrays – Passing Arrays to Function. Event Handling. Introduction to REST API-GET-POST-PUT Methods.		
Unit - III	**Server-side JS Framework:**	**9**
Node JS: Introduction – Architecture – Features – Creating Web Servers with HTTP Request – Response – Event Handling – GET and POST Methods – Modules – Connect to NoSQL Database using Node JS – Implementation of CRUD operations.		
Unit - IV	**ReactJS – Part 1:**	**9**
React: Introduction – Installation – create React app - components – state – props - props validation – state vs props – constructor – Component API – Component Life cycle - Forms – controlled and uncontrolled component – Events – conditional rendering.		
Unit - V	**ReactJS - Part 2:**	**9**
List – keys – refs – Fragments - Router – CSS – Animation – Map – Table –Code splitting – hooks – API Integration.		

Total:45

TEXT BOOK:

1.	Infosys campus connect material shared by infy, for Units 1, 3.
2.	https://www.javatpoint.com for Units 2, 4, 5.

REFERENCES:

1.	Paul Deitel, Harvey M.Deitel and Abbey Deitel, “Internet and World Wide Web - How To Program”, 5th Edition, Prentice Hall, 2011.
2.	David Choi, “Full-Stack React, TypeScript, and Node: Build cloud-ready web applications using React with Hooks and GraphQL”, Packt Publishing Limited, 1st Edition, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	design static web pages using HTML, CSS and Bootstrap.	Applying (K3)
CO2	develop interactive and dynamic web pages using javascript	Applying (K3)
CO3	develop a web application using node JS with database connectivity	Applying (K3)
CO4	apply the features of ReactJS to develop web applications.	Applying (K3)
CO5	demonstrate 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	2	1	2								3	2
CO2	3	2	2	1	2								3	2
CO3	3	2	2	1	2								3	2
CO4	3	2	2	1	2								3	2
CO5	3	2	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	20	60				100
CAT2	20	20	60				100
CAT3	10	20	70				100
ESE	10	30	60				100

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

20ALC41 - OBJECT ORIENTED PROGRAMMING

Programme & Branch	**BTech - Artificial Intelligence and Machine Learning**	**Sem**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	**PC**	**2**	**0**	**2**	**3**

Preamble	This course provides a concise introduction to the fundamental concepts of Java programming including inheritance, interfaces, exception handling and threads.	
Unit - I	**Introduction to OOP and Java:**	**6**
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.		
Unit - II	**Classes, objects and Methods:**	**6**
Classes: Class Fundamentals-objects–Assigning Object Reference Variables – Introducing Methods – Constructors – this keyword – Garbage Collection – Stack Class. Overloading Methods – Objects as Parameters – Argument Passing – Returning Objects – Recursion – Access Control–Static – Nested and Inner Classes – Command–Line Arguments – Variable Length Arguments.		
Unit - III	**Inheritance, Packages and Interfaces:**	**6**
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 - IV	**Exception handling, Multithreading and I/O:**	**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- I/O Basics – Reading and Writing Console I/O – Reading and Writing Files.		
Unit - V	**String handling, Generics and Collections:**	**6**
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.		

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.

Lecture: 30; Practical: 30; Total: 60

TEXT BOOK:

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

REFERENCES/MANUAL/SOFTWARE:

1.	Cay S. Horstmann, "Core Java Fundamentals", Volume 1, 11th Edition, Prentice Hall, 2020.
2.	Linux / Windows
3.	Eclipse IDE / Netbeans IDE
4.	Lab manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	interpret the role of object oriented programming, java and its variations	Applying (K3)

CO2	apply the concepts of classes, objects and methods to solve simple problems	Applying (K3)
CO3	develop programs using inheritance, packages and interfaces	Applying (K3)
CO4	make use of exception handling mechanisms and multithreaded model along with i/o packages to solve real world problems	Applying (K3)
CO5	build java applications with string classes, collections and generics concepts	Applying (K3)
CO6	design and develop java programs using object oriented programming concepts	Applying (K3) Precision (S3)
CO7	develop simple applications using package, exceptions and multithreading.	Applying (K3) Precision (S3)
CO8	develop a solution for real world problems using i/o, generics and collections.	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	2	2	1								3	2
CO7	3	2	2	2	1								3	2
CO8	3	2	2	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	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)**

20ALT43 - OPERATING SYSTEMS

Programme & Branch	BTech - Artificial Intelligence and Machine Learning.	Sem	Category	L	T	P	Credit
Prerequisites	Nil	4	PC	3	0	0	3

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**
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**
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**
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**
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**
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 – Case study: Linux System.		

Total: 45

TEXT BOOK:

1.	Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 10th Edition, John Wiley & Sons Inc., 2020.

REFERENCES:

1.	William Stallings, "Operating Systems Internals and Design Principles", 9th Edition, Prentice Hall, 2020.
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	2
CO2	3	2	1										3	2
CO3	3	2	1										3	2
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	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)**

20ALT44 - APPLIED MACHINE LEARNING

Programme& Branch	B.Tech. - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	4	PC	3	0	0	3

Preamble	The course provides the concepts and algorithms in machine learning and the methods to apply them in real time problems	
Unit - I	**Introduction to Machine Learning and Learning Theory:**	**9**
Need for Machine Learning – Machine Learning in relation to other fields – Types of Machine Learning – Challenges of Machine Learning – Machine Learning Process and Applications – Data – Data Analytics –Descriptive Statistics– Univariate, Bivariate and Multivariate Data – Feature Engineering – Dimensionality Reduction techniques– Learning and its Types – Computation Learning Theory – Concept Learning.		
Unit - II	**Similarity based Learning and Regression Analysis:**	**9**
Introduction to Similarity based Learning – Nearest Neighbor Learning – Weighted K-Nearest Neighbor Algorithm – Nearest Centroid Classifier – Locally weighted Regression – Introduction to Regression – Linearity, Correlation and Causation – Linear Regression – Multiple Linear Regression.		
Unit - III	**Decision Tree Learning:**	**9**
Decision Tree learning Model – Decision Tree Induction Algorithms: ID3 Tree Construction – C4.5 Construction – Classification and Regression Trees Construction – Regression Trees – Validating and Pruning of Decision Trees.		
Unit - IV	**Bayesian Learning and Support Vector Machines:**	**9**
Probability based Learning – Bayes Theorem – Classification using Bayes Model – Naïve Bayes Algorithm for Continuous Attributes – Other Naïve Bayes Classifiers – Introduction to Support Vector Machine – Optimal Hyperplane – Functional and Geometric Margin – Hard Margin – Soft Margin – Kernels and Non-Linear SVM.		
Unit - V	**Ensemble Learning, Clustering Algorithms and Reinforcement Learning:**	**9**
Introduction – Parallel Ensemble Models – Incremental Ensemble Models – Sequential Ensemble Models –Introduction to Clustering Approaches – Proximity Measures – Hierarchical Clustering Algorithms –Partitional Clustering Algorithm – Cluster Evaluation Methods – Overview of Reinforcement Learning – Reinforcement Learning as Machine Learning – Components – Markov Decision Process.		

Total: 45

TEXT BOOK:

1. S.Sridhar, M.Vijayalakshmi, “Machine Learning”, 1st Edition, Oxford University Press, 2021. for Unit I, II, III, IV and V.

REFERENCES:

1. David Forsyth, “Applied Machine Learning”, Springer, 2019.
2. M.Gopal, “Applied Machine Learning”, McGraw-Hill Education, 1st edition, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply the basic concepts of machine learning and data preprocessing to solve problems	Applying (K3)
CO2	demonstrate similarity based learning and various regression techniques	Applying (K3)
CO3	utilize the concepts of decision tree learning to solve real world problems	Applying (K3)
CO4	solve problems using Bayesian and support vector machine models	Applying (K3)
CO5	build ensemble models and work with clustering algorithms	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	2	2						2	3	2
CO2	3	2	2	2	2	2						2	3	2
CO3	3	2	2	2	2	2						2	3	2
CO4	3	2	2	2	2	2						2	3	2
CO5	3	2	2	2	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	40	50				100
CAT2	10	20	70				100
CAT3	10	40	50				100
ESE	5	35	60				100

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

20ALL41 - WEB TECHNOLOGY LABORATORY

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Object Oriented Programming	4	ES	0	0	2	1
Preamble	This course provides an introduction for developing web applications using html, CSS, Bootstrap, Node.js and ReactJS.						

List of Exercises / Experiments:

1.	Design a web page using HTML tags and host it in github repository
2.	Design an attractive webpage using style sheets
3.	Design a responsive website using Bootstrap
4.	Design a webpage to create simple interactive calculator using Event Handling
5.	Design a web application using HTTP Request and HTTP Response
6.	Develop simple login page by performing event handling using GET and POST method
7.	Design a simple calculator using “Modules” in Node.js
8.	Design a webpage to maintain personal information using CRUD operations in MongoDB
9.	Design a web application using components and forms in React
10.	Design a reactive form to maintain personal information and perform validation using React
11.	Implementation of simple project using ReactJS

Total: 30

REFERENCES / MANUAL /SOFTWARE

1.	Visual Studio code/ GEdit, Node JS+NPM, MongoDB
2.	ReactJS, Github

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Develop interactive web pages using HTML, CSS, JavaScript and Bootstrap.	Applying (K3), Precision (S3)
CO2	Develop a web application to maintain information in a database using server-side scripting.	Applying (K3), Precision (S3)
CO3	Apply the concepts of React to design full-fledged web applications.	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

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

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

20ALL42 - APPLIED MACHINE LEARNING LABORATORY

Programme & Branch	B.Tech. - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Python Programming	4	PC	0	0	2	1
Preamble	This course provides hands-on experience in applying machine learning algorithms for real world problems.						

List of Exercises / Experiments:

1.	Create a sample dataset and explore statistical operations using Pandas and visualize the results through plots
2.	Create a sample dataset and apply preprocessing techniques
3.	Perform dimensionality reduction using Principal Component Analysis
4.	Apply Find-S algorithm on sample dataset and find maximally specific hypothesis
5.	Implement K-Nearest Neighbor Algorithm
6.	Implement linear regression and multiple linear regression algorithms
7.	Implement and demonstrate decision tree based ID3 algorithm
8.	Implement and demonstrate the working of Naive Bayesian classifier
9.	Implement Support Vector Machine
10.	Implement and compare the working of Random Forest classifier with Adaboost model
11.	Implement K-Means clustering algorithm

Total: 30

REFERENCES/MANUAL/SOFTWARE:

1.	Laboratory Manual
2.	Software : Python

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	create dataset and apply preprocessing techniques	Applying (K3), Precision (S3)
CO2	implement supervised learning algorithms with sample dataset	Applying (K3), Precision (S3)
CO3	apply ensemble and clustering methods for sample dataset	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

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

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	4	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)**

20ALT51 - DEEP LEARNING

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	PC	3	1	0	4

Preamble	This course is designed to impart the skills required to build different deep neural network architectures.	
Unit – I	**Neural Networks:**	**9+3**
Introduction – Basic Architecture of Neural Networks – Training Neural Network with Backpropagation – Practical Issues in Neural Network Training - Power of Function Composition – Common Neural Architectures – Neural Architectures : Binary Classification Models – Multiclass Models – Matrix Factorization with Autoencoders – Basic Principles of Autoencoders – Nonlinear Activations –Deep Autoencoders.		
Unit – II	**Training Deep Neural Networks:**	**9+3**
Introduction – Backpropagation- Setup and Initialization Issues – Vanishing and Exploding Gradient Problems – Gradient Descent Strategies – Batch Normalization – Practical Tricks for Acceleration and Compression – Bias – Variance Trade-Off –Generalization Issues in Model Tuning and Evaluation – Penalty-based Regularization – Ensemble Methods – Early Stopping – Unsupervised Pretraining.		
Unit – III	**Radial Basis Function Networks and Boltzmann Machines:**	**9+3**
Radial Basis Function : Introduction –Training an RBF Network – Hopfield Network – The Boltzman Machine – Restricted Boltzman Machine – Applications of Restricted Boltzman Machines.		
Unit – IV	**Recurrent Neural Networks:**	**9+3**
Introduction – Architecture of Recurrent Neural Networks – Challenges of training Recurrent Networks – Echo-State Networks – Long Short-Term Memory (LSTM) – Gated Recurrent Units (GRUs) – Applications of Recurrent Neural Networks.		
Unit – V	**Convolution Neural Networks:**	**9+3**
Introduction – Basic Structure of Convolutional Network – Training a Convolutional Network – Case Studies of Convolutional Architectures – Applications of Convolutional Networks – Attention Mechanism.		

Lecture :45,Tutorial:15,Total: 60

TEXT BOOK:

1.	Aggarwal, Charu C, “Neural Networks and Deep learning”, 1st Edition, Springer Cham, 2018.

REFERENCES:

1.	Ian Goodfellow, Yoshua Bengio, and Aaron Courvill, “Deep Learning”, 1st Edition, MIT Press, USA, 2016.
2.	Josh Patterson and Adam Gibson, “Deep Learning – A Practitioner"s Approach”, 1st Edition, O"Reilly Series, August2017.
3.	Indra den Bakker, “Python Deep Learning Cookbook”, 1st Edition, Packt Publishing, October 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply Artificial Neural Network concepts to solve real world problems	Applying (K3)
CO2	solve simple real world problems using deep neural networks	Applying (K3)
CO3	demonstrate the concepts of RBF and Boltzman machines to solve real world problems	Applying (K3)
CO4	explicate the concepts of RNN models and apply it for solving Natural Language problems	Applying (K3)
CO5	exemplify the concepts of CNN models and apply it for solving computer vision relatedproblems	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							2	3	2
CO2	3	2	2	2	1							2	3	2
CO3	3	2	2	2	1							2	3	2
CO4	3	2	2	2	1							2	3	2
CO5	3	2	2	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	10	55	35				100
CAT2	10	55	35				100
CAT3	10	55	35				100
ESE	5	60	35				100

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

20ALT52 - BIG DATA ANALYTICS

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	PC	3	1	0	4

Preamble	This course focuses on real-world practical aspects of bigdata using spark and build scalable application using machine learning model	
Unit – I	**Bigdata, Apache Hadoop and Spark**	**9+3**
Introduction – Understanding Big Data – Capturing Big Data – Big Data Benefit – Big Data Management – Organizing Big Data – Analyzing Big Data – Big Data Challenges – Standard Big Data Architecture – Apache Hadoop Introduction – Apache Spark Introduction		
Unit – II	**PySpark**	**9+3**
PySpark: Introduction - Features - Advantages - PySpark Architecture - Cluster Manager Types - Modules and Packages - PySpark Installation on windows - PySpark RDD - RDD creation -RDD operations - PySpark DataFrame: DataFrame creation - Convert PySpark RDD to DataFrame - Convert DataFrame to Pandas -Pyspark commands – PySpark Datasources		
Unit – III	**Pyspark SQL**	**9+3**
Spark SQL: Introduction -Basic Transformations - Managing Tables - Basic DDL and DML in Spark SQL - DML and Create Partitioned Tables - Spark SQL Functions to manipulate strings, dates, null values -Windowing Functions ranking		
Unit – IV	**Stream Processing using Kafka**	**9+3**
Kafka: Introduction - Kafka Components - Cluster Architecture - Workflow -Role of ZooKeeper - Kafka Installation - Kafka Basic Operations: Single Node-Single Broker Configuration - Single Node-Multiple Brokers Configuration - Creating a Topic-Basic Topic Operations: modifying and Deleting - Apache Kafka - Simple Producer Example - Producer API - ProducerRecord API- Simple Consumer Example - ConsumerRecord API - ConsumerRecords API		
Unit – V	**Machine Learning using Mlib**	**9+3**
Introduction - Spark MLLib - Building ML pipelines with PySpark - Hyper parameter tuning - implementing Linear Regression: Performing Exploratory Data Analysis - Dealing with categorical data - Feature Engineering - Build and Train Linear Regression Model - Prediction from the model - Classification using PySpark: Logistic Regression - Decision Tree - Random Forest		

Lecture: 45, Tutorial: 15, Total:60

TEXT BOOK:

1.	Anil Maheshwari, “Big Data”. 1st Edition, McGraw Hill Education, 2017 for Unit 1.
2.	Ankam, V, “Big data analytics”. 1st Edition, Packt Publishing Ltd, 2016 for Units 2,3,4,5

REFERENCES:

1.	Seema Acharya, Subhashini Chellappan, “Big Data and Analytics”, 2nd Edition, Wiley, 2019.
2.	DT Editorial Services, “Big Data, Black Book: Covers Hadoop 2, MapReduce, Hive, YARN, Pig, R and Data Visualization”, 1st Edition, Dreamtech Press; 2016.
3.	https://sparkbyexamples.com/pyspark-tutorial/ https://www.tutorialspoint.com/apache_kafka/apache_kafka_quick_guide.htm https://sparkbyexamples.com/pyspark/pyspark-sql-with-examples/

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 its architecture	Understanding (K2)
CO2	make use of PySpark to perform data processing	Applying (K3)
CO3	perform Querying operations using PySpark SQL	Applying (K3)
CO4	perform real time streaming processing using Kafka	Applying (K3)
CO5	apply machine learning techniques using PySpark	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	2								3	2
CO2	3	2	2	2	2								3	2
CO3	3	2	2	2	2								3	2
CO4	3	2	2	2	2								3	2
CO5	3	2	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	60	30				100
CAT2	10	60	30				100
CAT3	10	60	30				100
ESE	5	65	30				100

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

20ALC51 - DATA MODELING AND BUSINESS INTELLIGENCE

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	PC	3	0	2	4

Preamble	This course provides an exposure on loading, transforming and handling of data. Also it provides Knowledge about analyzing, reporting results for better decision making.	
Unit – I	**Data Warehousing and Business Intelligence:**	**9**
Different Worlds of Data Capture and Data Analysis - Goals of Data Warehousing and Business Intelligence - Dimensional Modeling Introduction - Kimball's DW/BI Architecture - Alternative DW/BI Architectures - Dimensional Modeling Myths - More Reasons to Think Dimensionally - Agile Considerations		
Unit – II	**Dimensional Modeling Techniques:**	**9**
Dimensional Modeling Techniques: Fundamental Concepts - Basic Fact Table Techniques - Basic Dimension Table Techniques - Integration via Conformed Dimensions - Dealing with Slowly Changing Dimension Attributes - Dealing with Dimension Hierarchies - Advanced Fact Table Techniques - Advanced Dimension Techniques - Special Purpose Schemas – Retail Sales: Four-Step Dimensional Design Process – Case Study - Dimension Table Details - Retail Schema in Action - Retail Schema Extensibility – Factl ess Fact Tables - Dimension and Fact Table Keys - Resisting Normalization Urges		
Unit – III	**DW/BI Lifecycle, Process and Task:**	**9**
Lifecycle Roadmap – Launch Activities – Technology Track – Data Track – BI Applications Track – Wrap-up Activities – Dimensional Modeling Process and Task: Modeling Process – Get Organized – Design the Dimensional Model		
Unit – IV	**ETL Subsystems and Techniques:**	**9**
Round up the requirements – The 34 Subsystems of ETL – Extracting: Getting Data Into the Data Warehouse – Cleaning and Conforming Data – Delivering: Prepare for Presentation – Managing the ETL Environment		
Unit – V	**ETL System Design and Big Data Analytics:**	**9**
ETL Process Overview – Develop the ETL Plan - Develop One-Time Historic Load Processing - Develop Incremental ETL Processing - Real-Time Implications – Big Data Analytics: Big Data Overview - Recommended Best Practices for Big Data		

List of Exercises / Experiments:

1.	Installation and Configuration of tableau and airflow.
2.	Collecting, Cleaning and Connecting to data.
3.	Perform ETL process for the given data source.
4.	Create charts like bubble, bar, map using Airflow and Tableau.
5.	Create your story from the charts with valid reasons.
6.	Build a Map view using Tableau (Explore your data geographically)
7.	Collect appropriate data, Perform ETL process and develop Scorecard using Air flow and Tableau
8.	Collect appropriate data, Perform ETL process and develop dashboard for Health Care using Air flow and Tableau

Lecture: 45, Practical: 30, Total: 75

TEXT BOOK:

1.	Ralph Kimball, Margy Ross."The Data Warehouse Toolkit", 3rd Edition, Wiley, 2013.

REFERENCES / MANUALS / SOFTWARE:

1.	Ralph Kimball, Margy Ross, Warren Thornthwaite, Joy Mundy, Bob Becker. The Data Warehouse Lifecycle Toolkit, 3rd Edition, Wiley, 2008.

2.	Python
3.	Any ETL tool like, qlikview, qliksese, Airflow, Tableau
4	Lab Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	interpret basic business intelligence architectures	Applying (K3)
CO2	build various dimensional modeling data models and experiment various data preprocessing operations	Applying (K3)
CO3	apply Business Intelligence life cycle and its associated tasks	Applying (K3)
CO4	demonstrate ETL process and subsystems using ETL tools	Applying (K3)
CO5	design and implement ETL plan for various real life BI applications	Applying (K3)
CO6:	Experiment various data preprocessing operations	Applying (K3) Precision(S3)
CO7:	Use ETLTools for processing the data	Applying (K3) Precision(S3)
CO8	Create reports for various real life BI applications	Applying (K3) Precision(S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1									2	3	1
CO2	3	2	1									2	3	1
CO3	3	2	1									2	3	1
CO4	3	2	1									2	3	1
CO5	3	2	1									2	3	1
CO6	3	2	2	2	3							2	3	3
CO7	3	2	2	2	3							2	3	3
CO8	3	2	2	2	3							2	3	3

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

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	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)**

20ALL51 – DEEP LEARNING LABORATORY

Programme& Branch	BTech – Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	PC	0	0	2	1
Preamble	This course provides hands-on experience in applying deep learning algorithms for solving real world problems						

List of Exercises / Experiments:

1.	Create a multi-layer neural network and apply it to MNIST dataset.
2.	Develop an application for outlier detection using Autoencoder
3.	Perform hyper parameter tuning and regularization to improve the performance of a classifier.
4.	Implement a movie recommender system using RBM
5.	Implement Recurrent neural networks to generate new text.
6.	Implement LSTM to perform time series prediction
7.	Develop a chatbot using ChatGPT API
8.	Implement Convolutional neural networks and use them to classify images
9.	Develop a hand written character recognition application using CNN
10.	Implement a movie recommender system using RBM

Total: 30

REFERENCES / MANUAL / SOFTWARE:

1.	Operating System : Windows / Linux
2.	Software : Python
3.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	apply deep neural network for simple problems.	Applying (K3), Precision (S3)
CO2:	apply CNN for image processing and RNN for text analysis.	Applying (K3), Precision (S3)
CO3	bulid sequence – sequence applications using RNN	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	3							2	2	3
CO2	3	2	3	3	3							2	2	3
CO3	3	2	3	3	3							2	2	3

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

20ALL52 – BIG DATA ANALYTICS LABORATORY

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	PC	0	0	2	1
Preamble	This course provides hands-on experience in applying big data analytics for solving real world problems						

List of Exercises / Experiments:

1.	Install PySpark and establish the necessary context.
2.	Create RDD and perform transformations using PySpark.
3.	Perform computations on RDD.
4.	Perform data processing from different data sources.
5.	Perform DDL and DML operations in PySpark SQL.
6.	Implement Spark SQL Functions to manipulate strings, dates using PySpark SQL.
7.	Apply Windowing Functions and aggregate function using PySpark SQL.
8.	Implement producer consumer scenario using Kafka.
9.	Apply supervised learning algorithms using PySparkMLib
10.	Apply unsupervised learning algorithmsusing PySparkMLib

Total: 30

REFERENCES / MANUAL / SOFTWARE:

1.	Hadoop, Spark, PySpark, Kafka, PySparkSQL, Mlib Libraries
2.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	Apply data processing operation using PySpark and PySparkSQL	Applying (K3), Precision (S3)
CO2:	Implement real time applications using Kafka	Applying (K3), Precision (S3)
CO3	Build real time processing applications and Machine Learning Pipelines in PySpark	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

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

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

20GEL61 / 20GEI61 PROFESSIONAL SKILLS TRAINING II/ Industrial 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	5	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)**

20ALT61 - INFORMATION RETRIEVAL TECHNIQUES

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Applied Machine Learning	6	PC	3	1	0	4

Preamble	This course discusses the basics of information retrieval, search engine operations and web information retrieval techniques.	
Unit - I	**Introduction:**	**9+3**
Information Retrieval - The IR Problem - The users task - Information versus data retrieval - The IR System - Software architecture of IR system - Retrieval and ranking processes - The web - Web changed search - Practical issues on the web		
Unit - II	**IR Modeling:**	**9+3**
Basic IR Models – Boolean Model – Term Frequency-Inverse Document Frequency Weighting – Variants of TF-IDF – TF-IDF Properties – Document Length Normalization - Vector Model		
Unit - III	**Text Clustering and Classification:**	**9+3**
Introduction – Characterization of Text classification- Text classification Problems and Algorithms- Unsupervised Algorithm - Clustering - K means Clustering - Hierarchical Clustering - Supervised Algorithms – Decision Tree		
Unit - IV	**Web Retrieval:**	**9+3**
The Web – Characteristics – Structure of the web graph – Modeling the web – Link Analysis - Search Engine Architectures – Cluster Based Architecture – Caching – Multiple Indexes - Distributed Architectures - Harvest – Multi-site Architecture - Search Engine Ranking		
Unit - V	**Web Crawling:**	**9+3**
Web Crawling: Introduction – Applications of a Web Crawler – General and Vertical web search – Topical Crawling – Web Characterization – Mirroring –Web Archiving –Website Analysis – Taxonomy of Crawlers – Architecture of Crawlers – Parallel and Distributed Crawling - Scheduling Algorithm – Selection policy - Focused Crawling		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1. Ricardo Baeza-Yate, Berthier Ribeiro-Neto, “Modern Information Retrieval”, 2nd Edition, Pearson Education Asia, 2011

REFERENCE:

1. Chowdhury G.G., “Introduction to Modern Information Retrieval”, 2nd Edition, Neal-Schuman Publishers, 2003.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	describe the basic concepts of information retrieval	Understanding (K2)
CO2	apply the various modeling techniques	Applying (K3)
CO3	discuss the concepts of text clustering and classification	Applying (K3)
CO4	learn about web information retrieval	Applying (K3)
CO5	explore about web crawling 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	10	50	40				100
CAT2	10	50	40				100
CAT3	10	50	40				100
ESE	5	55	40				100

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

20ALT62 -NATURAL LANGUAGE PROCESSING

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	PC	3	0	0	3

Preamble	This course focuses on natural language text processing, text classification, text summarization and clustering.	
Unit – I	**Introduction to NLP:**	**9**
Natural Language – Language Acquisition and Usage – Language Syntax and Structure – Language Semantics – Lexical Semantic Relations – Semantics Representation– Text Corpora – Accessing Text Corpora – Natural Language Processing – Text Analytics		
Unit – II	**Processing and Understanding Text:**	**9**
Text Tokenization – Text Normalization – Correcting Words – Stemming – Lemmatization – Text Syntax and Structure – POS Tagging – Shallow Parsing – Dependency Based Parsing – Constituency Based Parsing		
Unit – III	**Text Classification:**	**9**
Text Classification – Automated Text Classification – Text Classification Blueprint – Text Normalization – Feature Extraction – Bag of Words Model – TF-IDF Model – Advanced Word Vectorization Model – Classification Algorithm – Evaluating Classification Models – Building a Multi-Class Classification System – Application and Uses		
Unit – IV	**Text Summarization:**	**9**
Text Summarization – Text Normalization – Feature Extraction – Key Phrase Extraction – Topic Modeling – Automated Document Summarization		
Unit – V	**Text Similarity and Clustering:**	**9**
Information Retrieval – Feature Engineering – Similarity Measures – Unsupervised Machine Learning Algorithms – Text Normalization – Feature Extraction – Text Similarity – Analyzing Term Similarity – Analyzing Document Similarity – Document Clustering – Clustering Greatest Movies of All Time		

Total: 45

TEXT BOOK:

1. Dipanjan Sarkar, “Text Analytics with Python: A Practical Real-World Approach to Gaining Actionable Insights from your Data”, 1st Edition, Apress, 2016.

REFERENCES:

1. Michael W. Berry & Jacob Kogan, "Text Mining Applications and Theory", Wiley publications, 2010
2. Christopher Manning and Hinrich Schuetze,” Foundations of Statistical Natural Language Processing”, 1st Edition, MIT Press, London, 2000.

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 various text processing techniques	Applying (K3)
CO3	build text classification model	Applying (K3)
CO4	perform automatic text summarization	Applying (K3)
CO5	perform text similarity and clustering	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	1									2	3	3
CO5	3	2	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	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)**

20ALT63 - IMAGE AND VIDEO ANALYTICS

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	PC	3	0	0	3

Preamble	This course aims to provide a broad view on processing and analyzing images and video.	
Unit – I	**Introduction:**	**9**
Deep Neural Networks – Introduction to Tensor flow – Keras Deep Learning library – OpenCV Library - Hand Written Number Recognition with Keras and OpenCV – Understanding Back propogation		
Unit – II	**Convolutional Neural Network for Computer Vision:**	**9**
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 - ResNet		
Unit – III	**Feature extraction, object detection and segmentation:**	**9**
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 – YOLO Object Detection Algorithm		
Unit – IV	**Generative Models:**	**9**
Pix2pix - Image-to-Image translation - GAN – code example – feature matching – applications of generative models – neural artistic style transfer – generative adversarial networks – visual dialogue model		
Unit – V	**Video Classification:**	**9**
Understanding and classifying videos – exploring video classification dataset – splitting videos into frames – approaches for classifying videos – extending image based approaches to videos: Regressing the human pose- segmenting videos – generating videos		

Total: 45

TEXT BOOK:

1.	Mohit Sewak, Md. Rezaul Karim and Pradeep Pujari, “Practical Convolutional Neural Networks, Packt Publishing, 2018 for Units 1, 2 and 3.
2.	Rajalingappaa Shanmugamani, “Deep Learning for Computer Vision”, Packt Publishing, 2018 for Units 4 and 5.

REFERENCES:

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.

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	2		1								3	2
CO2	3	2	2		1								3	2
CO3	3	2	2		1								3	2
CO4	3	2	2		1								3	2
CO5	3	2	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	40	50				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)**

20ALL61 - NATURAL LANGUAGE PROCESSING LABORATORY

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	PC	0	0	2	1
Preamble	This course provides hands-on experience in applying NLP concepts for solving real world problems						

List of Exercises / Experiments:

1.	Create text corpus for analysis
2.	Work with text analytics framework
3.	Apply text processing methods for sample dataset
4.	Work with feature extraction techniques
5.	Perform text classification for sample dataset
6.	Build multiclass classification model for sample dataset
7.	Perform text summarization for sample dataset
8.	Work with topic modeling
9.	Analyze text similarity using various measures
10.	Perform document clustering for sample dataset

Total: 30

REFERENCES / MANUAL / SOFTWARE:

1.	Laboratory Manual
2.	Python

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	work with text extraction and processing	Applying (K3) Precision (S3)
CO2:	perform text classification and summarization	Applying (K3) Precision (S3)
CO3	work with topic modeling and text similarity	Applying (K3) Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3							2	3	3
CO2	3	2	2	2	3							2	3	3
CO3	3	2	2	2	3							2	3	3

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

20ALL62 - IMAGE AND VIDEO ANALYTICS LABORATORY

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	PC	0	0	2	1
Preamble	This course provides hands-on experience in processing and analyzing images and video						

List of Exercises / Experiments:

1.	Build a CNN model to perform Handwritten Number Recognition using Tensorflow
2.	Build a CNN model to perform Handwritten Number Recognition using Keras
3.	Experiment the model performance using the ImageNet, LeNet and AlexNet CNN models.
4.	Experiment the model performance using the VGGNet, GoogleLENet and ResNet CNN models.
5.	Perform detection of object using Fast R-CNN
6.	Perform detection of object using Faster R-CNN
7.	Apply YOLO object detection algorithm for real world problem
8.	Experiment image to image translation using GAN
9.	Explore generative adversarial networks and its features on simple data set
10.	Perform video classification using deep learning techniques

Total: 30

REFERENCES / MANUAL / SOFTWARE:

1.	Tensorflow/OpenCV
2.	Matlab/Python
3.	Lab Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	experiment the basic features of Keras and Tensorflow to implement CNN model.	Applying (K3), Precision (S3)
CO2:	implement image segmentation and GAN to provide more effective solutions.	Applying (K3), Precision (S3)
CO3	develop a real time model for video analytics using deep learning techniques	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3							2	3	3
CO2	3	2	2	2	3							2	3	3
CO3	3	2	2	2	3							2	3	3

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

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

20MNT31 - ENVIRONMENTAL SCIENCE
(Common to all Engineering and Technology Branches)

Programme & Branch	All BE/BTech Engineering & Technology branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	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)

20ALP61 - PROJECT WORK I

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	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	All BE/BTech branches except Chemical 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)**

20ALC71 - TRANSFER LEARNING

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PC	3	0	2	4

Preamble	This course enables to learn foundations of transfer learning and its applications.	
Unit - I	**Transfer Learning Fundamentals:**	**9**
Introduction – Transfer learning strategies – Transfer learning and deep learning – Deep transfer learning types – Challenges of transfer learning – Need for transfer learning – Building CNN models – Leveraging transfer learning with pretrained CNN models – Evaluating deep learning models.		
Unit - II	**Image Recognition and Classification:**	**9**
Deep learning based image classification – Benchmarking datasets – State-of-the-art deep image classification models – Image classification and transfer learning – Working with CIFAR-10 – Working with dog breed identification dataset.		
Unit - III	**Text Document Categorization:**	**9**
Traditional text categorization – Shortcomings of BoW model – Benchmark datasets – Word2vec model – Using gensim – GloVe model – Building a review sentiment classifier – Working with IMDB dataset with word embeddings – Creating document summaries using CNN model – Multiclass classification with CNN model – Visualizing document embeddings.		
Unit - IV	**Audio Event Identification and Classification:**	**9**
Understanding audio event classification – Exploratory analysis of audio events – Feature engineering and representation of audio events – Audio event classification with transfer learning – Building a deep learning audio event identifier.		
Unit - V	**Image Colorization:**	**9**
Problem statement – Color images – Building a coloring deep neural network – Preprocessing – Loss function – Encoder – Transfer learning – Feature extraction – Fusion layer – Decoder – Postprocessing – Training and results – Challenges.		

List of Exercises / Experiments:

1.	Build CNN model for sample dataset
2.	Implement transfer learning with pretrained CNN model
3	Implement transfer learning for imge classification with CIFAR-10 dataset
4	Apply transfer learning for dog breed identification dataset
5	Build review sentiment classifier using transfer learning
6	Apply transfer learning for IMDB dataset with word embeddings
7	Create document summaries using transfer learning
8	Perform Audio event classification with transfer learning

Lecture: 45, Practical:30, Total:75

TEXT BOOK:

1.	Sarkar, D., Bali, R., & Ghosh, T., "Hands-On Transfer Learning with Python", 1st Edition, Packt Publishing, 2018.

REFERENCES/MANUAL/SOFTWARE:

1.	Qiang Yang, Yu Zhang, Wenyuan Dai, Sinno Jiallin Pan, "Transfer Learning", 1st Edition, Cambridge University, 2020.
2.	Jindong Wang, Yiqiang Chen, "Introduction to Transfer Learning", 1st Edition, Springer, 2023.
3.	Python, Keras Framework
4.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	utilize the basics of transfer learning to build CNN model	Applying (K3)
CO2	apply transfer learning techniques for image recognition and classification	Applying (K3)
CO3	experiment text document summarization using transfer learning	Applying (K3)
CO4	apply transfer learning for audio event identification and classification	Applying (K3)
CO5	perform image colorization using transfer learning	Applying (K3)
CO6	Apply CNN model for sample dataset	Applying (K3) Precision (S3)
CO7	Apply transfer learning to perform image and text classification	Applying (K3) Precision (S3)
CO8	Apply transfer learning for summary generation and audio event 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	2	2	2								3	2
CO2	3	2	2	2	2								3	2
CO3	3	2	2	2	2								3	2
CO4	3	2	2	2	2								3	2
CO5	3	2	2	2	2								3	2
CO6	3	2	2	2	2								3	2
CO7	3	2	2	2	2								3	2
CO8	3	2	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	40	50				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)**

20ALP71- PROJECT WORK II PHASE I

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	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

20ALP81- PROJECT WORK II PHASE II

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	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

20ALE01 - THEORY OF COMPUTATION

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	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, PearsonEducation, New Delhi, 2008.

REFERENCES:

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	1	1								3	1
CO2	3	2	1	1	1								3	1
CO3	3	2	1	1	1								3	1
CO4	3	2	1	1	1								3	1
CO5	3	2	1	1	1								3	1

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	30	60				100
CAT2	10	30	60				100
CAT3	10	30	60				100
ESE	5	25	70				100

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

20ALE02 - MULTICORE ARCHITECTURE

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	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 – Performance, Price and Power		
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 – : Memory Hierarchies in the ARM Cortex -A53 and Intel Core i7 6700.		
Unit – III	**Data Level Parallelism:**	**9**
Introduction – Vector Architectures – SIMD Instruction Set Extensions for Multimedia – Graphics Processing Units – Detecting and Enhancing Loop Level Parallelism – Embedded Versus Server GPUs and Tesla Versus Core i7.		
Unit – IV	**Thread Level Parallelism:**	**9**
Introduction - Centralized Shared-Memory Architectures – Performance of Symmetric Shared-Memory Multiprocessors – Distributed Shared-Memory and Directory-Based Coherence – Synchronization basics – Models of Memory Consistency - Multicore Processors and Their Performance		
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	make use of the fundamental design and quantitative analysis of multicore architecture	Applying (K3)
CO2	apply the various features and optimized techniques of memory hierarchy	Applying (K3)
CO3	achieve data level parallelism by applying loop level parallelism and understand the architecture of Vector/GPU processor	Applying (K3)
CO4	utilize the thread level parallelism for efficient shared memory access.	Applying (K3)
CO5	interpret the architectures of GPUs, warehouse scale computers and choose an appropriate model for a given problem.	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**	**1**									**3**	**1**
CO2	**3**	**3**	**2**	**1**									**3**	**1**
CO3	**3**	**3**	**1**	**1**									**3**	**1**
CO4	**3**	**3**	**2**	**1**									**3**	**1**
CO5	**3**	**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	60	30				100
CAT2	10	60	30				100
CAT3	10	60	30				100
ESE	5	60	35				100

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

20ALE03 - COMPUTER NETWORKS

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	PE	3	0	0	3

Preamble	This course deals with the fundamental concepts of computer networks. It presents bottom up approach of different layers along with their concepts and protocols.	
Unit – I	**Network Models and Physical Layer:**	**9**
Data Communications - Network - Networks Types. Network Models: TCP/IP Protocol model - The OSI Model. **Physical Layer:** Digital-to-digital conversion: Line coding - Line Coding Schemes - Transmission Modes - Transmission media: Guided - Unguided media.		
Unit – II	**Data Link Layer:**	**9**
Introduction – Link Layer Addressing – Error Detection and Correction: Introduction – Block Coding – CRC – Checksum– DLC Services –. Media Access Control Protocols: Random Access Protocols – Controlled Access- Wired LAN: Standard Ethernet – Connecting Devices		
Unit – III	**Network Layer:**	**9**
Network Layer Services- Network layer performance - IPV4 addresses – Internet Protocol (IP) - ICMPv4. Unicast Routing Algorithms: Distance Vector and Link-state routing – Routing Protocols: RIP and OSPF - IPV6 addressing- IPV6 protocol.		
Unit – IV	**Transport Layer:**	**9**
Introduction – Transport layer protocols: Simple – Stop-and-wait - Go-back-N – Selective Repeat - Piggybacking – User Datagram Protocol – Transmission Control Protocol.		
Unit – V	**Application Layer:**	**9**
Introduction: Application layer paradigms - WWW - Hypertext Transfer Protocol - File Transfer Protocol - Electronic mail –Telnet - SSH, Domain Name System. Network Management: Introduction - SNMP.		

Total: 45

TEXT BOOK:

1.	Behrouz A. Forouzan, “Data Communications and Networking”, McGraw-Hill, 5th Edition, 2013.

REFERENCES:

1.	Kurose James F. and Ross Keith W., “Computer Networking: A Top-Down Approach”, 6th Edition, Pearson Education, New Delhi, 2017.
2.	Stallings, “Data and Computer Communications”, PHI, 10th Edition, New Delhi, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the basic fundamentals of networks for data communication and apply the different line coding schemes for digital-to-digital conversion	Applying (K3)
CO2	demonstrate the knowledge of error detection and correction methods and protocols at data link layer	Applying (K3)
CO3	interpret the different addressing schemes and apply various routing protocols at network layer	Applying (K3)
CO4	illustrate the different transport layer protocols and employ suitable flow control techniques	Applying (K3)
CO5	generalize the various protocols and their working principles at application layer	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	30	50	20				100
CAT2	20	50	30				100
CAT3	30	50	20				100
ESE	10	50	40				100

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

20ALE04 - SOFT COMPUTING TECHNIQUES

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	PE	3	0	0	3

Preamble	To learn and understand Neural Network algorithms and Fuzzy inference systems for solving real time problems	
Unit – I	**Introduction To Neural Networks**:	**9**
Introduction to artificial Intelligence system –fundamentals of Neural Network :Basic concept of Neural networks-human brain – model of an artificial neuron-Nerural network Architecture-Characteristics of neural network-Learning Method –Taxonomy of neural network architecture-history – early Neural network architecture.		
Unit – II	**Backpropagation network:**	**9**
Architecture: the perception model –solutions-single layer artificial neural network-model for Multilayer perceptron-Backpropagation learning-Applications-Effect of tuning parameters of Backpropagation neural network-selection of various parameter on BPN-Variations of standard Backpropagation algorithm-research Directions.		
Unit – III	**Associative memory**:	**9**
Autocorrelators- Hetrocorrelator-WANG ETAL.'S multiple training encoding strategy-Exponential BAM-Associative memory for real-code pattern pairs: input normalization- evolution equations-Applications: recognition of characters-Fabric Defect Identification-recent trends.		
Unit – IV	**Fuzzy Logic**:	**9**
Fuzzy set theory :Fuzzy versus Crisp-crisp set :operations on Crisp sets-Properties of Crisp sets- partition and covering-Fuzzy sets: membership function-basic fuzzy set operations-properties of fuzzy sets-Crisp relations :Cartesian product-other crisp relations-operations on relations-Fuzzy relations.		
Unit – V	**Genetic Algorithms:**	**9**
Genetic algorithms-History –Basic concept-Creation of offspring-Working principle- Encoding-Fitness Function-reproduction: Roulette-wheel selection- Boltzmann selection-tournament selection-Rank selection-steady-state selection-Elitism-generation gap and steady statereplacement.		

Total: 45

TEXT BOOK:

1. S. Rajasekharan & G. A. VijayalakshmiPai, "Neural Networks, Fuzzy Systems and Evolutionary algorithms: synthesis and applications", 2nd Edition, Prentice Hall of India, New Delhi, 2018.

REFERENCES:

1. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", 3rd Edition, John Wiley, New Delhi, 2010
2. Sivanandam S.N, Sumathi S & Deepa S.N, "Introduction to Neural Networks using MATLAB 6.0", 1st Edition, Tata McGrawHill, New Delhi, 2006.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	make use of the neural network concepts along with its architecture	Applying (K3)
CO2	apply the techniques of back propagation network along with its parameter tuning for better result	Applying (K3)
CO3	illustrate the working of neural network and associative memory to solve real world problems	Applying (K3)
CO4	interpret the fuzzy logics to solve the neural network problems	Applying (K3)
CO5	utilize the genetic algorithm techniques to obtain the optimized solution	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	10	50	40				100
CAT2	10	50	40				100
CAT3	10	50	40				100
ESE	5	55	40				100

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

20ALE05 - WIRELESS AND SENSOR NETWORKS

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Computer Networks	7	PE	3	0	0	3

Preamble	This course provides the fundamental concepts of wireless sensor networks and explains functionalities of different layers. It also helps to devise appropriate node and network management strategies and throws light on sensor networks security.	
Unit - I	**Introduction:**	**9**
Introduction-Motivation and Wireless Sensor Nodes: Definitions and Background - Challenges and Constraints - Applications: Structural Health Monitoring - Traffic Control - Health Care, Pipeline Monitoring - Precision Agriculture - Active Volcano - Underground Mining - Node Architecture: The Sensing Subsystem - The Processor Subsystem - Communication Interfaces - Prototypes - Operating Systems: Functional Aspects - Nonfunctional Aspects – Prototypes - Evaluation.		
Unit - II	**Basic Architectural Framework and Medium Access Control:**	**9**
Physical Layer: Basic Components - Source Encoding - Channel Encoding – Modulation - Signal Propagation - Medium Access Control: Overview - Wireless MAC Protocols - Characteristics of MAC Protocols in Sensor Networks - Contention-Free MAC Protocols - Contention-Based MAC Protocols - Hybrid MAC Protocols.		
Unit - III	**Routing Protocols and Power Management:**	**9**
Network Layer: Overview - Routing Metrics - Flooding and Gossiping - Proactive Routing - On-Demand Routing - Hierarchical Routing - Location-Based Routing - QoS-Based Routing Protocols - Power Management: Local Power Management Aspects - Dynamic Power Management - Conceptual Architecture.		
Unit - IV	**Node and Network Management, Localization:**	**9**
Node and Network Management: Time Synchronization: Clocks and the Synchronization Problem - Time Synchronization in Wireless Sensor Networks - Basics of Time Synchronization - Time Synchronization Protocols. Localization: Overview, Ranging Techniques - Range-Based Localization - Range-Free Localization - Event-Driven Localization.		
Unit - V	**Security and Sensor Network Programming:**	**9**
Security: Fundamentals of Network Security - Challenges of Security in Wireless Sensor Networks - Security Attacks in Sensor Networks - Protocols and Mechanisms for Security - IEEE 802.15.4 and ZigBee Security - Sensor Network Programming: Challenges in Sensor Network Programming - Macro programming - Dynamic Reprogramming - Sensor Network Simulators.		

Total: 45

TEXT BOOK:

1. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", 1st Edition, John Wiley & Sons, 2011.

REFERENCES:

1. Mohammad S. Obaidat, Sudip Misra, "Principles of Wireless Sensor Networks", 1st Edition, Cambridge University Press, London, 2014.

'2. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks", 1st Edition, Elsevier, 2004.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply the basic concepts of wireless sensor networks in real life applications	Applying (K3)
CO2	illustrate the basic architectural framework using physical and MAC layer protocols	Applying (K3)
CO3	utilize various network layer protocols for inter and intra communication patterns	Applying (K3)
CO4	apply different synchronization and localization algorithms for managing node and network level functions	Applying (K3)
CO5	develop software and hardware components required for a sensor network 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	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	30	50	20				100
CAT2	30	50	20				100
CAT3	30	30	40				100
ESE	25	35	40				100

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

20ALE06 - AGILE METHODOLOGIES FOR SOFTWARE DEVELOPMENT

Pogramme& Branch	B.Tech. & Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PE	3	0	0	3

Preamble	This course introduces agile methodologies such as Scrum, Extreme Programming (XP), Lean, and Kanban.	
Unit – I	**Agile Principles:**	**9**
Understanding the Agile Values – Silver Bullet Methodology – Agile to the Rescue – A fractured perspective - Agile Manifesto and Purpose behind each practice – Agile Elephant – Where to start with a new Methodology – 12 principles of Agile Software – The Customer is always Right – Delivering the project – Communicating and Working Together – Project Execution – Constantly improving the project and the team – Agile Project.		
Unit – II	**Scrum and Self-Organizing Teams:**	**9**
Basic pattern for a Scrum Project – Rules of Scrum – Command-and-Control Team – Self-Organizing Teams - Scrum Values – Daily Scrum – Sprints, Planning and Retrospectives - User stories – Conditions of Satisfaction – Story Points and Velocity – Burndown Charts – Planning and Running a Sprint – GASP – Scrum Values Revisited.		
Unit – III	**XP Embracing Change and Simplicity:**	**9**
Practices Do Work Without the Values – Company Culture Compatible with Scrum Values- 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 – Code and Design – Make Code and Design Decisions at the Last Responsible Moments.		
Unit – IV	**Incremental Design and Lean:**	**9**
Incremental Design and the Holistic XP-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.		
Unit – V	**Kanban and Agile Coach:**	**9**
The Principles of Kanban – Improving Your Process with Kanban – Measure and Manage Flow – Little's Law – Emergent Behavior with Kanban – The Agile Coach – Shuhari – The Principles of Coaching.		

Total: 45

TEXT BOOK:

1. Andrew Stellman and Jennifer Greene, "Learning Agile: Understanding Scrum, XP, Lean and Kanban", 1st Edition, O'Reilly Media Inc, 2015.

REFERENCES:

1. Eric Brechner, "Agile Project Management with Kanban", 1st Edition, Microsoft Press, 2015.
2. Robert C. Martin, "Agile Software Development: Principles, Patterns, and Practices", Pearson Prentice Hall, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	outline the purpose of agile's core principles and apply for project development	Applying (K3)
CO2	utilize the scrum's emphasis on project management and self-organization	Applying (K3)
CO3	experiment various user practices using XP practices	Applying (K3)
CO4	model applications using incremental design and lean to empower the team	Applying (K3)
CO5	make use of Kanban's practices help deliver great software by managing flow	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					1	1	1		3	2
CO2	3	2	1	1					1	1	1		3	2
CO3	3	2	1	1					1	1	1		3	2
CO4	3	2	1	1					1	1	1		2	2
CO5	3	2	1	1					1	1	1		3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT 1	10	60	30				100
CAT 2	10	60	30				100
CAT 3	10	60	30				100
ESE	5	65	30				100

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

20ALE07 - WEB MINING

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Applied Machine Learning	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)", 2nd Edition, Springer; 2011 for Units 1, 2, 3, 4 and 5
2.	Zdravko Markov, Daniel T. Larose, "Data Mining the Web: Uncovering Patterns in Web Content, Structure, and Usage", John Wiley & Sons, Inc., 2010 for Unit 4.

REFERENCE:

1.	Matthew A. Russell, Mikhail Klassen, "Mining the Social Web", 3rd Edition, O'Reilly Media, 2019.

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	capture and model the behavioral patterns and profiles of users interacting with a web site	Applying (K3)
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**	**1**									**3**	**2**
CO2	**3**	**2**	**1**	**1**									**3**	**2**
CO3	**3**	**2**	**1**	**1**									**3**	**2**
CO4	**3**	**3**	**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	10	50	40				100
CAT2	10	50	40				100
CAT3	10	50	40				100
ESE	5	55	40				100

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

20ALE08 - MODELING AND SIMULATION

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PE	3	0	0	3

Preamble	This course focuses on applications of computer simulation and modeling to real world simple and complex problems.	
Unit – I	**Modeling Process:**	**9**
Introduction - Model Classifications - Steps of modeling - System Dynamics: Unconstrained Growth and decay: rate of change- Differential and Difference Equation - Simulation Programs - Analytical Solution - Further Refinement - Unconstrained Decay - Constrained Growth: Carrying Capacity, Revised Model, Equilibrium and Stability - Drug Dosage: One-Compartment Model, Two-Compartment Model		
Unit – II	**System Dynamics Models with Interactions:**	**9**
Competition: Introduction - Modeling of Competition - Predator–Prey Model - Modeling the spread of SARS: SIR Model - SAR Model - reproductive number - Enzyme Kinetics-A Model of Control: Enzymatic Reactions - Differential Equations – Model - Moles vs. Molar - Michaelis-Menten Equation - Modeling Inhibition		
Unit – III	**Error and Simulation Techniques:**	**9**
Errors : types of errors – precision - Absolute and Relative Errors - Round-off Error - Round-off Error - Overflow and Underflow - Arithmetic Errors - error propagation –Violation of Numeric Properties - truncation error - Simulation Techniques: Euler's Method - Runge-Kutta 2 Method - Runge-Kutta 4 Method		
Unit – IV	**Data Driven Models:**	**9**
Functions and its types – Empirical Models : Linear Empirical Model – Predictions - Linear Regression - Nonlinear One-Term Model - Multiterm Models - Simulating with Randomness - Random numbers from various distributions: types of distribution– Random Walk - Algorithm - Animate Path - Average Distance Covered -Relationship between Number of Steps and Distance Covered.		
Unit – V	**Cellular Automation:**	**9**
Diffusion: System initialization - Heat Diffusion - Boundary Conditions - Applying - Simulation Program and Display - Spreading of Fire: initialization – rules updating – Periodic Boundary Conditions – Movement of Ants: formulating models- Biofilms - High Performance Computing: Concurrent Processing – Parallel Algorithms		

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. Cesar De Prada, Costas Pantelides, Jose Luis Pitarch, "Process Modelling and Simulation", 1st Edition, MDPI Books, 2019.

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	identify sources of computational error and make use of simulation techniques	Applying (K3)
CO4	make use of randomness and data for modeling	Applying (K3)
CO5	utilize cellular automation for modeling natural processes and explain concurrent processingand parallel algorithms	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									3	1
CO2	3	2	1	2									3	1
CO3	3	2	1	2									3	1
CO4	3	2	1	2									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	60	30				100
CAT2	10	60	30				100
CAT3	10	60	30				100
ESE	5	65	30				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)**

20ALE09 - INFORMATION SECURITY

Programme& Branch	BTech – Artificial Intelligence and Machine Learning	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					2	1
CO2	3	2	1					2					2	1
CO3	3	2	1					2					2	1
CO4	3	2	1					2					2	1
CO5	3	2	1					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	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)**

20ALE10 - REGRESSION ANALYSIS

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	PE	2	0	2	3

Preamble	This course enables to learn and use different regression models to predict outcomes.	
Unit - I	**Linear Regression:**	**6**
Regression analysis and data science : exploring the promise of data science-The challenge-The linerar model- Python packages for datascience– python packages and functions for Linear models – Defining a regression problem-starting from the basics-extending to linear regression – minimizing the cost function		
Unit - II	**Multiple Regression and Logistic Regression:**	**6**
Multiple Features– Revisiting gradient descent – Estimating features importance – Interaction models – Polynomial regression-Defining a classification problem –Defining a probability-based approach-revisiting gradient descent –Multiclass Logistic regression.		
Unit - III	**Data Preparation and Generalization:**	**6**
Numeric feature scaling– Qualitative feature encoding-Numeric feature transformation – Missing data – outliers-checking on out-of-sample data –Greedy selection of features-Regularization optimized by grid-search-stability selection.		
Unit - IV	**Advanced Regression Methods:**	**6**
Least angle regression – Bayesian regression – SGD classification with hinge loss – Regression Trees – Bagging and Boosting – Real world applications of regression models:Downloading the datasets-A Regression Problem.		
Unit - V	**Real world Applications:**	**6**
Downloading the datasets: Time series problem dataset-regression dataset-multiclass classification problem dataset –ranking problem-regression problem-imbalanced and multiclass classification problem –ranking problem-A time series problem.		

List of Exercises / Experiments:

1.	Work with Numpy, Scipy, Statsmodels and Scikit-Learn
2.	Implement linear regression with Scikit-Learn
3.	Implement multiple regression
4.	Implement polynomial regression
5.	Implement logistic regression
6.	Apply Regression techniques for time series data
7.	Apply regression technique for multi class classification problem
8.	Apply regression technique for imbalaned dataset

Lecture:30, Practical:30, Total:60

TEXT BOOK:

1.	Luca Massaron, Alberto Boschetti, “Regression Analysis with Python”, 1st Edition, Packt Publishing, 2016.

REFERENCE:

1.	Alvaro Fuentes, “Hands-On Predictive Analytics with Python: Master the complete predictive analytics process, from problem definition to model deployment”, Packt Publishing, 2018.
2.	Douglas C Montgomery, Elizabeth A Peck, G.Geoffrey Vining, “Introduction to Linear Regression Analysis”, 3rd Edition, Wiley India, 2006.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply linear regression model to solve problems	Applying (K3)
CO2	make use of multiple regression and logistic regression models for a given problem	Applying (K3)
CO3	prepare data and perform regularization	Applying (K3)
CO4	demonstrate the ensembling approaches to regression problems	Applying (K3)
CO5	apply regression methods to real world problems	Applying (K3)
CO6	work with linear and multiple regression	Applying (K3) Precision (S3)
CO7	work with polynomial and logistic regression	Applying (K3) Precision (S3)
CO8	work with advanced regression methods	Applying (K3) Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1								3	2
CO2	3	2	2	1	1								3	2
CO3	3	2	2	1	1								3	2
CO4	3	2	2	1	1								3	2
CO5	3	2	2	1	1								3	2
CO6	3	2	2	1	1							2	3	2
CO7	3	2	2	1	1							2	3	2
CO8	3	2	2	1	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	10	40	50				100
CAT2	10	40	50				100
CAT3	10	40	50				100
ESE	5	45	50				100

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

20ALE11 - REINFORCEMENT LEARNING

Programme& Branch	B.Tech. & Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Appllied Machine Learning	7	PE	3	0	0	3

Preamble	This course deals with modeling, analysis tools and techniques for problems of dynamic decision making under uncertainty. It also deals with convergence and accuracy of such algorithms.

Unit – I	**Introduction and Basics of RL:**	**9**
Reinforcement Learning – Examples - Elements of Reinforcement Learning - Limitations and Scope - An Extended Example: Tic-Tac-Toe - History of Reinforcement Learning		
Unit – II	**Tabular Solution Methods:**	**9**
Multi-arm Bandits - An n-Armed Bandit Problem - Action-Value Methods - Incremental Implementation- Tracking a Nonstationary Problem - Optimistic Initial Values - Upper-Confidence - Bound Action Selection - Gradient Bandit - Associative Search		
Unit – III	**Finite Markov Decision Processes:**	**9**
The Agent – Environment Interface - Goals and Rewards – Returns - Unified Notation for Episodic and Continuing Tasks - Policies and Value Functions - Optimal Policies and Optimal Value Functions - Optimality and Approximation		
Unit – IV	**Dynamic Programming and Monte Carlo Methods:**	**9**
Dynamic Programming - Policy Evaluation - Policy Improvement - Policy Iteration - Value Iteration - Generalized Policy Iteration. Monte Carlo Methods: Monte Carlo Prediction - Monte Carlo Estimation of Action Values - Monte Carlo Control - Monte Carlo Control without Exploring Starts		
Unit – V	**Temporal-Difference Learning:**	**9**
TD Prediction - Advantages of TD Prediction Methods - Optimality of TD(0) - Sarsa: On-Policy TD Control - Q-Learning: Off-Policy TD Control - Games, After states, and Other Special Cases		

Total: 45

TEXT BOOK:

1	Richard S. Sutton and Andrew G. Barto, “Reinforcement Learning: An Introduction", 2nd Edition, MIT Press, London, 2018

REFERENCE:

1	Phill winder, “Reinforcement Learning: Industrial applications of intelligent agents", 1st Edition, O'Reilly Media, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	illustrate RL tasks and the core principles behind the RL	Understanding (K2)
CO2	apply tabular methods to solve classical control problems	Applying (K3)
CO3	utilize Markov decision process in optimization of complex problems	Applying (K3)
CO4	solve problems using dynamic programming and Monte-Carlo methods	Applying (K3)
CO5	make use of temporal-difference learning and Q-learning methods in special cases	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									3	1
CO2	3	2	2	1									3	2
CO3	3	2	2	1									3	2
CO4	3	2	2	1									3	2
CO5	3	2	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	45	45				100
CAT2	10	45	45				100
CAT3	10	45	45				100
ESE	5	45	50				100

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

20ALE12 – HEALTH CARE ANALYTICS

Programme& Branch	B.Tech. & Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	PE	3	0	0	3

Preamble	This course enables the students to learn and understand health data formats, frameworks and work with clinical prediction models

Unit – I	**Healthcare Analytics and Data Sources:**	**9**
Introduction to Healthcare Data Analytics: Introduction– Healthcare Data Sources and Basic Analytics– Advanced Data Analytics for Healthcare-Applications and practical systems for Healthcare – Resources for healthcare data analytics. Electronic Health Records: Introduction– History-Components– Coding Systems – Benefits- Barrier– Challenges– Phenotyping Algorithms.		
Unit – II	**Healthcare Image and Text Data Analytics:**	**9**
Biomedical Image Analysis: Introduction– Modalities– Object Detection– Image Segmentation– Image Registration– Feature Extraction. Natural Language Processing: Introduction– Natural Language Processing– Mining Information from Clinical Text– Challenges of Processing Clinical Reports– Clinical Applications.		
Unit – III	**Biomedical and Social Media Data Analytics:**	**9**
Mining the Biomedical Literature: Introduction- Resources– Terminology Acquisition and Management– Information Extraction-Discourse Interpretation– Text Mining Environments– Applications– Integration with Clinical Text Mining. Social Media Analytics for Healthcare: Introduction– Detection and Tracking of Infectious Disease– Public Health Research–Use in Healthcare.		
Unit – IV	**Clinical Prediction Models:**	**9**
Review of Clinical Prediction Models: Introduction– Basic Statistical Prediction Models: Linear Regression– Generative Additive Model- Logistic Regression– Bayesian Models- Markov Random Fields– Alternative Clinical Prediction Models– Survival Models-Evaluation and Validation: Evaluation Metrics– Validation.		
Unit – V	**Temporal and Visual Data Analytics:**	**9**
Temporal Data Mining for Healthcare Data: Introduction– Association Analysis– Temporal Pattern Mining– Sensor Data Analysis-Other Temporal Modeling Methods– Resources. Visual Analytics for Healthcare: Introduction to Visual Analytics and Medical Data Visualization– Visual Analytics in Healthcare.		

Total: 45

TEXT BOOK:

1	Chandan K.Reddy, Charu C. Aggarwal, “HealthCare Data Analytics”, CRC, 2015.

REFERENCE:

1.	Vikas Kumar, “Health Care Analysis Made Simple”, Packt Publishing, 2018.
2.	Nilanjan Dey, Amira Ashour , Simon James Fong, Chintan Bhatl, “Health Care Data Analysis and management, Academic Press, 2018.
3.	Hui Jang, Eva K.Lee, “HealthCare Analysis, From Data to Knowledge to Healthcare Improvement”, Wiley, 2016.
4.	Kulkarni , Siarry, Singh ,Abraham, Zhang, Zomaya , Baki, “Big Data Analytics in HealthCare”, Springer, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	discuss about the various healthcare data sources and the analytical techniques.	Understanding (K2)
CO2	Perform medical image and text data analysis.	Applying (K3)
CO3	enumerate the concept of biomedical text mining and social media healthcare analytics	Applying (K3)
CO4	apply prediction models for healthcare data and perform evaluation.	Applying (K3)
CO5	summarize temporal data mining and visualization techniques for healthcare 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	2	2										2	2
CO2	3	2	2										2	2
CO3	3	2	2										2	2
CO4	3	2	2										2	2
CO5	3	2	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	10	60	30				100
CAT2	10	55	35				100
CAT3	10	55	35				100
ESE	5	60	35				100

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

20ALE13 - TIME SERIES ANALYSIS AND FORECASTING

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	Sem	Category	L	T	P	Credit
Prerequisites	Nil	7	PE	2	0	2	3

Preamble	The course familiarizes students with various forecasting approaches and new statistical methods for analyzing and evaluating time-series data.	
Unit – I	**Exploratory analysis:**	**6**
Graphical displays – Numerical description of Time Series Data – Use of Data transformations and Adjustments – General Approach to Time Series Modeling and Forecasting – Evaluating and Monitoring Forecasting Model Performance		
Unit – II	**Smoothing methods:**	**6**
First-Order Exponential Smoothing – Modeling Time Series data – Second-Order Exponential Smoothing – Higher-Order Exponential Smoothing – Forecasting – Exponential Smoothing for Seasonal Data – Exponential Smoothing of Biosurveillance data – Exponential Smoothers and ARIMA models		
Unit – III	**ARIMA models:**	**6**
Linear Models for Stationary Time Series – Finite Order Moving Average Processes – Finite Order Autoregressive Processes – Mixed Autoregressive-Moving Average Processes – Nonstationary Processes – Time Series Model building – Forecasting ARIMA Processes – Seasonal Processes – ARIMA Modeling of Biosurveillance data		
Unit – IV	**Transfer Functions and Intervention Models:**	**6**
Transfer Function Models – Transfer Function-Noise Models – Cross-Correlation Function – Model Specification – Forecasting with Transfer Function-Noise Models – Intervention Analysis		
Unit – V	**Other Forecasting Methods:**	**6**
Multivariate Time Series Models and Forecasting – State Space Models – Arch and Garch models – Direct Forecasting of Percentiles – Combining Forecasts to improve Prediction Performance – Aggregation and Disaggregation of Forecasts – Neural Networks and Forecasting – Spectral Analysis – Bayesian Methods in Forecasting		

List of Exercises / Experiments:

1.	Visualization of Stationary and Non-stationary time series data.
2.	Implement Moving Average Time Series Model and Differencing.
3.	Implement Exponential smoothing technique (Single, double and triple).
4.	Implement Auto-Regressive Model for Stationary Time Series.
5.	Implement Auto-Regressive Integrated Moving Average for Non-Stationary Time Series.
6.	Apply Univariate Models to forecast data
7.	Implement Transfer Functions and Autoregressive Distributed Lag Modeling.
8.	Apply Spectral density function to forecast data.

Lecture: 30, Practical: 30, Total: 60

TEXT BOOK:

1. Douglas C. Montgomery, Cheryl L. Jennings, Murat Kulahci, “Introduction to Time Series Analysis and Forecasting”, 2nd Edition, Wiley, 2016

REFERENCES/MANUAL/SOFTWARE:

1. George E. P. Box, Gwilym M. Jenkins, Gregory C. Reinsel, Greta M. Ljung, “Time Series Analysis: Forecasting and Control”, 5th Edition, Wiley, 2016.

2.	Python
3.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	understand the necessity of forecasting and apply in a given situation	Applying (K3)
CO2	apply smoothing methods in time series data	Applying (K3)
CO3	perform Stationary and Non-Stationary time series analysis	Applying (K3)
CO4	make use of variance transformation techniques for time series analysis and forecasting	Applying (K3)
CO5	understand and apply frequency-domain time series analysis	Applying (K3)
CO6	implement models for stationary and non-stationary time series analysis	Applying (K3), Precision (S3)
CO7	make use of various smoothing methods for time series data analysis	Applying (K3), Precision (S3)
CO8	implement models for frequency-domain time series 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	2	1	1								3	2
CO2	3	2	2	1	1								3	2
CO3	3	2	2	1	1								3	2
CO4	3	2	2	1	1								3	2
CO5	3	2	2	1	1								3	2
CO6	3	2	2	2	2								3	2
CO7	3	2	2	2	2								3	2
CO8	3	2	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	50	40				100
CAT2	10	40	50				100
CAT3	10	40	50				100
ESE	5	45	50				100

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

20ALE14- ETHICS OF ARTIFICIAL INTELLIGENCE

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PE	3	0	0	3

Preamble	This course gives the background knowledge on ethical analysis in AI. It also interrogates ethical implications of AI technology and their liability on various applications.	
Unit – I	**Introduction:**	**9**
Introduction to AI - Hard for AI - Science and Fiction of AI - Ethics: Descriptive Ethics - Normative Ethics - Meta Ethics - Applied Ethics - Relationship between Ethics and law - Machine Ethics.		
Unit – II	**Trust and Liability of AI Systems:**	**9**
Trust and Fairness in AI Systems: User Acceptance and Trust - Functional Elements of Trust - Ethical Principles for Trustworthy and Fair AI – Responsibility and Liability: Case Study - Strict Liability - Complex Liability - Consequence of Liability.		
Unit – III	**Business Ethics and Psychological Aspects:**	**9**
Risk in Business of AI: Business Risk - Ethical Risk - Managing Risk of AI - Business Ethics for AI - Risk of AI to Workers – Psychological Aspects: Anthropomorphisation - Persuasive AI - Emotional Bonding with AI.		
Unit – IV	**AI Privacy Issues and its Applications**	**9**
Privacy Issues: Privacy, Role of Data in AI, Private Data Collection, Future Perspectives – Application areas of AI: Ethical Issues related to enhancement, Ethical Issues related to Robots and Healthcare, Robots and Telemedicine, Education.		
Unit – V	**Autonomous Vehicles**	**9**
Autonomous Vehicles: Levels of Driving, Ethical Benefits of AVs, Accidents with AVs, Ethical Guidelines of AVs, Ethical Questions in AVs – Military Uses: Autonomous Weapons Systems, Regulation Governing an AWS, Ethical Arguments for and Against AI for Military – Ethics Challenge: Role of Ethics, International Cooperation.		

Total: 45

TEXT BOOK:

1. Christoph Bartneck, Christoph Lutge, Alan Wagner and Sean Welsh, “An Introduction to Ethics in robotics and AI”, Springer, 2021.

REFERENCES:

1. S. Matthew Liao, “Ethics of Artificial Intelligence”, 1st Edition, Oxford University Press, USA, 2020.
2. Mark Coeckelbergh, “AI Ethics”, 1st Edition, MIT Press, USA, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	describe the theories that form the basis of ethical review on AI systems and illustrates the relation of ethics to law.	Understanding (K2)
CO2	articulate the challenges involved in the liability of AI systems	Applying (K3)
CO3	Illustrate various business risk faced when developing an AI systems	Understanding (K2
CO4	describe the role of AI system in collecting the privacy data and demonstrate the ethics involved in AI and its applications	Applying (K3)
CO5	demonstrate the ethics involved in autonomous vehicles and autonomous weapons.	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**		**3**					**1**	**1**
CO2	**3**	**2**	**1**			**3**		**3**					**1**	**1**
CO3	**3**	**2**	**1**			**3**		**3**					**1**	**1**
CO4	**3**	**2**	**1**			**3**		**3**					**1**	**1**
CO5	**3**	**2**	**1**			**3**		**3**					**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	60	20				100
CAT2	20	60	20				100
CAT3	20	60	20				100
ESE	8	62	30				100

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

20ALE15 - SOCIAL MEDIA ANALYTICS

Programme & Branch	B.Tech. & Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PE	3	0	0	3

Preamble	This course gives an exposure to perform analytical operations on different types of data in social media	
Unit – I	**Introduction to Social Media Data:**	**9**
Social graph - Delving into social data - Understanding the process: Working environment - Getting the data - Analyzing the data - Visualizing the data - APIs in a nutshell - Authentication techniques - Parsing API outputs - Basic cleaning techniques - MongoDB to store and access social data using python		
Unit – II	**Uncovering Brand Activity, Popularity, and Emotions on Facebook:**	**9**
Facebook brand page - Facebook API - Project planning - Analysis - Extracting verbatims for keywords - User Keyword - Brand posts - User hashtags - Noun phrases - User comments - Detecting trends in time series - Maximum Shares - Uncovering emotions - Setting up the application - Applying Alchemy API		
Unit – III	**Analyzing Twitter and YouTube Data Analysis:**	**9**
Scope and process - Data extraction - Rate Limits - Data cleaning - Customized sentiment analysis - Named entity recognition - Combining NER and sentiment analysis - Consumer Reaction Analytics on YouTube: Scope and process - Data pull - Data processing - Data analysis - Sentiment by weekday - Number of comments by weekday		
Unit – IV	**Trends Mining on GitHub:**	**9**
Scope and process - Getting the data - Data pull - Data processing - Data analysis - Programming languages used in top technologies - Comparison of technologies in terms of forks, open issues, size, and watchers count - Extracting Conversational Topics on Internet: Introduction to scraping - Data pull and pre-processing - Data analysis		
Unit – V	**Demystifying Pinterest API:**	**9**
Pinterest API - Scraping Pinterest search results - Data pull and pre-processing - Pinterest API data - Pinterest search result datas - Data analysis - Finding influencers - Community Structure		

Total: 45

TEXT BOOK:

1.	Siddhartha Chatterjee, Michal Krystyanczuk, “Python Social Media Analytics”, 1st Edition, Packt Publishing Limited, 2017.

REFERENCE:

1	Marshall Sponder, “Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics”, 1st Edition, McGrawHill, 2011..

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	get familiar with basic foundations of social media data and MongoDB Toolkit	Understanding(K2)
CO2:	apply data analytics for Facebook data	Applying (K3)
CO3:	implement sentiment analysis on Twitter and YouTube data	Applying (K3)
CO4:	perform trend mining on Github data	Applying (K3)
CO5:	explore real time social media data analytics using pintrest API	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	2	1							2	2
CO2	**3**	2	2	2	2	1							2	2
CO3	**3**	2	2	2	2	1							2	2
CO4	**3**	2	2	2	2	1							2	2
CO5	**3**	2	2	2	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 %
CAT 1	10	65	25				100
CAT 2	10	60	30				100
CAT 3	10	60	30				100
ESE	5	65	30				100

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

20ALE16 - REAL TIME ANALYTICS

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	7	PE	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	**Real time analytics and its application:**	**9**
Big data- Big data infrastructure – real- time analytics the myth and the reality - near-real time solution - Lambda architecture – IOT thoughts and possibilities – Cloud considerations for NRT and IOT - Real Time Applications: The NRT systems and its building blocks – NRT high level system view – NRT technology view		
Unit - II	**Tailing Data streams and infrastructure for storm:**	**9**
Understanding data streams - setting up infrastructure for data ingestion - taping data from source to the processor – comparing and choosing the use case - setting up the infrastructure for storm: overview of storm-storm architecture and its components - setting up and configuring storm - real time processing job on storm. .		
Unit - III	**Configuring Apache Spark and Flink:**	**9**
Setting up and a quick execution of spark: building from source - Downloading spark - Running an example - Setting up and a quick execution of Flink:Build Flink Source - Download Flink - Running examples - setting up and a quick execution of Apache Beam - balancing in apache beam.		
Unit - IV	**Integrating storm with a Data source:**	**9**
RabbitMQ messaging that works - RabbitMQ exchanges-Direct exchange – RabbitMQ setup - RabbitMQ publish and subscribe - RabbitMQ integration with storm:AMQPSpout - PubNub data stream publisher - String together storm .		
Unit - V	**From storm to sink and storm Trident**:	9
Setting up and configuring Cassandra - Storm and Cassandra topology - IBDB integration for dimensional data - Integrating the presentation layer with storm - State Retention and the need for trident - Basic storm trident topology - trident Intenals -Trident operations - DRPC.		

Total: 45

TEXT BOOK:

1. Shilpi Saxena,Saurabh Gupta,"Practical Real-Time Data processing and analytics", 1st Edition, Packt Publishing Ltd, 2017

REFERENCE:

1. Goetz, P.Taylor, and Brian O'Neill, "Storm blueprints: patterns for distributed real-time computation", 1st Edition, Packt Publishing Ltd, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	discuss the concepts of real time analytics and its application.	Understanding (K2)
CO2	demonstrate the use of storm for real time processing	Applying (K3)
CO3	configure flink tool for scalable data analytics	Applying (K3)
CO4	make use of rabbitMQ tool to integrate storm with a Data source	Applying (K3)
CO5	perform real time batch processing using Trident tool	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2								2	2
CO2	3	2	2	2	2								2	2
CO3	3	2	2	2	2								2	2
CO4	3	2	2	2	2								2	2
CO5	3	2	2	2	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	10	60	30				100
CAT2	10	50	40				100
CAT3	10	50	40				100
ESE	5	55	40				100

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

20ALE17 - GRAPH THEORY AND ITS APPLICATIONS

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PE	3	0	0	3

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**
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**
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 – Tree traversal		
Unit – III	**Graph Coloring:**	**9**
Vertex coloring – Chromatic number – Chromatic partitioning – Independent sets – Chromatic polynomial – Matching – Covering – Four color problem (statement only) – Simple applications		
Unit – IV	**Basic Algorithms:**	**9**
Shortest paths – Shortest path algorithms: Dijkstra's algorithm – Warshall's algorithm – Minimum Spanning tree – Minimal spanning tree algorithms: Prim's algorithm – Krushkal's algorithm – Optimal assignment – Kuhn and Munkres algorithm – Travelling salesman problem: Two optimal algorithm – Closest Insertion Algorithm		
Unit – V	**Network Flows and Applications:**	**9**
Flows and cuts in networks - Max-flow Min-cut Theorem – Algorithms: Flow Augmenting Path – Ford-Fulkerson Algorithm for Maximum Flow – Edmonds and Karp algorithm		

Total: 45

TEXT BOOK:

1. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", 1st Edition, Prentice Hall, New Delhi, 2010.

REFERENCE:

1. Douglas B.West, "Graph Theory", 2nd Edition, Prentice Hall, New Delhi, 2017.
2. Jonathan L. Gross & Jay Yellen, "Graph Theory and its Applications", 2nd Edition, CRC Press, New York, 2006.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	explain the types of graphs and illustrate isomorphism on graphs.	Understanding (K2)
CO2	use the concepts and properties of different types of trees in data structures.	Applying (K3)
CO3	estimate the chromatic partition, chromatic polynomial and matching of a given graph.	Applying (K3)
CO4	apply various graph theoretic algorithms to communication and network problems.	Applying (K3)
CO5	identify the maximal flow in network by means of algorithms.	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	1	1	1									3	2
CO3	3	1	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	10	50	40				100
CAT2	10	30	60				100
CAT3	10	30	60				100
ESE	5	35	60				100

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

20ALE18 - OPERATIONS AND SUPPLY CHAIN MANAGEMENT

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PE	3	0	0	3

Preamble	The course provides an insight on the operations, quality management and sampling tools and fundamentals of supply chain networks, tools and techniques	
Unit – I	**Introduction to operations and supply chain management:**	**9**
Scope and Importance- Evolution of Supply Chain - Decision Phases in Supply Chain - Competitive and supply chain Strategies – Drivers of Supply Chain Performance and Obstacles - The Operations Function - The Evolution of Operations and Supply Chain Management – Globalization - Productivity and Competitiveness - Strategy and Operations-Operational Decision-Making Tools: Decision Analysis-Decision Analysis with and without Probabilities		
Unit – II	**Quality management:**	**9**
Quality and Value in Athletic Shoes -What Is Quality-Quality Management System-Quality Tools- Quality in Services-Six SigmaQuality Costs and Productivity-Quality Awards-ISO 9000-Statistical Process Control-Operational Decision-Making Tools: Acceptance Sampling		
Unit – III	**Network design and transportation:**	**9**
Factors influencing Distribution network design – Design options for Distribution Network-– factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation		
Unit – IV	**Sourcing and coordination:**	**9**
Role of sourcing supply chain - supplier selection assessment and contracts- Design collaboration - sourcing planning and analysis - supply chain coordination - Bull whip effect – Effect of lack of co- ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain		
Unit – V	**Supply chain and information technology:**	**9**
The role IT in supply chain - The supply chain IT framework - Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain – Sustainability and the supply chain.		

Total: 45

TEXT BOOK:

1.	Roberta S. Russell, Bernard W. Taylor, "Operations and Supply Chain Management", 11th Edition, Wiley Publications, 2023.

REFERENCE:

1.	Sunil Chopra, Peter Meindl and Kalra, Supply Chain Management, Strategy, Planning, and Operation, Pearson Education, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	know about the operations and fundamentals of supply chain	Applying (K3)
CO2	explore the quality management tools and sampling process	Applying (K3)
CO3	learn about design factors and various design options of distribution networksin industries and the role of transportation and ware housing	Applying (K3)
CO4	elaborate various sourcing decisions in supply chain	Applying (K3)
CO5	explore the role of IT in supply chain	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	3	1
CO2	3	2	1			2						2	3	1
CO3	3	2	1			2						2	3	1
CO4	3	2	1			2						2	3	1
CO5	3	2	1			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	30	40	30				100
CAT2	30	40	30				100
CAT3	30	40	30				100
ESE	20	45	35				100

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

20ALE19 - MULTI VARIATE DATA ANALYSIS

Programme & Branch	BTech - Artificial Intelligence & Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PE	3	0	0	3

Preamble	This course enables the students to learn various multivariate data analysis	
Unit - I	**Introduction to Multivariate Methods:**	**9**
Multivariate Analysis - Basic Concepts – Managing the Multivariate model – Classification of multivariate techniques – Types of multivariate techniques – Guidelines for multivariate analyses and interpretation – Approach to multivariate modeling		
Unit - II	**Preparing for Multivariate Analysis:**	**9**
Introduction – Examination of the Data : Univariate – Bivariate – Multivariate – Missing Data : Impact – Missing Data Analysis – Process for identifying missing data and remedies – Outliers: Contexts for defining outliers – impact – classifying outliers – detecting and handling outliers – example – Testing the assumptions of multivariate Analysis – Data transformations – Illustrating of testing the assumptions		
Unit – III	**Interdependence Techniques:**	**9**
Exploratory Factor Analysis : Introduction- Examples – Factor analysis decision process – Stages – Illustration -**Cluster Analysis** : Introduction to cluster analysis – working - Cluster analysis decision process : Stages - Illustration		
Unit – IV	**Dependence Technique:**	**9**
Introduction to Multiple Regression Analysis – Simple and Multiple Regression – Decision process for multiple regression analysis – Stages – Illustration		
Unit – V	**MANOVA:**	**9**
Introduction to MANOVA – Illustration – Decision process for MANOVA – Stages : Objectives – Issues – Assumptions of ANOVA and MANOVA – Estimation of MANOVA model and Assessing overall Fit – Interpretation of MANOVA results - Validation		

Total: 45

TEXT BOOK:

1.	Joesph F. Hair Jr., William C. Black, Barry J. Babin, Rolph E.Anderson "Multivariate Data Analysis", Annabel Ainscow, 8th Edition (2019).

REFERENCE:

1.	Spencer, N. H. Essentials of multivariate data analysis. CRC press, (2013).

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	perform multivariate modeling by classifying and Interpreting multivariate data	Applying (K3)
CO2	examine multivariate data for missing data and outliers to perform multivariate analysis	Applying (K3)
CO3	assess the interdependence using factor and cluster analysis	Applying (K3)
CO4	explore the dependence relationship between variables using multiple regression analysis	Applying (K3)
CO5	test the statistical significance of the effect of one or more independent variables on a set of two or more dependent variables, using MANOVA	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	2										3	2
CO3	3	2	2										3	2
CO4	3	2	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	40	40	20				
CAT2	20	30	50				
CAT3	30	30	40				
ESE	20	30	50				

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

20ALE20 - COGNITIVE SCIENCE AND ANALYTICS

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PE	3	0	0	3

Preamble	To impart knowledge on cognitive science and various analytical methods	
Unit – I	**Introduction to Cognitive Science:**	**9**
Foundation of Cognitive Computing - Design Principles for Cognitive Systems: Components of a Cognitive System - Building the Corpus- Bringing Data into the Cognitive System - Machine Learning - Hypotheses -Generation and Scoring - Presentation and Visualization Services.		
Unit – II	**Natural Language Processing, Big Data and Cognitive Computing:**	**9**
Natural Language Processing in Support of a Cognitive System - Relationship Between Big Data and Cognitive Computing: Dealing with Human-Generated Data - Defining Big Data - Architectural Foundation for Big Data - Analytical Data Warehouses - Hadoop - Data in Motion and Streaming Data - Integration of Big Data with Traditional Data.		
Unit – III	**Taxonomies and Ontologies, Cloud and Distributed Computing:**	**9**
Representing Knowledge in Taxonomies and Ontologies - Applying Advanced Analytics to Cognitive Computing - Role of Cloud and Distributed Computing in Cognitive Computing.		
Unit – IV	**The Process of Building Cognitive Applications:**	**9**
Business Implications of Cognitive Computing - IBM's Watson as a Cognitive System - Process of Building a Cognitive Application - Smarter Cities: Cognitive Computing in Government.		
Unit – V	**Applications and case studies:**	**9**
Building a Cognitive Healthcare Application -Emerging Cognitive Computing Areas - Future Applications for Cognitive Computing.		

Total: 45

TEXT BOOK:

1.	Judith S. Hurwitz, Marcia Kaufman, Adrian Bowles. Cognitive Computing and Big Data Analytics. 1st Edition, Wiley, 2015**.**

REFERENCES:

1.	Jose Luis Bermudez, "Cognitive Science: An Introduction to the Science of the Mind. Cambridge University Press", 1st Edition, 2020.
2.	Carolyn P. Sobel, Paul Li, "Cognitive Sciences: An Interdisciplinary Approach", 2nd edition, Sage Publications Inc, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	describe the basic concepts of cognitive science	Understanding (K2)
CO2:	interpret the principles of Natural Language Processing and Big Data with Cognitive Computing	Understanding (K2)
CO3:	explore Taxonomies and Ontologies and Cloud and Distributed Computing in cognitive environment	Understanding (K2)
CO4:	implement Watson for Cognitive system and develop applications	Applying (K3)
CO5:	demonstrate case studies of applying cognitive computing for various real life 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**	**3**										**3**	**2**
CO2	**3**	**3**	**2**										**3**	**2**
CO3	**3**	**2**	**3**										**3**	**3**
CO4	**3**	**2**	**3**										**3**	**3**
CO5	**3**	**2**	**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 %
CAT 1	30	70					100
CAT 2	10	60	30				100
CAT 3	10	60	30				100
ESE	5	65	30				100

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

20ALE21 - SOFTWARE TESTING

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	PE	3	0	0	3

Preamble	This course focuses on testing 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	**Basics of Software Testing**	**9**
Software Testing: Introduction, Evolution, Myths & Facts, Goals, Psychology, Definition, Model for testing, Effective Vs Exhaustive Software Testing. Software Testing Terminology and Methodology: Software Testing Terminology, Software Testing Life Cycle, relating test life cycle to development life cycle, Software Testing Methodology.		
Unit – II	**Building a Software Testing Environment**	**9**
Assessing Capabilities, Staff Competency, and User Satisfaction-Creating an environment supportive of software testing - Building the software testing process		
Unit – III	**Overview, Organizing and Developing the Testing Process**	**9**
The Seven-Step Software Testing Process : Overview of the Software Testing process – Organizing for testing-Workbench-Procedure -Developing the test plan- Workbench-Procedure		
Unit – IV	**Verification, Validation and Analyzing the Testing Process**	**9**
Verification testing- Workbench-Procedure -Validation testing- Workbench-Procedure - Analyzing and reporting test results-Workbench-Procedure		
Unit – V	**Incorporating Specialized Testing Responsibilities**	**9**
Testing client/server systems- Testing software system security -Testing web-based systems -Using Agile Methods to Improve Software Testing		

Total: 45

TEXT BOOK:

1. Naresh Chauhan, “Software Testing, Principles and Practices”, Oxford University Press, 2010. Unit-1
2. Perry William, “Effective Methods for Software Testing”, 3rd Edition, Wiley India, Reprint 2013. Unit-2,3,4,5

REFERENCES:

1. Kelkar S.A, "Software Quality and Testing: A Concise Study", 1st Edition, PHI Learning, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	identify the step-by-step activities and set up environment for software testing	Applying (K3)
CO2	express the procedure to develop test plan and analyze as well as report the test results	Applying (K3)
CO3	demonstrate the process of testing the various modules of the application	Applying (K3)
CO4	apply software testing for client server and web-based systems	Applying (K3)
CO5	point out the agile methods to improve testing	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	1	2		3	1
CO2	3	2	1						1	1	2		3	1
CO3	3	2	1						1	1	2		3	1
CO4	3	2	1						1	1	2		3	1
CO5	3	2	1						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	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)**

20ALE22 - SOFTWARE DEFINED NETWORKS

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Computer Networks	8	PE	3	0	0	3

Preamble	This course provides an insight on programmability protocols, interfaces, controllers and its applications in various environments like data centers and service provider networks.	
Unit – I	**Introduction to SDN:**	**9**
Introduction: Basic packet switching terminology – The modern data center – Traditional switch architecture – Autonomous and dynamic forwarding table. Evolution of switches and control planes – Cost – Data center innovation – Data center needs. The Genesis of SDN: The evolution of networking technology – Forerunners of SDN		
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		
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 – 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 – 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**
Wide area networks – Service provider and carrier networks – Campus networks – Hospitality networks – Mobile networks – Optical networks – SDN vs P2P/Overlay networks. SDN Applications: Application Types – A Brief History of SDN Controllers – Using Floodlight for Training Purposes – A Simple Reactive Java Application		

Total: 45

TEXT BOOK:

1. Paul Goransson, Chuck Black and Timothy Culver, "Software Defined Networks: A Comprehensive Approach", 2nd Edition, Morgan Kaufmann, 2017.

REFERENCES:

1. Siamak Azodolmolky, "Software Defined Networking with OpenFlow", 1st Edition, Packt Publishing, 2013.
2. Thomas D. Nadeau and Ken Gray, "SDN: Software Defined Networks", 1st Edition, O'Reilly Media , 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										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	5	35	60				100

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

20ALE23 - EMBEDDED SYSTEMS AND PROGRAMMING

Programme& Branch	B.Tech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Python programming and problem solving techniques	8	PE	3	0	0	3

Preamble	This course provides knowledge on real-time programming with embedded systems using raspberry Pi.	
Unit – I	**Introduction to Embedded Systems:**	**9**
Introducing Embedded Linux - Managing Linux Systems - Raspberry Pi Hardware: Introduction to the Platform – Rpi Documentation - The RPi Hardware - Raspberry Pi Accessories – HATs - Raspberry Pi Software: Linux on the Raspberry Pi - Connecting to a Network - Communicating with the RPi - Controlling the Raspberry Pi - Configuring the Raspberry Pi		
Unit – II	**Programming on the Raspberry Pi:**	**9**
Introduction - Scripting Languages - Dynamically Compiled Languages-C and C++ on the RPi - Overview of Object Oriented Programming. Interfacing to the LinuxOS: Improving the Performance of Python - Interfacing to the RaspberryPi. Input/Outputs: Introduction – General - Purpose Input/Outputs - C++-Control of GPIOs using sysfs - Memory-Based GPIO Control		
Unit – III	**Cross-Compilation and the Eclipse IDE:**	**9**
Setting up a Cross - Compilation Tool chain - Cross-Compilation using Eclipse - Building Linux - Interfacing to the Raspberry Pi Buses:Introduction to Bus Communication - I2C-SPI-UART - Logic-Level Translation		
Unit – IV	**Interacting with the Physical Environment:**	**9**
Interfacing to Actuators, Interfacing to Analog Sensors, Interfacing to Local Displays, Building C/C++ Libraries - Real-Time Interfacing Using the Arduino: The Arduino - An Arduino Serial Slave - An Arduino I2C Slave - An Arduino SPI Slave - Programming the Arduino from the RPi Command Line		
Unit – V	**The Internet of Things:**	**9**
The Internet of Things (IoT) - The RPi as an IoT Sensor - The RPi as a Sensor - Web Server - AC/C++Web Client - The RPi as a Thing - Large-Scale IoT Frameworks - The C++ Client/Server - IoT Device Management		

Lecture: 45, Total: 45

TEXT BOOK:

1. DerekMolloy, “Exploring RaspberryPi Interfacing to the Real World with Embedded Linux”, 1st Edition, JohnWiley&Sons, Inc., Indianapolis, 2016.

REFERENCES:

1. QingLi, CarolineL.Yao, "Real-TimeConceptsfor EmbeddedSystems",1st Edition, CMP Books, UK,2003.
2. Rajkamal,"Embedded Systems Architecture, Programming and Design",3rd Edition, McGraw-Hill, NewDelhi, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	interpret various hardware and software features in embedded programming using Raspberry Pi.	Applying (K3)
CO2	experiment with programming and interfacing of RaspberryPi hardware.	Applying (K3)
CO3	manipulate cross compilation tools and bus communication of RaspberryPi.	Applying (K3)
CO4	illustrate interfacing concepts with real physical environment and Arduino	Applying (K3)
CO5	apply embedded programming knowledge for IoT application developments	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	1	1								2	1
CO2	3	2	2	1	1								2	1
CO3	3	2	2	1	1								2	1
CO4	3	2	2	1	1								2	1
CO5	3	2	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	60	30				100
CAT2	10	60	30				100
CAT3	10	60	30				100
ESE	5	65	30				100

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

20ALE24- SOFTWARE PROJECT MANAGEMENT

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	8	PE	3	0	0	3

Preamble	This course provides 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 bestproject.	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 organizing 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										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	35	45				100
CAT2	20	45	35				100
CAT3	20	35	45				100
ESE	10	45	45				100

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

20ALE25 - CYBER FORENSICS

Programme& Branch	BTech - Artificial Intelligence and Machine Learning	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 –Digital Hash –Case Studies.		
Unit - IV	**Digital Forensics Tools, Analysis and Validation:**	**9**
Evaluating Computer Forensics Tool – Digital Forensics Software Tools – Digital Forensics Hardware Tools –Validating and Testing Forensic Software – Digital 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– 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.	Marjie T.Britz,“Computer Forensics and Cyber Crime : An Introduction”, 3rd Edition, Prentice Hall, 2013.

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	apply various tools for data acquisition	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	interpret investigation on 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			2		2				1	3	1
CO2	3	2	1			2		2				1	3	1
CO3	3	2	1			2		2				1	3	1
CO4	3	2	1			2		2				1	3	1
CO5	3	3	1			2		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	5	55	40				100

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

20ALE26 - ARTIFICIAL INTELLIGENCE AND ROBOTICS

Programme & Branch	BTech - Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**8**	**PC**	**3**	**0**	**0**	**3**

Preamble	This course describes the fundamental concepts of AI in robotics and the major paradigms for achieving it. It also provides the knowledge about Robot Kinematics, Dynamics, sensor and vision system.	
Unit - I	**Introduction to Robotics:**	**9**
Types and components of a robot- Classification of robots - Closed loop and open loop control systems. Kinematics systems: Definition of mechanisms and manipulators- Social issues and safety.		
Unit - II	**Autonomy Robot and Hierarchical Paradigm:**	**9**
Overview –Use of Robots – Teleoperation - Areas of AI. Hierarchical Paradigm: Attributes of the Hierarchical Paradigm - Closed World Assumption - Representative Architectures - Advantages and Disadvantages.		
Unit - III	**Reactive Paradigm:**	**9**
Overview - Reflexive behaviors - Coordination and Control of Behaviors - Perception in Behaviors - Schema Theory - Principles and Issues in Transferring Insights to Robots - Attributes of Reactive Paradigm - Subsumption Architecture - Potential Fields Methodologies - Evaluation of Reactive Architectures.		
Unit - IV	**Robot Kinematics and Dynamics:**	**9**
Kinematic Modelling: Translation and rotation representation- Coordinate transformation- DH parameters- Jacobian-Singularity and Statics. Dynamic Modelling: Equations of motion- Euler-Lagrange formulation.		
Unit - V	**Sensors and Vision System:**	**9**
Sensor: Contact and Proximity, Position, Velocity, Force, Tactile. Introduction to Cameras- Camera calibration- Geometry of image formation- Euclidean/Similarity/Affine/Projective transformations- Vision applications in robotics.		

Total: 45

TEXT BOOK:

1.	Ronald C. Arkin, Robin R. Murphy, “An Introduction to AI Robotics”, 1st Edition, MIT Press, USA, 2001, for Units 1, 2.
2	Saha S.K., "Introduction to Robotics", 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014, for Units 3, 4, 5.

REFERENCES:

1.	Niku Saeed B., "Introduction to Robotics: Analysis", PHI Learning, New Delhi, 2011.
2.	Ghosal A., "Robotics", Oxford, New Delhi, 2006.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	interpret the features of an industrial robots with end effectors	Applying (K3)
CO2	identify the characteristics of Autonomy Robot and use Hierarchical Paradigm for organizing intelligence in Robots.	Applying (K3)
CO3	apply reactive paradigm for AI Robots	Applying (K3)
CO4	perform kinematic and dynamic analyses with simulation	Applying (K3)
CO5	design sensor and vision system for robots	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	50	25				100
CAT2	25	45	30				100
CAT3	25	45	30				100
ESE	20	40	40				100

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

20ALO01 - BUSINESS INTELLIGENCE
(Offered by Department of Artifical Intelligence)

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

Preamble	This course focuses on learners to apply the business intelligence concepts and techniques to various applications for making better decisions.	
Unit – I	**Business View of Information Technology Applications:**	**9+3**
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+3**
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		
Unit – III	**OLTP, OLAP and Multidimensional Data Modeling:**	**9+3**
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+3**
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+3**
Understanding Statistics - Role of Statistics in Analytics –Data Description and Summarization – Statistical Test – Understanding Hypothesis and t-Test - Correlation Analysis – Regression – ANOVA -The F-Test - Time Series Analysis - BI Applications: BI and Mobility – BI and Cloud Computing –Business Intelligence for ERP systems – Social CRM and Business Intelligence.		

Lecture: 45; Tutorial: 15; Total: 60

TEXT BOOK:

1. Prasad R.N. and SeemaAcharya, "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 performance evaluation metrics for a given problem	Applying (K3)
CO5	Perform statistical analysis and 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											
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	50	40				100
CAT2	10	50	40				100
CAT3	10	50	40				100
ESE	10	50	40				100

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

20ALO02 - DATA EXPLORATION AND VISUALIZATION TECHNIQUES
(Offered by Department of Artifical Intelligence)

Programme& Branch	BE/BTech All branches except AIML	Sem.	Category	L	T	P	Credit
Prerequisites	Python Programming	5	OE	3	0	2	4

Preamble	To provide practical exposure to Python Programming frameworks required for visualizing various types of data	
Unit – I	**Data visualization in business intelligence:**	**9**
Introduction to data visualization – need for data visualization – visualization in business decision making – Data visualization techniques and libraries – Data gathering and cleaning: cleaning data – reading – merging and integrating data – reading data from JSON		
Unit – II	**Data Exploring and Analysis:**	**9**
Data collection structures: series – data frames – panels - Series data structures – Data frame data structure – data analysis: Statistical Analysis – Data grouping – Iterating through groups – Aggregations – Transformations – Filtration.		
Unit – III	**Data visualization techniques:**	**9**
Direct plotting: line plot – bar plot – pie chart – box plot – histogram plot – scatter plot – seaborn plotting system:strip plot – box plot – swarm plot – joint plot – Matplotlib plot: Line plot – bar chart - histogram plot – scatter plot – stack plot – pie chart.		
Unit – IV	**Time series analysis:**	**9**
Date and time data types and tools – time conversion - time series basics – date ranges, frequencies and shifting – time zone handling - periods and period arithmetic – Resampling and frequency conversion – Moving Window functions.		
Unit – V	**Categorical Data Analysis and Modeling Libraries:**	**9**
Categorical data – advanced groupby – Techniques for method chaining – Interfacing between pandas and model code – Creating model descriptions with Patsy – statsmodel.		

List of Exercises / Experiments:

1.	Load data in different formats and apply preprocessing
2.	Perform grouping aggregating and transforming operations on data
3.	Design different types of plots using direct plotting methods
4.	Create different types of plots using Matplolib
5.	Design different types of plot using Seaborn
6.	Demonstrate time series operations
7.	Visualize categorical data and perform operations on it
8.	Apply data transformations using Patsy

Lecture: 45; Practical: 30; Total: 75

TEXT BOOK:

1.	Dr. Ossama Embarak, " Data Analysis and Visualization using Python ", 1st Edition, APress, 2018 for Units 1, 2 and 3
2.	Wes McKinney, "Python for Data Analysis", 3rd Edition, O'Reilly, 2022 for Units 4 and 5.

REFERENCES/MANUAL/SOFTWARE:

1.	Daniel Nelson. Data Visualization in Python, 1st Edition, StackAbuse, 2020.
2	Jake Vander Plas, "Python Data Science Handbook Essential Tools for Working with Data", 1st Edition, O'Reilly Media, 2016.
3.	Python, Matplotlib, Seaborn, Plotly
4.	Linux / Windows
5.	Lab manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	explore the concepts of data visualization and decision making using different formats	Applying (K3)
CO2:	make use of the features of data frames, panels and series data structure to analyze data	Applying (K3)
CO3:	apply the plotting techniques for efficient data visualization	Applying (K3)
CO4:	perform time series data analysis using appropriate methods	Applying (K3)
CO5:	implement suitable techniques to analyze categorical data and use libraries for modeling the data	Applying (K3)
CO6:	perform data preprocessing and transformation operations	Applying (K3) Precision (S3)
CO7:	explore various plotting to interpret various visualizations	Applying (K3) Precision (S3)
CO8:	demonstrate the use of Patsy for modeling and analyze categorical data.	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	2	2	3									
CO7	3	2	2	2	3									
CO8	3	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 %**
CAT 1	10	40	50				100
CAT 2	10	40	50				100
CAT 3	10	40	50				100
ESE	5	45	50				100

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

22ALO03 - INDUSTRIAL MACHINE LEARNING
(Offered by Department of Artifical Intelligence)

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

Preamble	The course helps the students to understand and apply various machine learning algorithms in industrial applications.	
Unit – I	**Introduction:**	**9**
The Fourth Industrial Revolution: Introduction – Industry Summarization – Machine Learning Challenges and Opportunities within Smart Industries – Applications: Energy Sector – Basic Materials Sector – Industrials Sector – Customer Services Sector – Healthcare Sector – Customer Goods Sector – Telecommunications Sector – Utilities Sector – Financial services Sector – Information Technology Sector		
Unit – II	**Component-Level Case Study:**	**9**
Introduction – Ball Bearing Prognostics: Data - Driven Techniques – PRONOSTIA Testbed – Feature Extraction from Vibration Signals – Hidden Markov Model-Based RUL Estimation: Hidden Markov Model Construction – RUL Results – Interpretation of the Degradation model		
Unit – III	**Machine-Level Case Study:**	**9**
Introduction – Performance of Industrial Motors as a Fingerprint: Improving Reliability Models with Fingerprints – Industrial Internet Consortium Testbed – Testbed Dataset Description – Clustering Algorithms for Fingerprint Development: Agglomerative Hierarchical Clustering – K-means Clustering – Spectral Clustering – Affinity Propagation – Gaussian Mixture Model Clustering – Implementation Details		
Unit – IV	**Production-Level Case Study:**	**9**
Introduction – Laser Surface Heat Treatment: Image Acquisition – Response Time Requirement – Anomaly Detection-Based AVI System: Anomaly Detection Algorithms in Image Processing – Proposed Methodology – Performance of the AVI System – Interpretation of the Normality Model		
Unit – V	**Distribution-Level Case Study:**	**9**
Introduction – Air Freight Process: Data Preprocessing – Supervised Classification Algorithms for Forecasting: k-Nearest Neighbors – Classification Trees – Rule Induction – Artificial Neural Networks – Support Vector Machines – Logistic Regression – Bayesian Network Classifiers –.Meta classifiers – Implementation		

Total: 45

TEXT BOOK:

1. Pedro Larranaga, David Atienza,Javier Diaz-Rozo, Alberto Ogbechie, Carlos Esteban Puerto-Santana, Concha Bielza, "Industrial Applications of Machine Learning", 1st Edition, CRC Press, 2019 .

REFERENCE:

1. Andreas François Vermeulen," Industrial Machine Learning: Using Artificial Intelligence as a Transformational Disruptor", 1st Edition, Apress, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Understand and apply machine learning concepts in various industry applications	Applying (K3)
CO2	Use Hidden Markov models for handling industrial data	Applying (K3)
CO3	Apply various clustering techniques in solving industry problems	Applying (K3)
CO4	Make use of anomaly prediction algorithms in industrial image processing	Applying (K3)
CO5	Apply classification algorithms for industrial forecasting	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											
CO2	3	2	2											
CO3	3	2	2											
CO4	3	2	2											
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	50	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)**

20ALO04 - MACHINE LEARNING FOR SMART CITIES
(Offered by Department of Artifical Intelligence)

Programme& Branch	BE/BTech All branches except AIML and AIDS	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	8	OE	3	0	0	3

Preamble	This course provides working principles of Sensors, UAV's, Geriatric Design and IoT Enabled Homes and applying machine learning for Smart Cities.	
Unit – I	**Machine Learning for Sustainable and Resilient Buildings**	**9**
Introduction – Sustainability and Resiliency Conditions – Paradigm and challenges of Sustainability and Resilience – Sustainability and Resilience of Engineered System – Structure Engineering Dilemmas and Resilient Epcot – Smart Building Appliances – Intelligent Tools (SRB) – Component of Smart Buildings – Machine Learning Tasks – ML Tools and Services – Big Data Application in SB		
Unit – II	**Sensors and UAV's**	**9**
Introduction – Sensors – Unmanned Aerial Vehicle – Bluetooth – Problem Description – Univariate Time series – Multivariate Time Series – Hidden Markov Model – Fuzzy Logic		
Unit – III	**Data Fusion Approaches**	**9**
Introduction to Data Fusion – Types of Data Fusion Architecture – Centralized Architecture – Decentralized Architecture – Distributed Architecture – Hierarchical Architecture – Case Study –Smart City Infrastructure – IoT Deployments – Smart City Control and Management Centers – Theory of Unified City Modeling – Smart City Operational Model- Theories and Models – Case Study – Web Browsing History Analysis – Data Model for Group Construction in Student's Industrial Placement.		
Unit – IV	**Geriatric Design and IoT Enabled Smart Homes**	**9**
Introduction to Geriatric Design – Background – Development of Smart Homes – Development of Smart Homes for Elderly – Indian Scenario –Geriatric Smart Home Requirements – Design – Framework for Smart homes –Architectural Interventions – Case Study: Schematic Design for a Nesting Home – IoT Based Real Time Automation – Technical Components of Smart Home		
Unit – V	**Impact of IoT Enabled Smart Cities**	**9**
Recent Development in IoT Application for Modern City – Classification of IoT based Smart Cities – Impact of 5G Technology – IoT Five Layer Architecture – IoT Computing Paradigm – Research Advancement and Drawbacks – Integration of Cloud Computing - integration of Applications – System Security – Research Challenges and Guidelines		

Total: 45

TEXT BOOK:

1. Adarsh Kumar, Anand Nayyar, Arun Solanki, "Digital Cities Road map IoT-Based Architecture and Sustainable Buildings", 1st Edition, Wiley, 2021.

REFERENCE:

1. . Joshua Thomas, Vasiliki Geropanta, Anna Karagianni, Vladimir Panchenko "Smart Cities and Machine Learning in Urban Health", IGIGlobal, 2021.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	interpret the machine learning concepts for sustainable and resilient buildings	Applying (K3)
CO2	demonstrate the concept of sensors and time series data	Applying (K3)
CO3	explore data fusion approach	Applying (K3)
CO4	develop Geriatric design on IoT enabled homes	Applying (K3)
CO5	study the impact of IoT enabled 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	PSO1	PSO2
CO1	**3**	**2**	**2**	**2**										
CO2	**3**	**2**	**2**	**2**										
CO3	**3**	**2**	**2**	**2**										
CO4	**3**	**2**	**2**	**2**										
CO5	**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)**

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

(Offered by Department of Computer Science and Engineering)

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

Preamble	In this course, systematic process of thinking which empowers even the most traditional thinker to develop new, innovative solutions to the problem at handare studied with an emphasis on bringing ideas to life based on how real users think, feel and behave.	
Unit - I	**Introduction::**	**9**
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	**Visualization:**	**9**
Introduction – Visualization – Journey Mapping – Value Chain Analysis – Mind Mapping – Empathize –Observations – Need Finding – User Personas.		
Unit - III	**Brainstorming:**	**9**
Introduction – Brainstorming – Concept Development – Experiment – Ideation – Prototyping – Idea Refinement.		
Unit - IV	**Assumption Testing:**	**9**
Introduction – Assumption Testing – Rapid Prototyping – Engage – Storyboarding.		
Unit - V	**Customer Co-Creation Learning Launch:**	**9**
Introduction – Customer Co-Creation Learning Launch – Leading Growth and Innovation – Evolve– Concept Synthesis – Strategic Requirements – Evolved Activity Systems – Quick Wins.		

Total:45

TEXT BOOK:

1. Jeanne Liedtka and Tim Ogilvie, "Designing for Growth: A Design Thinking Tool Kit for Managers", Columbia University Press, 2011.

REFERENCES:

1. Lee Chong Hwa, "Design Thinking The Guidebook", Design Thinking Master Trainers of Bhutan, 2017.
2. Jeanne Liedtka, Tim Ogilvie, and Rachel Brozenske, "The Designing for Growth FieldBook: 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,2nd Edition, Springer, 2017.

REFERENCES:

1.	R. Winston, Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering, Revie 4th 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)**

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 : BTech & Artificial Intelligence and Data Science
BTech & Artificial Intelligence and Machine Learning

HONOURS DEGREE TITLE: Internet of Things

The following courses are identified to earn additional 18 credits to get a Honours degree with specialization in **Internet of Things**

S.No	Course Code	Course Title	Credits	Prerequisites	Semester
1.	20ADH01	Introduction to Internet of Things	4	NIL	5
2.	20ADH02	Internet of Things and Machine Learning	4	NIL	6
3.	20ADH03	Industrial and Medical Internet of Things	4	NIL	6
4.	20ADH04	Practical Aspects of IoT	3	NIL	7
5.	20ADH05	Privacy and Security in Internet of Things	3	NIL	7
		TOTAL	**18**		

20ADH01 - INTRODUCTION TO INTERNET OF THINGS							
(Common to AI &DS and AI&ML branches)							
Programme & Branch	**BTech – Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5/6/7**	**HN**	**3**	**1**	**0**	**4**

Preamble	This course provides insights about the basics of networking, network security, precursor technologies of IoT and the emergence of IoT. It gives an overview of various connectivity technologies prevalent in the field. It also focuses on various challenges of IoT and real-time IoT case studies.	
Unit – I	**Basics of Networking and Security:**	**9+3**
Basics of Networking: Introduction – Network Types – Layered Network Models – Addressing – TCP/IP Transport layer. Basics of Network Security: Introduction – Security – Network Confidentiality – Cryptography – Message Integrity and Authenticity – Key Management – Internet Security – Firewall		
Unit – II	**Predecessors and Emergence of IoT:**	**9+3**
Predecessors of IoT: Introduction – Wireless Sensor Networks – Machine-to-Machine Communications – Cyber Physical Systems. Emergence of IoT: Introduction – Evolution of IoT – Enabling IoT and the Complex Interdependence of Technologies – IoT Networking Components – Addressing Strategies in IoT. IoT Sensing: Introduction – Sensors – Sensor Characteristics – Sensorial Deviations - Sensing Types – Sensing Considerations		
Unit – III	**IoT Actuators and Topologies:**	**9+3**
IoT Actuators: Actuator Types – Actuator Characteristics. IoT Processing Topologies and Types: Data Format – Importance of Processing in IoT – Processing Topologies – IoT Device Design and Selection Considerations – Processing Offloading. IoT Connectivity Technologies		
Unit – IV	**Cloud Computing and Fog Computing:**	**9+3**
Cloud Computing: Introduction – Virtualization – Cloud Models – Service-Level Agreement in Cloud Computing – Cloud Implementation – Sensor-Cloud: Sensors-as-a-Service. Fog Computing and Its Applications: Introduction – View of a Fog Computing Architecture – Fog Computing in IoT – Selected Applications of Fog Computing.		
Unit – V	**IoT Paradigms and Case Studies:**	**9+3**
Paradigms, Challenges, and the Future: Evolution of New IoT Paradigms – Challenges Associated with IoT – Emerging Pillars of IoT. IoT case studies: Agricultural IoT – Vehicular IoT – Healthcare IoT		

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy. “Introduction to IoT”. Cambridge University Press, 1st Edition, United Kingdom, 2021.

REFERENCES:

1. Cuno Pfister. “Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud”. Make Community, LLC, 1st Edition, United States, 2011.
2. Vlasios Tsiatsis, Stamatis Karnouskos, Jan Holler, David Boyle, Catherine Mulligan. “The Internet of Things – Technologies and Applications for a New Age of Intelligence”. Academic Press, 2nd Edition, United States, 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped** **(Highest Level)**
CO1	recall the networking fundamentals and its security concepts	Understanding (K2)
CO2	emphasize the importance of IoT fundamentals and IoT sensors	Understanding (K2)
CO3	explain the IoT Actuators and IoT Processing Topologies	Understanding (K2)
CO4	investigate the Cloud computing and Fog computing technologies	Applying (K3)
CO5	examine the IoT Paradigms, Challenges and Case Studies	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	45	55					100
CAT2	35	65					100
CAT3	20	55	25				100
ESE	20	55	25				100

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

20ADH02 – INTERNET OF THINGS AND MACHINE LEARNING							
(Common to AI &DS and AI&ML branches)							
Programme & Branch	**Btech – Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5/6/7**	**HN**	**3**	**1**	**0**	**4**

Preamble	To impart knowledge on various mechanisms of integrating IoT devices and Machine Learning algorithms	
Unit – I	**Introduction:**	**9+3**
Infusion of AI and data science in IoT – Data Access and Distributed Processing for IoT :txt, csv,xlsx,json,HDF5,SQL, NoSQL, HDFS. Edge Computing on IoT Devices – Distributed Machine Learning – Machine Learning Accelerator – Machine Learning Model Optimization.		
Unit – II	**Machine Learning for IoT:**	**9+3**
Prediction using linear regression – Logistic regression for classification – Ensemble learning – Improving machine learning model.		
Unit – III	**Deep Learning for IoT:**	**9+3**
Introduction to Deep learning - Multilayered perceptrons for regression and classification – Convolutional neural networks – Recurrent neural networks – Autoencoders.		
Unit – IV	**Genetic Algorithms for IoT Optimization:**	**9+3**
Deterministic and analytic methods – Natural optimization methods- Introduction to genetic algorithms – Coding genetic algorithms using Distributed Evolutionary Algorithms in Python – Reinforcement Learning for IoT.		
Unit – V	**Advanced models for IoT:**	**9+3**
Generative Models for IoT – Distributed AI for IoT – AI for the Industrial IoT – Processing different types of data – Computing in the cloud.		
Lecture:45, Tutorial:15, Total:60		

TEXT BOOK:

1.	Hantao Huang, Hao Yu. “Compact and Fast Machine Learning Accelerator for IoT Devices”. Springer, 1st Edition, 2019, for Units 1, 2, 3, 4.
2.	Amita Kapoor. “Hands-On Artificial Intelligence for IoT”. Packt Publishing, 1st Edition, 2019, for Unit 5.

REFERENCES:

1.	Shrirang Ambaji Kulkarni, Varadaraj P.Gurupur, Steven L.Fernandes. Introduction to IoT with machine learning and image processing using Raspberry pi. CRC Press, 1st Edition, 2020..

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	describe the basic concepts of IoT and Machine learning	Understanding (K2)
CO2	implement machine learning algorithms for IoT applications	Applying (K3)
CO3	describe various Deep Learning algorithms for IoT	Understanding (K2)
CO4	apply Genetic Algorithms for IoT Optimization	Applying (K3)
CO5	understand advanced models for IoT	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	3	3		3								3	2
CO2	3	3	2		2								3	2
CO3	3	2	3		3								3	3
CO4	3	2	3		3								3	3
CO5	3	2	2		3								3	3

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

ASSESSMENT PATTERN – THEORY

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

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

20ADH03 - INDUSTRIAL AND MEDICAL INTERNET OF THINGS							
(Common to AI &DS and AI&ML branches)							
Programme & Branch	**Btech – Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5/6/7**	**HN**	**3**	**1**	**0**	**4**
Preamble	This course deals with introduction to Industrial and medical IoT and how IoMT is used to for remote healthcare.						
Unit – I	**Industrial IoT:**						**9+3**
Introduction to IoT- key technologies- I-IoT- IoT Analytics and AI- Industrial process – CIM pyramid architecture –devices and networks- I-IoT data Flow							
Unit – II	**Industrial Data Flow:**						**9+3**
I-IoT dataflow-Industrial protocols-Supervisory control and Data Acquisition-Discovering OPC-Understanding I-IoT Edge-Implementing I-IoT dataflow-OPC UA Simulation server-							
Unit – III	**Implementing I-IoT:**						**9+3**
Developing Industrial I-IoT and Architecture-Implementing custom Industrial IoT Platform –Implementing a cloud Industrial IoT solution with AWS							
Unit – IV	**Internet of Medical things:**						**9+3**
Introduction-IoMT- IoMT Medical Devices- Remote Patient monitoring- privacy of IoT –based health records – remote Health Care: wearable smart devices – Communication technologies							
Unit – V	**IoMT Applications:**						**9+3**
Smart Assistance for Elderly Individuals –Parkinson's Disease handling using IoMT- Machine Learning with IoMT							
Lecture:45, Tutorial:15, Total:60							
TEXT BOOK:							
1.	Giacomo Veneri,Antonio Capsso, "Hands-On Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0,Packt Publishing Ltd, 1st Edition,2018, for Units 1, 2 and 3.						
2.	D.Jude Hemanth,J.Anitha,George A. Tsihrintzis "Internet of Medical things- remote healthcare systems and applications", Springer, 1st Edition, 2021, for Units 4 and 5.						
REFERENCES:							
1.	Ismail Butun,"Industrial IoT Challenges, Design Principles, Applications, and Security", Springer Publications,1st Edition, 2020.						

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand the basic concepts of Industrial IoT	Understanding (K2)
CO2	explain the principles of Industrial Data Flow	Understanding (K2)
CO3	explore different aspects of implementing I-IoT	Understanding (K2)
CO4	implement the concepts of Internet of Medical things	Applying(K3)
CO5	demonstrate various IoMT 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		3								3	2
CO5	3	2	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	50	50					100
CAT2	20	50	30				100
CAT3	20	50	30				100
ESE	20	50	30				100

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

20ADH04 - PRACTICAL ASPECTS OF IOT							
(Common to AI &DS and AI&ML branches)							
Programme& Branch	**B.Tech. Artificial Intelligence and Machine Learning & B.Tech. Artificial Intelligence and Data Science**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5/6/7**	**PC**	**3**	**0**	**0**	**3**
Preamble	This course provides an chance on practical exploration of IoT and its applications. It also extended its concepts of storage and data analytics using IoT						
Unit – I	**IoT System Management:**						**9**
IoT and M2M: Introduction – difference between IoT and M2M – SDN and NFV for IoT- need for IoT system management – simple network management protocol – network operator requirements – NETCONF – YANG – IoT System management with NETCONG – YANG – IoT platforms design methodology – IoT design methodology							
Unit – II	**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 – III	**IoT Physical Servers and Cloud offerings:**						**9**
: Introduction to cloud storage models and communication APIs- WAMP – autobahn for IoT – Xively cloud for IoT - python web application frame work - Djanga – designing a RESTful web API - Amazon web services for IoT – Case Studies							
Unit – IV	**Data Analytics for IoT:**						**9**
Apache Hadoop, Hadoop MapReduce for batch data analysis, Apache Oozie, Apache Spark, Apache Storm for real time data analysis, Tools for IoT: Chef, Puppet							
Unit – V	**Applications and Case studies:**						**9**
Smart home – wearables – connected cars – industrial IoT applications – smart cities – IoT in agriculture – IoT in healthcare – IoT applications in retail							
							Total:45

TEXT BOOK:	
1.	Arshdeep Bahga and Vijay Madisetti, “Internet of Things – A Hands-on Approach”, Universities Press, 2015.(units 1-4)
2.	Mohammad Ali Jabraeil Jamali, Bahareh Bahrami, Arash Heidari, Parisa Allahverdizadeh, Farhad Norouzi, “Towards the Internet of ThingsArchitectures, Security, and Applications, Springer, 2019(Unit – 5)
REFERENCES:	
1.	Jeeva Jose, “Internet of Things”, Khanna Publishing, 2018
2.	Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, 1st Edition, CRC Press, 2012

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	make use of network management systems along with IoT specifications	Applying(K3)
CO2	outline the role of Python packages for IoT applications and develop simple IoT applications using Raspberry Pi and Python	Applying(K3)
CO3	solve the storage problems using physical and cloud servers	Applying(K3)
CO4	perform data analysis on IoT data using various tools	Applying(K3)
CO5	interpret various applications and case studies of 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	2	1	1									3	2
CO2	3	2	1	1	1								3	2
CO3	3	2	1	1									3	2
CO4	3	2	1	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	10	50	40				100
CAT2	10	50	40				100
CAT3	10	50	40				100
ESE	5	55	40				100

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

20ADH05 - PRIVACY AND SECURITY IN INTERNET OF THINGS							
(Common to AI &DS and AI&ML branches)							
Programme & Branch	**BTech - Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5/6/7**	**HN**	**3**	**0**	**0**	**3**

Preamble	This syllabus explores issues of privacy and security with regard to the IoT environments, as well as technical solutions to help address them.	
Unit – I	**Attacks and Protection Mechanisms in IoT Devices:**	**9**
Introduction-physical attacks in IoT Devices-Profiling Attacks-Real World Attacks-count measures- Remote Attestation- Types of Remote Attestation-remote Attestation-Human Aspects of IoT Security and privacy		
Unit – II	**Defence Mechanisms Against Attacks:**	**9**
Introduction - Data Exfiltration- Types-Attack Mechanisms, and Defence Technique- Types of Data Exfiltration-Data Exfiltration Attack Techniques-Data Exfiltration Threats-Counter Data Exfiltration-Mechanisms to Defend Against Physical Data Exfiltration-Threat Scenario-Scenario Execution and Analysis-Discussion		
Unit – III	**Protocol for UAV Remote Identification:**	**9**
Introduction- Drone Security - Drone Security in UTM-Security Attacks on Drones -Security Attacks from Drones-Drone Safety-Drone Detection and Classification-Interdiction Technologies-UAV Remote Identification-Authentication Protocol for Remote Identification-Secure Communication Protocol-Security Analysis- Formal Verification		
Unit – IV	**Cyber-Security IoT Infrastructure:**	**9**
Cyber-Attacks on IoT Infrastructure – Eavesdropping - Solutions-Network Activity Analysis Solutions-Active Reconnaissance-Solutions-Volumetric Attack -Solutions - Masquerading Attack -Solutions- Access Attack – Solutions-Active Crypto Attack - Solutions - Data Exfiltration- Solutions-Blocking Attack- Solutions-Sleep Deprivation Attack - Solutions Trigger Action Attack-Solutions- Network Behavioral Model of IoTs -Enforcing MUD Profile to Network		
Unit – V	**Security and privacy - Case studies:**	**9**
Securing Contemporary eHealth Architectures- Techniques and Methods: Introduction - eHealth- Fog or Edge Computing for eHealth- Cloud Computing for eHealth -Applications of IoT in eHealth- eHealth Threat Landscape-eHealth Threat Model- eHealth IoT Vulnerabilities and Threats-Real-world Attacks-Counter measures. Security and Privacy of Smart Homes- Issues and Solutions :Smart Homes' Security and Privacy-Smart Home Technologies-Privacy Techniques and Mechanisms		
		Total:45

TEXT BOOK:

1.	Ali Ismail Awad, Jemal Abawajy, "Security and Privacy in the Internet of Things -Architectures, Techniques, and Applications", Wiley-IEEE Press, 1st Edition, 2018 for Units 1, 2, 3.
2.	Fei Hu, Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations, CRC Press; 1st Edition, 2016, for Units 4, 5.

REFERENCES:

1.	Zaigham Mahmood, Security, Privacy and Trust in the IoT Environment", Springer, 1stEdition2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	describe Attacks and Protection Mechanisms in IoT Devices	Understanding (K2)
CO2	explain Defence Mechanisms Against Attacks	Understanding (K2)
CO3	summarize Protocol for UAV Remote Identification	Understanding (K2)
CO4	design Cyber-Security IoT Infrastructure	Understanding (K2)
CO5	implement Security and privacy mechanisms	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	2										3	2
CO3	3	2	2										3	2
CO4	3	2	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	50	50					100
CAT2	50	50					100
CAT3	20	50	30				100
ESE	20	50	30				100

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