KONGU ENGINEERING COLLEGE

(Autonomous Institution Affiliated to Anna University, Chennai)

PERUNDURAI ERODE – 638 060

TAMILNADU INDIA

Estd : 1984

REGULATIONS, CURRICULUM & SYLLABI – 2022

(CHOICE BASED CREDIT SYSTEM AND OUTCOME BASED EDUCATION)

(For the students admitted during 2022 - 2023 and onwards)

BACHELOR OF TECHNOLOGY DEGREE IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

DEPARTMENT OF ARTIFICIAL INTELLIGENCE

KONGU
Assuring the Best

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638060

(Autonomous)

REGULATIONS 2022

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 2022 – 2023 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 (COE)" means authorized person who is responsible for all examination related activities of the College.

xi. "Head of the Department (HOD)" means Head of the Department concerned.

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.

(OR)

The candidates who hold a BSc degree in Science(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 also 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, English Communication Skills, Universal Human Values and Yoga & Values for Holistic Development.
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/Industrial Training, Comprehensive Test & Viva, Entrepreneurships/Start ups and Internship / In-plant Training 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 168.

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 7.5 CGPA and no history of arrears to opt for the honours degree and has to maintain the same during the entire programme.
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, and entrepreneurships/start ups during the programme to gain/exhibit the knowledge/skills.

4.3.1 Professional Skills Training/ Indsutrial Training/Entrepreneurships/Start Ups/ Inplant Training

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 fourth semester and phase II in fifth 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 fifth semester vacation period. Such candidate can earn two credits for this training course in place of Professional Skills Training course II in fifth semester. He/She shall attend Professional Skills Training Phase I in fourth 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 2 credits in place of Professional Skills Training II. The area in which the candidate wants to initiate a start up may be interdisciplinary or multidisciplinary. The progress of the startup shall be evaluated by a panel of members constituted by the Principal through periodic reviews.

4.3.2 Comprehensive Test and 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 Full Time Project through 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-II Phase-I 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 One/Two Credit 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 One / Two Credit 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.

4.3.4 A student shall go for in-plant training for duration of two weeks during the entire programme. It is mandatory for all the students.

4.4 One / Two Credit Courses / Online Courses / Self Study Courses

The candidates may optionally undergo One / Two Credit Courses / Online Courses / Self Study Courses as elective courses.

4.4.1 **One / Two Credit Courses:** One / Two credit courses shall be offered by the college with the prior approval from respective Board of Studies. A candidate can earn a maximum of six credits through one / two credit 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 one / two credit 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 seventh 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.

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) and 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, Comprehensive Test and Viva, Project Work, Industrial Training /Professional Skills Training, Internship/In-plant Training and Entrepreneurships/ Start ups. Performance in each course of study shall be evaluated based on (i) Continuous Assessments (CA) throughout the semester and (ii) End Semester Examination (ESE) at the end of the semester except for the courses which are evaluated based on continuous assessment only. Each course shall be evaluated for a maximum of 100 marks as shown below:

Sl. No.	Category of Course	Continuous Assessment Marks	End Semester Examination Marks
1.	Theory	40	60
2.	Theory cum Practical (The distribution of marks shall be decided based on the credit weightage assigned to theory and practical components.)	50	50
3.	Practical	60	40
4.	Professional Skills Training / Comprehensive Test & Viva / Entrepreneurships / Start ups / Project Work I / Mandatory Course/Industrial Training/ Universal Human Values / Yoga and Values for Holistic Development	100	---
5.	Project Work II Phase I / Project Work II Phase II / Internships	50	50
6.	One / Two credit Course	The distribution of marks shall be decided based on the credit weightage assigned	---
7.	All other Courses		

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

7.3 Theory Courses

For all theory courses out of 100 marks, the continuous assessment shall be 40 marks and the end semester examination shall be for 60 marks. However, the end semester examinations shall be conducted for 100 marks and the marks obtained shall be reduced to 60. The continuous assessment tests shall be conducted as per the schedule laid down in the academic schedule. 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	20	Average of best 2 tests (20 marks)
	Test - II	20	
	Test - III	20	
2.	Tutorial: (Tutorial/Problem Solving (or) Simulation (or) Simulation & Mini Project (or) Mini Project (or) Case Studies (or) Any other relevant to the course)	15	Type of assessment is to be chosen based on the nature of the course and to be approved by Principal
3.	Others: 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	40	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 of 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 60 marks and the end semester examination shall be for 40 marks. Every exercise / experiment shall be evaluated based on the candidate's performance during the practical class and the candidates' 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.

7.5.2 The end semester examination shall be conducted for a maximum of 100 marks for duration of 3 hours and reduced to 40 marks. The appointment of examiners and the schedule shall be decided by chairman of Board of Study of the relevant board.

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 Phase I /Project Work II 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	Super visor	Review Committee (excluding supervisor)	Super visor	Review Committee (excluding supervisor)	Super visor	Ext. Exr.	Super visor	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 end semester examination of 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 supervisor 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 / 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	Supervisor	Review Committee (excluding supervisor)	Supervisor	Review Committee (excluding supervisor)	Supervisor	Review Committee	Supervisor	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 3rd semester vacation and during 4th semester. Phase II training shall be conducted for minimum of 80 hours in 4th semester vacation and during 5th semester. The evaluation procedure shall be approved by the board of the offering department and 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 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 In-Plant Training

Each candidate shall go for In-Plant training for a duration of minimum of two weeks during the entire programme of study and submit a brief report about the training undergone and a certificate issued from the organization concerned.

7.12 One / Twe Credit Courses

For all one/ two credit courses out of 100 marks, the continuous assessment shall be 50 marks and the model examination shall be for 50 marks. Minimum of two continuous assessments tests shall be conducted during the one / two credit course duration by the offering department concerned. Model examination shall be conducted at the end of the course.

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 SC (Successfully Completed). 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 Courses

A candidate joined in first semester shall attend and complete a mandatory course namely Student Induction Program of duration three weeks at the beginning of first semester. The candidates studying in second year shall attend and complete another one mandatory course namely Environmental Science. No credits shall be given for mandatory courses and shall be evaluated through continuous assessment tests only vide clause 7.1 for a maximum of 100 marks each. Upon the successful completion, these courses will be listed in the semester grade sheet and in the consolidated grade sheet with the grade "SC" (Successfully Completed). Since no grade points are assigned, these courses will not be counted for the purpose of GPA and CGPA calculations.

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

Courses YVHD shall be offered to all first year candidates of all BE/ BTech programmes to impart knowledge on yoga and human values. Course UHV shall be offered to all the second year BE/ BTech students. 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:

For all the passed candidates, the relative grading principle is applied to assign the letter grades.

Marks / Examination Status	Letter Grade	Grade Point
Based on the relative grading	O (Outstanding)	10
	A+ (Excellent)	9
	A (Very Good)	8
	B+ (Good)	7
	B (Average)	6
	C (Satisfactory)	5
Less than 50	U (Reappearance)	0
Successfully Completed	SC	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-2022 (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 or a candidate 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 6.50

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 Honors 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 7.50

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 College, reserves the right to modify/amend without notice, the Regulations, Curricula, Syllabi, Scheme of Examinations, procedures, requirements, and rules pertaining to its BE / BTech programme.

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B.TECH. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING CURRICULUM – R2022
(For the students admitted in the academic year 2022-23 onwards)

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**	**5**	**2**			**2**	**3**		**15**	**8.93**
BS	**8**	**8**	**4**						**20**	**11.90**
ES	**9**	**9**	**4**	**3**					**25**	**14.88**
PC	**3**	**4**	**13**	**17**	**12**	**8**			**57**	**33.93**
PE					**3**	**3**	**9**	**3**	**18**	**10.71**
OE					**4**	**4**	**3**	**3**	**14**	**8.33**
EC				**2**	**2**	**6**	**5**	**4**	**19**	**11.31**
Semesterwise Total	**23**	**26**	**23**	**22**	**21**	**23**	**20**	**10**	**168**	**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.	22EGT11	Communication Skills I	3	0	0	3	I
2.	22EGT21	Communication Skills II	3	0	0	3	II
3.	22VEC11	Yoga and Values for Holistic Development	1	0	1	1	II
4.	22TAM01	Heritage of Tamils	1	0	0	1	II
5.	22EGL31	Communication Skills Development Laboratory	0	0	2	1	III
6.	22TAM02	Tamils and Technology	1	0	0	1	III
7.	22GET31	Universal Human Values	2	0	0	2	VI

8.	22GCT71	Engineering Economics and Management	3	0	0	3	VII
Total Credits to be earned						**15**	

BASIC SCIENCE (BS)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	22MAC11	Matrices and Ordinary Differential Equations	3	1*	2*	4	I
2.	22CYT12	Chemistry for Computer Systems	3	0	0	3	I
3.	22CYL12	Chemistry Laboratory for Computer Systems	0	0	2	1	I
4.	22MAC24	Probability Theory and Inferential Statistics	3	1*	2*	4	II
5.	22PHT22	Physics for Computer Systems	3	0	0	3	II
6.	22PHL22	Physics Laboratory for Computer Systems	0	0	2	1	II
7.	22MAT33	Discrete Mathematics and Linear Algebra	3	1	0	4	III
Total Credits to be earned						**20**	

ENGINEERING SCIENCE (ES)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	22ADC11	C Programming	3	0	2	4	I
2.	22EEC11	Basics of Electrical and Electronics Engineering	3	0	2	4	I
3.	22ADL11	Open Source and Web Designing Laboratory	0	0	2	1	I
4.	22ECC21	Digital Principles and Design	3	0	2	4	II
5.	22ADC22	Python Programming	3	0	2	4	II
6.	22MEL11	Engineering Practices Laboratory	0	0	2	1	II
7.	22ALT32	Java Programming	3	0	0	3	III
8.	22ALL32	Java Programming Laboratory	0	0	2	1	III
9.	22ALT42	Computer Organization	3	0	0	3	IV
Total Credits to be earned						**25**	

PROFESSIONAL CORE (PC)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**	**Domain/ Stream**
1.	22ADT11	Foundations of Information Technology	3	0	0	3	I	SD
2.	22ADC21	Data Structures	3	0	2	4	II	SD
3.	22ADC31	Data Processing and Visualization	3	0	2	4	III	AI
4.	22ALT31	Machine Learning	3	1	0	4	III	AI
5.	22ALT33	Design and Analysis of Algorithms	3	1	0	4	III	SD
6.	22ALL31	Machine Learning Laboratory	0	0	2	1	III	AI
7.	22ALT41	Database Management Systems	3	1	0	4	IV	SD
8.	22ALT43	Operating Systems	3	1	0	4	IV	SD
9.	22ALC41	Deep Learning	3	0	2	4	IV	AI
10.	22ADC41	Web Technology	3	0	2	4	IV	SD
11.	22ALL41	Database Management Systems Laboratory	0	0	2	1	IV	SD
12.	22ADT51	Big Data Analytics	3	0	0	3	V	AI
13.	22ALC51	Natural Language Processing	3	0	2	4	V	AI
14.	22ALC52	Computer Vision	3	0	2	4	V	AI
15.	22ADL51	Big Data Analytics Laboratory	0	0	2	1	V	AI
16.	22ALT61	Transfer Learning	3	0	0	3	VI	AI
17.	22ADT61	Data Modeling and Business Intelligence	3	0	0	3	VI	AI
18.	22ALL61	Transfer Learning Laboratory	0	0	2	1	VI	AI
19.	22ADL61	Data Modeling and Business Intelligence Laboratory	0	0	2	1	VI	AI
Total Credits to be earned						**57**		

LIST OF PROFESSIONAL ELECTIVES (PEs)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Domain/ Stream**
Semester – V							
Elective – I							
1.	22ALE01	Theory of Computation	3	0	0	3	SD
2.	22ADE01	Design Thinking	3	0	0	3	SD
3.	22ALE02	Multicore Architecture	3	0	0	3	SD
4.	22ADE02	Soft Computing Techniques	3	0	0	3	SD
5.	22ADF01	Data Analysis	2	0	2	3	AI
Semester – VI							
Elective – II							
6.	22ADE05	Communication Networks	3	0	0	3	NS
7.	22ADF02	R Programming for Machine Learning	2	0	2	3	AI
8.	22ADE06	Modeling and Simulation	3	0	0	3	AI
9.	22ALE03	Nature Inspired Optimization Techniques	3	0	0	3	AI
10.	22ALF01	Design Patterns and Principles	2	0	2	3	SD
Semester – VII							
Elective – III							
11.	22ADE09	Reinforcement Learning	3	0	0	3	AI
12.	22ADE10	Agile Methodologies for Software Development	3	0	0	3	SDE
13.	22ADE11	Information Retrieval Techniques	3	0	0	3	AI
14.	22ADE12	Search Methods in Artificial Intelligence	3	0	0	3	AI
15.	22ALE04	Graph Theory and its Applications	3	0	0	3	AI
Elective – IV							
16.	22GEE01	Fundamentals of Research	3	0	0	3	GE
17.	22ALE05	Numerical Methods	3	0	0	3	AI
18.	22ALF02	Mobile Application Development	2	0	2	3	SD
19.	22ALE06	Cyber Security	3	0	0	3	NS
20.	22ADE15	Ethics of Artificial Intelligence	3	0	0	3	AI
Elective – V							
21.	22ADE18	Quantum Computing	3	0	0	3	AI
22.	22ADF05	Robotic Process Automation	2	0	2	3	AI

23.	22ADE16	Cloud Computing	3	0	0	3	SD
24.	22ALE07	Neural Machine Translation	3	0	0	3	AI
25.	22ALF03	Game Development	2	0	2	3	AI
Semester – VIII							
Elective – VI							
26.	22ADE20	Software Quality Assurance	3	0	0	3	SDE
27.	22ALE08	Software Defined Networks	3	0	0	3	NS
28.	22ADE21	Software Testing	3	0	0	3	SDE
29.	22ADE22	Software Project Management	3	0	0	3	SDE
Total Credits to be earned						**18**	

***** AI – Artificial Intelligence, SD – System Development, SDE – Software Development and Engineering, NS- Networks and Security, GE – General Engineering

EMPLOYABILITY ENHANCEMENT COURSES (EC)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**	**Domain/ Stream**
1.	22GCL41/ 22GCI41	Professional Skills Training I / Industrial Training I	-	-	-	2	IV	--
2.	22GCL51/ 22GCI51	Professional Skills Training II / Industrial Training II	-	-	-	2	V	--
3.	22ALP61	Project Work I	0	0	8	4	VI	--
4.	22GEP61	Comprehensive Test and Viva	-	-	-	2	VI	--
5.	22ALP71	Project Work II Phase I	0	0	10	5	VII	--
6.	22ALP81	Project Work II Phase II	0	0	8	4	VIII	--
Total Credits to be earned						**19**		

MANDATORY COURSES							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1	22MNT11	Student Induction Program	-	-	-	0	I
2.	22MNT31	Environmental Science	2	0	0	0	III

B.TECH. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING CURRICULUM – R2022
(For the students admitted in the academic year 2023-24 onwards)

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	**5**	**4**	**1**			**2**	**3**		**15**	**8.93**
BS	**8**	**8**	**4**						**20**	**11.90**
ES	**10**	**7**	**4**	**3**					**24**	**14.29**
PC		**4**	**13**	**17**	**15**	**7**	**3**		**59**	**35.12**
PE					**3**	**3**	**6**	**3**	**15**	**8.93**
OE					**4**	**4**	**3**	**3**	**14**	**8.33**
EC				**2**	**2**	**7**	**6**	**4**	**21**	**12.50**
Semesterwise Total	**23**	**23**	**22**	**22**	**24**	**23**	**21**	**10**	**168**	**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.	22EGT11	Communication Skills I	3	0	0	3	I
2.	22VEC11	Yoga and Values for Holistic Development	-	-	-	1	I
3.	22TAM01	Heritage of Tamils	1	0	0	1	I
4.	22EGT21	Communication Skills II	3	0	0	3	II
5.	22TAM02	Tamils and Technology	1	0	0	1	II
6.	22EGL31	Communication Skills Development Laboratory	0	0	2	1	III
7.	22GET31	Universal Human Values	2	0	0	2	VI

8.	22GCT71	Engineering Economics and Management	3	0	0	3	VII
Total Credits to be earned						**15**	

BASIC SCIENCE (BS)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	22MAC11	Matrices and Ordinary Differential Equations	3	1*	2*	4	I
2.	22PHT22	Physics for Computer Systems	3	0	0	3	I
3.	22PHL22	Physics Laboratory for Computer Systems	0	0	2	1	I
4.	22MAC24	Probability Theory and Inferential Statistics	3	1*	2*	4	II
5.	22CYT12	Chemistry for Computer Systems	3	0	0	3	II
6.	22CYL12	Chemistry Laboratory for Computer Systems	0	0	2	1	II
7.	22MAT33	Discrete Mathematics and Linear Algebra	3	1	0	4	III
Total Credits to be earned						**20**	

ENGINEERING SCIENCE (ES)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	22ADC11	C Programming	3	0	2	4	I
2.	22ADC12	Essentials of Information Technology	2	0	2	3	I
3.	22GCL11	Foundation Laboratory- Manufactoring, Design and Robotics	0	0	6	3	I
4.	22ADC22	Python Programming	3	0	2	4	II
5.	22GCL12	Foundation Laboratory- Electrical ,IoT and Web	0	0	6	3	II
6.	22ALT32	Java Programming	3	0	0	3	III
7.	22ALL32	Java Programming Laboratory	0	0	2	1	III
7.	22ALT42	Computer Organization	3	0	0	3	IV
Total Credits to be earned						**24**	

PROFESSIONAL CORE (PC)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**	**Domain/ Stream**
1.	22ADC21	Data Structures	3	0	2	4	II	SD
2.	22ADC31	Data Processing and Visualization	3	0	2	4	III	AI
3.	22ALT31	Machine Learning	3	1	0	4	III	AI
4.	22ALT33	Design and Analysis of Algorithms	3	1	0	4	III	SD
5.	22ALL31	Machine Learning Laboratory	0	0	2	1	III	AI
6.	22ALT41	Database Management Systems	3	1	0	4	IV	SD
7.	22ALT43	Operating Systems	3	1	0	4	IV	SD
8.	22ALC41	Deep Learning	3	0	2	4	IV	AI
9.	22ADC41	Web Technology	3	0	2	4	IV	SD
10.	22ALL41	Database Management Systems Laboratory	0	0	2	1	IV	SD
11.	22ADT51	Big Data Analytics	3	0	0	3	V	AI
12.	22ALC51	Natural Language Processing	3	0	2	4	V	AI
13.	22ALC52	Computer Vision	3	0	2	4	V	AI
14.	22ADT52	Computer Networks	3	0	0	3	V	NS
15.	22ADL51	Big Data Analytics Laboratory	0	0	2	1	V	AI
16.	22ALT61	Transfer Learning	3	0	0	3	VI	AI
17.	22ADT61	Data Modeling and Business Intelligence	3	0	0	3	VI	AI
18.	22ALL61	Transfer Learning Laboratory	0	0	2	1	VI	AI
19.	22ADT71	Agile Methodologies	3	0	0	3	VII	SDE
Total Credits to be earned						**59**		

LIST OF PROFESSIONAL ELECTIVES (PEs)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Domain/ Stream**
Semester – V							
Elective – I							
1.	22ALE01	Theory of Computation	3	0	0	3	SD
2.	22ADE01	Design Thinking	3	0	0	3	SD
3.	22ALE02	Multicore Architecture	3	0	0	3	SD
4.	22ADE02	Soft Computing Techniques	3	0	0	3	SD
5.	22ADF01	Data Analysis	2	0	2	3	AI
Semester – VI							
Elective – II							
6.	22ADE05	Communication Networks	3	0	0	3	NS
7.	22ADF02	R Programming for Machine Learning	2	0	2	3	AI
8.	22ADE06	Modeling and Simulation	3	0	0	3	AI
9.	22ALE03	Nature Inspired Optimization Techniques	3	0	0	3	AI
10.	22ALF01	Design Patterns and Principles	2	0	2	3	SD
Semester – VII							
Elective – III							
11.	22ADE09	Reinforcement Learning	3	0	0	3	AI
12.	22ADE10	Agile Methodologies for Software Development	3	0	0	3	SDE
13.	22ADE11	Information Retrieval Techniques	3	0	0	3	AI
14.	22ADE12	Search Methods in Artificial Intelligence	3	0	0	3	AI
15.	22ALE04	Graph Theory and its Applications	3	0	0	3	AI
Elective – IV							
16.	22GEE01	Fundamentals of Research	3	0	0	3	GE
17.	22ALE05	Numerical Methods	3	0	0	3	AI
18.	22ALF02	Mobile Application Development	2	0	2	3	SD
19.	22ALE06	Cyber Security	3	0	0	3	NS
20.	22ADE15	Ethics of Artificial Intelligence	3	0	0	3	AI
21.	22ADE18	Quantum Computing	3	0	0	3	AI
22.	22ADF05	Robotic Process Automation	2	0	2	3	AI

23.	22ADE16	Cloud Computing	3	0	0	3	SD
24.	22ALE07	Neural Machine Translation	3	0	0	3	AI
25.	22ALF03	Game Development	2	0	2	3	AI
Semester – VIII							
Elective – V							
26.	22ADE20	Software Quality Assurance	3	0	0	3	SDE
27.	22ALE08	Software Defined Networks	3	0	0	3	NS
28.	22ADE21	Software Testing	3	0	0	3	SDE
29.	22ADE22	Software Project Management	3	0	0	3	SDE
Total Credits to be earned						**15**	

***** AI – Artificial Intelligence, SD – System Development, SDE – Software Development and Engineering, NS- Networks and Security, GE – General Engineering

EMPLOYABILITY ENHANCEMENT COURSES (EC)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**	**Domain/ Stream**
1.	22GCL41/ 22GCI41	Professional Skills Training I / Industrial Training I	-	-	-	2	IV	--
2.	22GCL51/ 22GCI51	Professional Skills Training II / Industrial Training II	-	-	-	2	V	--
3.	22ALP62	Project Work I	0	0	4	5	VI	--
4.	22GEP61	Comprehensive Test and Viva	-	-	-	2	VI	--
5.	22ALP72	Project Work II Phase I	0	0	8	6	VII	--
6.	22ALP82	Project Work II Phase II	-	-	14	4	VIII	--
Total Credits to be earned						**21**		

MANDATORY COURSES							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1	22MNT11	Student Induction Program	-	-	-	0	I
2.	22MNT31	Environmental Science	2	0	0	0	III

OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Sem**
1.	22ALO01	Business Intelligence	3	1	0	4	V
2.	22ALX01	Data Exploration and Visualization Techniques	3	0	2	4	VI
3.	22ALO02	Industrial Machine Learning	3	0	0	3	VII
4.	22ALO03	Machine Learning for Smart Cities	3	0	0	3	VIII
Total Credits to be earned						**14**	

KEC R2022: SCHEDULING OF COURSES – BTech (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING) Total Credits: 168

(For the students admitted in the academic year 2022-23 onwards)

Sem.	Course1	Course2	Course3	Course4	Course5	Course6	Course7	Course8	Course9	Course10	Credits
I	22EGT11 Communication Skills I (3-0-0-3)	22MAC11 Matrices and Ordinary Differential Equations (3-1*-2*-4)	22ADT11 Foundations of Information Technology (3-0-0-3)	22CYT12 Chemistry for Computer Systems (3-0-0-3)	22ADC11 C Programming(3-0-2-4)	22EEC11 Basics of Electrical and Electronics Engineering (3-0-2-4)	22CYL12 Chemistry Laboratory for Computer Systems (0-0-2-1)	22ADL11 Open Source and Web Designing Laboratory (0-0-2-1)	22MNT11 Student Induction Program (0-0-0-0)		**23**
II	22EGT21 Communication Skills II (3-0-0-3)	22MAC24 Probability Theory And Inferential Statistics (3-1*-2*-4)	22PHT22 Physics for Computer Systems (3-0-0-3)	22ECC21 Digital Principles and Design (3-0-2-4)	22ADC21 Data Structures (3-0-2-4)	22ADC22 Python Programming (3-0-2-4)	22PHL22 Physics Laboratory for Computer Systems (0-0-2-1)	22MEL11 Engineering Practices Laboratory (0-0-2-1)	22VEC11 Yoga and Values for Holistic Development (1-0-1-1)	22TAM01 Heritage for Tamils (1-0-0-1)	**26**
III	22MAT33 Discrete Mathematics and Linear Algebra (3-1-0-4)	22ADC31 Data Processing and Visualization (3-0-2-4)	22ALT31 Machine Learning (3-1-0-4)	22ALT32 Java Programming (3-0-0-3)	22ALT33 Design and Analysis of Algorithms (3-1-0-4)	22ALL31 Machine Learning Laboratory (0-0-2-1)	22ALL32 Java Programming Laboratory (0-0-2-1)	22EGL31 Communication Skills Development Laboratory (0-0-2-1)	22MNT31 Environmental Science (2-0-0-0)	22TAM02 Tamils and Technology (1-0-0-1)	**23**
IV	22ALT41 Database Management Systems (3-1-0-4)	22ALT42 Computer Organization (3-0-0-3)	22ALT43 Operating Systems (3-1-0-4)	22ALC41 Deep Learning (3-0-2-4)	22ADC41 Web Technology (3-0-2-4)	22ALL41 Database Management Systems Laboratory (0-0-2-1)	22GCL41/22GCI41 Professional Skills Training I/Industrial Training I (0-0-0-2)				**22**
V	22ADT51 Big Data Analytics (3-0-0-3)	22ALC51 Natural Language Processing (3-0-2-4)	22ALC52 Computer Vision (3-0-2-4)	Professional Elective – 1 (3-0-0-3)	Open Elective – 1 (3-0/1-2/0-4)	22ADL51 Big Data Analytics Laboratory (0-0-2-1)	22GCL51/22GCI51 Professional Skills Training II/ Industrial Training II (0-0-0-2)				**21**
VI	22ALT61 Transfer Learning (3-0-0-3)	22ADT61 Data Modeling and Business intelligence (3-0-0-3)	Professional Elective – 2 (3-0-0-3)	Open Elective – 2 (3-1/0-0/2-4)	22ALL61 Transfer Learning Laboratory (0-0-2-1)	22ADL61 Data Modeling and Business intelligence Laboratory (0-0-2-1)	22ALP61 Project Work 1 (0-0-8-4)	22GET31 Universal Human Values (2-0-0-2)	22GEP61 Comprehensive Test and Viva(0-0-0-2)		**23**

VII	22GCT71 Engineering Economics and Management (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)	Open Elective – 3 (3-0-0-3)	22ALP71 Project Work II Phase I (0-0-10-5)					**20**
VIII	Professional Elective -6 (3-0-0-3)	Open Elective – 4 (3-0-0-3)	22ALP81 Project work II Phase II (0-0-8-4)								**10**

KEC R2022: SCHEDULING OF COURSES – BTech (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE) Total Credits: 168

(For the students admitted in the academic year 2023-24 onwards)

Sem.	Course1	Course2	Course3	Course4	Course5	Course6	Course7	Course8	Course9	Course10	Credits
I	22EGT11 Communication Skills I (3-0-0-3)	22MAC11 Matrices and Ordinary Differential Equations (3-1*-2*-4)	22PHT22 Physics for Computer Systems (3-0-0-3)	22ADC11 C Programming(3-0-2-4)	22ADC12 Essentials of Information Technology (2-0-2-3)	22PHL22 Physics Laboratory for Computer Systems (0-0-2-1)	22GCL11 Foundation Laboratory-Manufactoring, Design and Robotics (0-0-6-3)	22VEC11 Yoga and Values for Holistic Development (1-0-1-1)	22TAM01 Heritage for Tamils (1-0-0-1)	22MNT11 Student Induction Program (0-0-0-0)	**23**
II	22EGT21 Communication Skills II (3-0-0-3)	22MAC24 Probability Theory And Inferential Statistics (3-1*-2*-4)	22CYT12 Chemistry for Computer Systems (3-0-0-3)	22ADC21 Data Structures (3-0-2-4)	22ADC22 Python Programming (3-0-2-4)	22CYL12 Chemistry Laboratory for Computer Systems (0-0-2-1)	22GCL12 Foundation Laboratory-Electrical ,IoT and Web (0-0-6-3)	22TAM02 Tamils and Technology (1-0-0-1)			**23**
III	22MAT33 Discrete Mathematics and Linear Algebra (3-1-0-4)	22ADC31 Data Processing and Visualization (3-0-2-4)	22ALT31 Machine Learning (3-1-0-4)	22ALT32 Java Programming (3-0-0-3)	22ALT33 Design and Analysis of Algorithms (3-1-0-4)	22ALL31 Machine Learning Laboratory (0-0-2-1)	22ALL32 Java Programming Laboratory (0-0-2-1)	22EGL31 Communication Skills Development Laboratory (0-0-2-1)	22MNT31 Environmental Science (2-0-0-0)		**22**
IV	22ALT41 Database Management Systems (3-1-0-4)	22ALT42 Computer Organization (3-0-0-3)	22ALT43 Operating Systems (3-1-0-4)	22ALC41 Deep Learning (3-0-2-4)	22ADC41 Web Technology (3-0-2-4)	22ALL41 Database Management Systems Laboratory (0-0-2-1)	22GCL41/22GCI41 Professional Skills Training I/Industrial Training I (0-0-0-2)				**22**
V	22ADT51 Big Data Analytics (3-0-0-3)	22ALC51 Natural Language Processing (3-0-2-4)	22ALC52 Computer Vision (3-0-2-4)	22ADT52 Computer Networks (3-0-0-3)	Professional Elective – 1 (3-0-0-3)	Open Elective – 1 (3-0/1-2/0-4)	22ADL51 Big Data Analytics Laboratory (0-0-2-1)	22GCL51/ 22GCI51 Professional Skills Training II/ Industrial Training II (0-0-0-2)			**24**
VI	22ALT61 Transfer Learning (3-0-0-3)	22ADT61 Data Modeling and Business intelligence (3-0-0-3)	Professional Elective – 2 (3-0-0-3)	Open Elective – 2 (3-1/0-0/2-4)	22ALL61 Transfer Learning Laboratory (0-0-2-1)	22ALP61 Project Work 1 (0-0-10-5)	22GET31 Universal Human Values (2-0-0-2)	22GEP61 Comprehensive Test and Viva(0-0-0-2)			**23**

VII	22GCT71 Engineering Economics and Management (3-0-0-3)	22ADT71 Agile Methodologies (3-0-0-3)	Professional Elective – 3 (3-0-0-3)	Professional Elective – 4 (3-0-0-3)	Open Elective – 3 (3-0-0-3)	22ALP71 Project Work II Phase I (0-0-12-6)					**21**
VIII	Professional Elective -5 (3-0-0-3)	Open Elective – 4 (3-0-0-3)	22ALP81 Project work II Phase II (0-0-8-4)								**10**

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	22EGT11	Communication Skills I						✓			✓	✓	✓	✓		
1	22MAC11	Matrices and Ordinary Differential	✓	✓	✓		✓									
1	22ADT11	Foundations of Information Technology	✓	✓	✓	✓	✓								✓	✓
1/2	22CYT12	Chemistry for Computer Systems	✓	✓	✓	✓			✓							
1	22ADC11	C Programming	✓	✓	✓	✓	✓							✓	✓	✓
1	22EEC11	Basics of Electrical and Electronics Engineering	✓	✓	✓	✓									✓	✓
1/2	22CYL12	Chemistry Laboratory for Computer Systems	✓	✓	✓	✓			✓							
1	22ADL11	Open Source and Web Designing Laboratory	✓	✓	✓	✓	✓							✓	✓	✓
1	22ADC12	Essentials of Information technology	✓	✓	✓		✓								✓	✓
1	22GCL11	Foundation Laboratory-Manufactoring, Design and Robotics	✓	✓	✓		✓				✓	✓		✓		
2	22EGT21	Communication Skills II						✓			✓	✓	✓	✓		
2	22MAC24	Probability Theory And Inferential Statistics	✓	✓	✓	✓	✓								✓	
1/2	22PHT22	Physics for Computer Systems	✓	✓	✓						✓	✓		✓	✓	✓
2	22ECC21	Digital Principles and Design	✓	✓	✓	✓					✓	✓		✓	✓	✓
2	22ADC21	Data Structures	✓	✓	✓	✓	✓							✓	✓	✓
2	22ADC22	Python Programming	✓	✓	✓	✓	✓							✓	✓	✓
1/2	22PHL22	Physics Laboratory for Computer Systems	✓	✓	✓	✓					✓	✓		✓	✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
2	22MEL11	Engineering Practices Laboratory	✓		✓	✓	✓	✓			✓	✓		✓	✓	✓
1/2	22VEC11	Yoga Values for Holistic Development						✓		✓	✓					
1/2	22TAM01	Heritage of Tamils						✓		✓	✓	✓		✓		
2	22GCL12	Foundation Laboratory-Electrical ,IoT and Web	✓	✓	✓	✓					✓					
3	22MAT33	Discrete Mathematics and Linear Algebra	✓	✓	✓	✓									✓	
3	22ADC31	Data Processing and Visualization	✓	✓	✓	✓	✓							✓	✓	✓
3	22ALT31	Machine Learning	✓	✓	✓	✓	✓	✓						✓	✓	✓
3	22ALT32	Java Programming	✓	✓	✓	✓	✓								✓	✓
3	22ALT33	Design and Analysis of Algorithms	✓	✓	✓										✓	✓
3	22ALL31	Machine Learning Laboratory	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
3	22ALL32	Java Programming Laboratory	✓	✓	✓	✓	✓				✓				✓	✓
3	22EGL31	Communication Skills Development Laboratory									✓	✓		✓		
3	22MNT31	Environmental Science	✓	✓	✓				✓							
2/3	22TAM02	Tamils and Technology						✓		✓	✓	✓		✓		
4	22ALT41	Database Management Systems	✓	✓	✓	✓	✓							✓	✓	✓
4	22ALT42	Computer Organization	✓	✓	✓										✓	✓
4	22ALT43	Operating Systems	✓	✓	✓	✓									✓	✓
4	22ALC41	Deep Learning	✓	✓	✓	✓	✓							✓	✓	✓
4	22ADC41	Web Technology	✓	✓	✓	✓	✓								✓	✓
4	22ALL41	Database Management Systems Laboratory	✓	✓	✓	✓	✓							✓	✓	✓
4	22GCL41/ 22GCI41	Professional Skills Training I / Industrial Training I						✓	✓		✓	✓	✓	✓		
5	22ADT51	Big Data Analytics	✓	✓	✓	✓	✓								✓	✓
5	22ALC51	Natural Language Processing	✓	✓	✓	✓	✓								✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
5	22ALC52	Computer Vision	✓	✓	✓		✓								✓	✓
5	22ADT52	Computer Networks	✓	✓	✓	✓									✓	✓
5	22ADL51	Big Data Analytics Laboratory	✓	✓	✓	✓	✓								✓	✓
5	22GCL51/ 22GCI51	Professional Skills Training II / Industrial Training II						✓	✓		✓	✓	✓	✓		
6	22ALT61	Transfer Learning	✓	✓	✓	✓	✓								✓	✓
6	22ADT61	Data Modeling and Business Intelligence	✓	✓	✓									✓	✓	✓
6	22ALL61	Transfer Learning Laboratory	✓	✓	✓	✓	✓								✓	✓
6	22ADL61	Data Modeling and Business Intelligence Laboratory	✓	✓	✓	✓	✓				✓	✓		✓	✓	✓
6	22ALP61	Project Work I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	22GET31	Universal Human Values	✓	✓	✓	✓										
6	22GEP61	Comprehensive Test and Viva	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
7	22GCT71	Engineering Economics and Management	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓
7	22ADT71	Agile Methodologies	✓	✓	✓	✓					✓	✓	✓		✓	✓
7	22ALP71	Project Work II Phase I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	22ALP81	Project Work II Phase II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PROFESSIONAL ELECTIVES																
5	22ALE01	Theory of Computation	✓	✓	✓	✓	✓								✓	✓
5	22ADE01	Design Thinking	✓	✓	✓	✓					✓	✓	✓		✓	✓
5	22ALE02	Multicore Architecture	✓	✓	✓	✓									✓	✓
5	22ADE02	Soft Computing Techniques	✓	✓	✓	✓									✓	✓
5	22ADF01	Data Analysis	✓	✓	✓										✓	✓
6	22ADE05	Communication Networks	✓	✓	✓	✓									✓	✓
6	22ADF02	R Programming for Machine Learning	✓	✓	✓	✓	✓							✓	✓	✓
6	22ADE06	Modeling and Simulation	✓	✓	✓	✓									✓	✓

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
6	22ALE03	Nature Inspired Optimization Techniques	✓	✓	✓	✓									✓	✓
6	22ALF01	Design Patterns and Principles	✓	✓	✓	✓	✓							✓	✓	✓
7	22ADE09	Reinforcement Learning	✓	✓	✓	✓									✓	✓
7	22ADE10	Agile Methodologies for Software Development	✓	✓	✓	✓					✓	✓	✓		✓	✓
7	22ADE11	Information Retrieval Techniques	✓	✓	✓										✓	✓
7	22ADE12	Search Methods in Artificial Intelligence	✓	✓	✓										✓	✓
7	22ALE04	Graph Theory and its Applications	✓	✓	✓	✓									✓	✓
7	22GEE01	Fundamentals of Research	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	22ALE05	Numerical Methods	✓	✓	✓											
7	22ALF02	Mobile Application Development	✓	✓	✓	✓	✓								✓	✓
7	22ALE06	Cyber Security	✓	✓	✓										✓	✓
7	22ADE15	Ethics of Artificial Intelligence	✓	✓	✓			✓		✓					✓	✓
7	22ADE18	Quantum Computing	✓	✓	✓	✓									✓	✓
7	22ADF05	Robotic Process Automation	✓	✓	✓	✓	✓								✓	✓
7	22ADE16	Cloud Computing	✓	✓	✓	✓	✓									
7	22ALE07	Neural Machine Translation	✓	✓	✓										✓	✓
7	22ALF03	Game Development	✓	✓	✓	✓	✓								✓	✓
7	22ADE20	Software Quality Assurance	✓	✓	✓								✓		✓	✓
8	22ALE08	Software Defined Networks	✓	✓	✓										✓	✓
8	22ADE21	Software Testing	✓	✓	✓						✓	✓	✓		✓	✓
8	22ADE22	Software Project Management	✓	✓	✓										✓	✓

OPEN ELECTIVE

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
5	22CEX01	Remote Sensing and its Applications	✓	✓	✓	✓		✓			✓			✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
5	22MEX01	Renewable Energy Sources	✓		✓	✓	✓	✓	✓	✓	✓					
5	22MTO01	Design of Mechatronics Systems	✓	✓	✓	✓	✓							✓		
5	22MTX01	Data Acquisition and Virtual Instrumentation	✓	✓	✓	✓	✓							✓		
5	22MTX02	Factory Automation	✓	✓	✓	✓	✓				✓	✓		✓		
5	22AUX01	Automotive Engineering	✓	✓	✓			✓	✓		✓	✓		✓		
5	22ECX01	Basics of Electronics in Automation Appliances	✓	✓	✓	✓		✓	✓	✓			✓	✓		
5	22ECX02	Image Processing	✓	✓	✓	✓	✓				✓	✓		✓		
5	22EEO01	Solar and Wind Energy Systems	✓	✓	✓			✓	✓					✓		
5	22EEO02	Electrical Wiring and Lighting	✓	✓	✓	✓	✓							✓		
5	22EEO03	Programmable Logic Controller and SCADA	✓	✓	✓	✓		✓			✓			✓		
5	22EEO04	Analog and Digital Electronics	✓	✓	✓	✓	✓							✓		
5	22EEO05	Power Electronics and Drives	✓	✓	✓	✓	✓	✓			✓					
5	22EEO06	Sensors and Actuators	✓	✓	✓			✓						✓		
5	22EIO01	Measurements and Instrumentation	✓	✓	✓	✓	✓									
5	22EIO02	Biomedical Instrumentation and Applications	✓	✓	✓	✓	✓	✓		✓						
5	22EIO03	Industrial Automation	✓	✓	✓	✓	✓									
5	22CSX01	Fundamentals of Databases	✓	✓	✓											
5	22CSX02	Data science for Engineers	✓	✓	✓	✓	✓									
5	22CSX03	Enterprise Application Development Using Java	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
5	22CSO01	Computational science for Engineers	✓	✓	✓											
5	22CSO02	Formal Languages and Automata Theory	✓	✓	✓											
5	22ITO01	Artificial Intelligence	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓			
5	22ITX01	Next Generation Databases	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
5	22CDO01	Fundamentals of User Experience Design	✓	✓	✓	✓	✓				✓	✓	✓			
5	22ADO01	Data Warehousing and Data Mining	✓	✓	✓											

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
5	22ALO01	Business Intelligence	✓	✓	✓											
5	22CHO01	Industrial Enzymology	✓	✓	✓							✓	✓	✓		
5	22CHO02	Waste to Energy Conversion	✓	✓												
5	22CHO03	Applied Nanotechnology	✓	✓	✓	✓	✓	✓	✓	✓				✓		
5	22FTX01	Baking Technology	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓		
5	22FTO01	Food Processing Technology	✓	✓	✓	✓		✓				✓		✓		
5	22MAO01	Mathematical Foundations for Machine Learning	✓	✓	✓	✓	✓									
5	22MAO02	Numerical Computing	✓	✓	✓											
5	22MAO03	Stochastic Processes and Queuing Theory	✓	✓	✓											
5	22MAO04	Statistics for Engineers	✓	✓	✓											
5	22PHO01	Thin Film Technology	✓	✓	✓						✓	✓		✓		
5	22PHO02	High Energy Storage Devices	✓	✓	✓						✓	✓		✓		
5	22PHO03	Structural and Optical Characterization of Materials	✓	✓	✓						✓	✓		✓		
5	22CYO01	Instrumental Methods of Analysis	✓	✓	✓	✓										
5	22CYO02	Chemistry Concepts for Competitive Examinations	✓	✓	✓											
5	22CYO03	Organic Chemistry for Industry	✓	✓	✓	✓										
5	22MBO01	Cost Accounting for Engineers										✓	✓	✓		
6	22CEO01	Disaster Management	✓	✓	✓			✓	✓					✓		
6	22MEX02	Design of Experiments	✓	✓	✓	✓	✓				✓					
6	22GEO04	Innovation and Business Model Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
6	22MTO02	Robotics	✓	✓	✓	✓	✓							✓		
6	22MTO03	3D Printing and Design	✓	✓			✓							✓		
6	22AUO01	Automotive Electronics	✓	✓	✓	✓								✓		
6	22ECX03	PCB Design and Fabrication	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		
6	22EEO07	Energy Conservation and Management	✓	✓	✓		✓		✓	✓	✓			✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
6	22EEO08	Microprocessors and Microcontrollers Interfacing	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		
6	22EEO09	Electrical Safety	✓	✓	✓				✓	✓			✓	✓		
6	22EEO10	VLSI System Design	✓	✓	✓	✓	✓				✓		✓	✓		
6	22EEO11	Automation for Industrial Applications	✓	✓	✓	✓			✓		✓			✓		
6	22EIO04	PLC Programming with High Level Languages	✓	✓	✓	✓	✓									
6	22EIO05	Virtual Instrumentation	✓	✓	✓	✓	✓									
6	22CSX04	Foundations of Machine Learning	✓	✓	✓											
6	22CSX05	Web Engineering	✓	✓	✓											
6	22ITX02	Advanced Java Programming	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
6	22ITO02	Internet of Things	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓			
6	22ITO03	Fundamentals of Software Development	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓			
6	22ITO04	Mobile Application Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
6	22CDX01	Fundamentals of User Interactive Design	✓	✓	✓	✓										
6	22ADX01	Data Visualization	✓	✓	✓											
6	22ALX01	Data Exploration and Visualization Techniques	✓	✓	✓											
6	22CHO04	Air Pollution Monitoring and Control	✓	✓	✓			✓	✓							
6	22CHO05	Paints and Coatings	✓	✓	✓				✓							
6	22CHO06	Powder Technology	✓	✓	✓			✓	✓					✓		
6	22FTX02	Processing of milk and milk products	✓	✓	✓		✓	✓		✓	✓	✓		✓		
6	22FTX03	Processing of Fruits and Vegetables	✓	✓	✓		✓	✓		✓	✓	✓		✓		
6	22MAO05	Graph Theory and its Applications	✓	✓	✓											
6	22MAX01	Data Analytics using R Programming	✓	✓	✓	✓	✓									
6	22MAO06	Operations Research	✓	✓	✓											
6	22MAO07	Number Theory and Cryptography	✓	✓	✓		✓									
6	22PHO04	Synthesis, Characterization and Biological Applications of Nanomaterials	✓	✓	✓						✓	✓		✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
6	22PHO05	Techniques of Crystal Growth	✓	✓	✓						✓	✓		✓		
6	22CYO04	Corrosion Science and Engineering	✓	✓	✓	✓										
6	22CYO05	Chemistry of Cosmetics in Daily Life	✓	✓	✓											
6	22CYO06	Nanocomposite Materials	✓	✓	✓	✓										
6	22MBO02	Economic Analysis for Decision Making					✓					✓	✓			
7	22CEO02	Introduction to Smart Cities	✓	✓	✓	✓	✓									
7	22CEO03	Environmental Health and Safety	✓	✓	✓			✓	✓							
7	22MEO01	Fundamentals of Ergonomics	✓	✓	✓	✓	✓	✓	✓					✓		
7	22MEO02	Principles of Management and Industrial Psychology	✓					✓				✓	✓			
7	22MEO03	Waste Heat Recovery System and Storage	✓	✓	✓	✓			✓							
7	22GEO05	Entrepreneurship Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
7	22MTO04	Drone System Technology	✓	✓	✓	✓	✓							✓		
7	22AUO02	Vehicle Maintenance	✓	✓			✓		✓					✓		
7	22ECO01	Wearable Devices	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		
7	22ECX04	Electronic Hardware and Troubleshooting	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		
7	22EEO12	Electric Vehicle	✓	✓	✓	✓		✓	✓		✓			✓		
7	22EEO13	E-Waste Management	✓	✓	✓	✓		✓	✓					✓		
7	22EEO14	Embedded System Design	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		
7	22EEO15	Energy Storage Systems and Controllers	✓	✓	✓			✓			✓		✓	✓		
7	22EEO16	AI Techniques for Engineering Applications	✓	✓	✓	✓										
7	22EIO06	Introduction to Distributed Control Systems	✓	✓	✓	✓	✓			✓		✓				
7	22EIO07	Instrumentation in Aircraft Navigation and Control	✓	✓	✓	✓	✓									
7	22EIO08	Industry 4.0 with Industrial IoT	✓	✓	✓	✓	✓			✓						
7	22EIO09	Industrial Data Communication	✓	✓	✓	✓	✓	✓								
7	22EIO10	Wireless Instrumentation	✓	✓	✓	✓	✓		✓							

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
7	22EIO11	Instrumentation Techniques in Agriculture	✓	✓	✓	✓	✓									
7	22CSO03	Nature Inspired optimization techniques	✓	✓	✓											
7	22ITO05	Fundamentals of Cloud Computing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
7	22ITO06	Introduction to Ethical Hacking	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
7	22CDO02	Introduction to Mobile Game Design	✓	✓	✓	✓										
7	22CDO03	Introduction to Graphics Design	✓	✓	✓	✓										
7	22ADO02	Neural Networks and Deep Learning	✓	✓	✓	✓										
7	22ALO02	Industrial Machine Learning	✓	✓	✓											
7	22CHO07	Hydrogen Energy	✓	✓										✓		
7	22CHO08	Rubber Technology	✓	✓				✓	✓					✓		
7	22FTO02	Principles of Food safety	✓	✓	✓			✓	✓	✓		✓		✓		
7	22FTO03	Fundamentals of Food Packaging and Storage	✓	✓	✓	✓	✓	✓		✓		✓		✓		
7	22MAO08	Non-Linear Optimization	✓	✓	✓											
7	22MAO09	Optimization for Engineers	✓	✓	✓											
7	22CYO07	Waste and Hazardous Waste Management	✓	✓	✓	✓			✓							
7	22CYO08	Chemistry in Every day Life	✓	✓	✓	✓										
7	22MBO03	Marketing Analytics										✓	✓	✓		
8	22CEO04	Infrastructure Planning and Management	✓	✓	✓		✓									
8	22CEO05	Environmental Laws and Policy	✓	✓			✓									
8	22MEO04	Safety Measures for Engineers	✓					✓	✓	✓						
8	22MEO05	Energy Conservation in Thermal Equipments	✓		✓		✓	✓	✓					✓		
8	22MEO06	Climate Change and New Energy Technology	✓		✓			✓	✓	✓						
8	22MTO05	Micro and Nano Electromechanical Systems	✓	✓	✓	✓								✓		
8	22AUO03	Public Transport Management	✓	✓				✓	✓	✓				✓		
8	22AUO04	Autonomous Vehicles	✓	✓	✓	✓	✓	✓	✓					✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
8	22ECO02	Optical Engineering	✓	✓	✓	✓		✓	✓	✓	✓			✓		
8	22EEO17	Smart Grid Technologies	✓	✓	✓	✓	✓			✓				✓		
8	22EEO18	Biomass Energy Systems	✓	✓	✓			✓	✓				✓	✓		
8	22EIO12	Environmental Sensors	✓	✓	✓	✓	✓		✓							
8	22EIO13	Pollution Control and Management	✓	✓	✓	✓	✓	✓		✓						
8	22CSO04	Machine Translation	✓	✓	✓											
8	22CSO05	Fundamentals of Blockchain	✓	✓	✓											
8	22ITO07	Business Continuity Planning	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓			
8	22CDX02	Virtual Reality and Augmented Reality	✓	✓	✓	✓										
8	22ADO03	Business Analytics	✓	✓	✓	✓										
8	22ALO03	Machine Learning for Smart Cities	✓	✓	✓	✓										
8	22CHO09	Industrial Accident Prevention and Management	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓		
8	22CHO10	Electrochemical Engineering	✓	✓	✓											
8	22CHO11	Smart and Functional Materials	✓	✓					✓	✓	✓			✓		
8	22FTO04	Food Ingredients	✓	✓	✓			✓		✓		✓		✓		
8	22FTO05	Food and Nutrition	✓	✓	✓			✓				✓		✓		
8	22CYO09	Chemistry of Nutrition for Women Health	✓	✓	✓											
		General Open Elective Courses														
ALL	22GEO01	German Language Level 1								✓	✓	✓		✓		
ALL	22GEO02	Japanese Language Level 1								✓	✓	✓		✓		
5	22GEO03	Design Thinking for Engineers	✓	✓	✓	✓										
6	22GEO04	Innovation and Business Model Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
ALL	22GEO05	German Language Level 2								✓	✓	✓		✓		
ALL	22GEO06	German Language Level 3								✓	✓	✓		✓		
ALL	22GEO07	German Language Level 4								✓	✓	✓		✓		

Sem.	Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ALL	22GEO08	Japanese Language Level 2								✓	✓	✓		✓		
ALL	22GEO09	Japanese Language Level 3								✓	✓	✓		✓		
ALL	22GEO10	Japanese Language Level 4								✓	✓	✓		✓		
ALL	22GEO11	French Language Level 1								✓	✓	✓		✓		
ALL	22GEO12	French Language Level 2								✓	✓	✓		✓		
ALL	22GEO13	French Language Level 3								✓	✓	✓		✓		
ALL	22GEO14	Spanish Language Level 1								✓	✓	✓		✓		
ALL	22GEO15	Spanish Language Level 2								✓	✓	✓		✓		
ALL	22GEO16	Spanish Language Level 3								✓	✓	✓		✓		
7	22GEO17	Entrepreneurship Development	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
5 / 6	22GEX01	NCC Studies (Army Wing) - I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
5 / 6	22GEX02	NCC Studies (Air Wing) - 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
5	22MBO01	Cost Accounting for Engineers										✓	✓	✓		
6	22MBO02	Economic Analysis for Decision Making					✓					✓	✓			
7	22MBO03	Marketing Analytics										✓	✓	✓		

B.TECH. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING CURRICULUM – R2022
(For the students admitted in the academic year 2022-23 onwards)

SEMESTER – I

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22EGT11	Communication Skills I	3	0	0	3	40	60	100	HS
22MAC11	Matrices and Ordinary Differential Equations	3	1*	2*	4	50	50	100	BS
22ADT11	Foundations of Information Technology	3	0	0	3	40	60	100	PC
22CYT12	Chemistry for Computer Systems	3	0	0	3	40	60	100	BS
22ADC11	C Programming	3	0	2	4	100	0	100	ES
22EEC11	Basics of Electrical and Electronics Engineering	3	0	2	4	50	50	100	ES
Practical / Employability Enhancement									
22CYL12	Chemistry Laboratory for Computer Systems	0	0	2	1	60	40	100	BS
22ADL11	Open Source and Web Designing Laboratory	0	0	2	1	60	40	100	ES
22MNT11	Student Induction Program	---	---	---	0	100	0	100	MC
Total Credits to be earned					23				

*Alternate weeks

SEMESTER – II

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22EGT21	Communication Skills II	3	0	0	3	40	60	100	HS
22MAC24	Probability Theory and Inferential Statistics	3	1*	2*	4	50	50	100	BS
22PHT22	Physics for Computer Systems	3	0	0	3	40	60	100	BS
22ECC21	Digital Principles and Design	3	0	2	4	50	50	100	ES
22ADC21	Data Structures	3	0	2	4	50	50	100	PC
22ADC22	Python Programming	3	0	2	4	100	0	100	ES
22TAM01	Heritage of Tamils	1	0	0	1	100	0	100	HS
Practical / Employability Enhancement									
22PHL22	Physics Laboratory for Computer Systems	0	0	2	1	60	40	100	BS
22MEL11	Engineering Practices Laboratory	0	0	2	1	60	40	100	ES
22VEC11	Yoga and Values for Holistic Development	1	0	1	1	100	0	100	HS
Total Credits to be earned					26				

*Alternate weeks

B.TECH. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING CURRICULUM – R2022
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SEMESTER – III									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22MAT33	Discrete Mathematics and Linear Algebra	3	1	0	4	40	60	100	BS
22ADC31	Data Processing and Visualization	3	0	2	4	50	50	100	PC
22ALT31	Machine Learning	3	1	0	4	40	60	100	PC
22ALT32	Java Programming	3	0	0	3	40	60	100	ES
22ALT33	Design and Analysis of Algorithms	3	1	0	4	40	60	100	PC
22MNT31	Environmental Science	2	0	0	0	100	0	100	MC
22TAM02	Tamils and Technology	1	0	0	1	100	0	100	HS
Practical / Employability Enhancement									
22ALL31	Machine Learning Laboratory	0	0	2	1	60	40	100	PC
22ALL32	Java Programming Laboratory	0	0	2	1	100	0	100	ES
22EGL31	Communication Skills Development Laboratory	0	0	2	1	60	40	100	HS
Total Credits to be earned					23				

SEMESTER – IV									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22ALT41	Database Management Systems	3	1	0	4	40	60	100	PC
22ALT42	Computer Organization	3	0	0	3	40	60	100	ES
22ALT43	Operating Systems	3	1	0	4	40	60	100	PC
22ALC41	Deep Learning	3	0	2	4	50	50	100	PC
22ADC41	Web Technology	3	0	2	4	50	50	100	PC
Practical / Employability Enhancement									
22ALL41	Database Management Systems Laboratory	0	0	2	1	60	40	100	PC
22GCL41/ 22GCI41	Professional Skills Training I / Industrial Training I*	--	--	--	2	100	0	100	EC
Total Credits to be earned					22				

*80 hours of training

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SEMESTER – V									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22ADT51	Big Data Analytics	3	0	0	3	40	60	100	PC
22ALC51	Natural language Processing	3	0	2	4	50	50	100	PC
22ALC52	Computer Vision	3	0	2	4	50	50	100	PC
	Professional Elective – I	3	0	0	3	40	60	100	PE
	Open Elective – I	3	0/1	2/0	4	50	50	100	OE
Practical / Employability Enhancement									
22ADL51	Big Data Analytics Laboratory	0	0	2	1	60	40	100	PC
22GCL51/ 22GCI51	Professional Skills Training II/Industrial Training II*	--	--	--	2	100	0	100	EC
Total Credits to be earned					21				

*80 hours of training

SEMESTER – VI									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22ALT61	Transfer Learning	3	0	0	3	40	60	100	PC
22ADT61	Data Modeling and Business Intelligence	3	0	0	3	40	60	100	PC
	Professional Elective – II	3	0	0	3	40	60	100	PE
	Open Elective - II	3	1/0	0/2	4	50	50	100	OE
Practical / Employability Enhancement									
22ALL61	Transfer Learning Laboratory	0	0	2	1	60	40	100	PC
22ADL61	Data Modeling and Business Intelligence Laboratory	0	0	2	1	60	40	100	PC
22ALP61	Project Work I	0	0	8	4	50	50	100	EC
22GET31	Universal Human Values	2	0	0	2	100	0	100	HS
22GEP61	Comprehensive Test and Viva	--	--	--	2	100	0	100	EC
Total Credits to be earned					23				

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SEMESTER – VII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22GCT71	Engineering Economics and Management	3	0	0	3	40	60	100	HS
	Professional Elective – III	3	0	0	3	40	60	100	PE
	Professional Elective – IV	3	0	0	3	40	60	100	PE
	Professional Elective – V	3	0	0	3	40	60	100	PE
	Open Elective - III	3	0	0	3	40	60	100	OE
Practical / Employability Enhancement									
22ALP71	Project Work II Phase I	0	0	10	5	50	50	100	EC
Total Credits to be earned					20				

SEMESTER – VIII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
	Professional Elective - VI	3	0	0	3	40	60	100	PE
	Open Elective - IV	3	0	0	3	40	60	100	OE
Practical / Employability Enhancement									
22ALP81	Project Work II Phase II	0	0	8	4	50	50	100	EC
Total Credits to be earned					10				

Total Credits: 168

B.TECH. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING CURRICULUM – R2022
(For the students admitted in the academic year 2022-23)

LIST OF PROFESSIONAL ELECTIVES (PEs)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Domain/ Stream**
Semester – V							
Elective – I							
1.	22ALE01	Theory of Computation	3	0	0	3	SD
2.	22ADE01	Design Thinking	3	0	0	3	SD
3.	22ALE02	Multicore Architecture	3	0	0	3	SD
4.	22ADE02	Soft Computing Techniques	3	0	0	3	SD
5.	22ADF01	Data Analysis	2	0	2	3	AI
Semester – VI							
Elective – II							
6.	22ADE05	Communication Networks	3	0	0	3	NS
7.	22ADF02	R Programming for Machine Learning	2	0	2	3	AI
8.	22ADE06	Modeling and Simulation	3	0	0	3	AI
9.	22ALE03	Nature Inspired Optimization Techniques	3	0	0	3	AI
10.	22ALF01	Design Patterns and Principles	2	0	2	3	SD
Semester – VII							
Elective – III							
11.	22ADE09	Reinforcement Learning	3	0	0	3	AI
12.	22ADE10	Agile Methodologies for Software Development	3	0	0	3	SDE
13.	22ADE11	Information Retrieval Techniques	3	0	0	3	AI
14.	22ADE12	Search Methods in Artificial Intelligence	3	0	0	3	AI
15.	22ALE04	Graph Theory and its Applications	3	0	0	3	AI
Elective – IV							
16.	22GEE01	Fundamentals of Research	3	0	0	3	GE
17.	22ALE05	Numerical Methods	3	0	0	3	AI
18.	22ALF02	Mobile Application Development	2	0	2	3	SD
19.	22ALE06	Cyber Security	3	0	0	3	NS
20.	22ADE15	Ethics of Artificial Intelligence	3	0	0	3	AI

Elective – V							
21.	22ADE18	Quantum Computing	3	0	0	3	AI
22.	22ADF05	Robotic Process Automation	2	0	2	3	AI
23.	22ADE16	Cloud Computing	3	0	0	3	SD
24.	22ALE07	Neural Machine Translation	3	0	0	3	AI
25.	22ALF03	Game Development	2	0	2	3	AI
Semester – VIII							
Elective – VI							
26.	22ADE20	Software Quality Assurance	3	0	0	3	SDE
27.	22ALE08	Software Defined Networks	3	0	0	3	NS
28.	22ADE21	Software Testing	3	0	0	3	SDE
29.	22ADE22	Software Project Management	3	0	0	3	SDE
Total Credits to be earned						**18**	

Domain:AI – Artificial Intelligence, SD-Systems Development, SDE – Software Development and Engineering, NS- Networks and Security, GE – General Engineering

B.TECH. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING CURRICULUM – R2022
(For the students admitted from the academic year 2023-24 onwards)

SEMESTER – I

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22EGT11	Communication Skills – I	3	0	0	3	40	60	100	HS
22MAC11	Matrices and Ordinary Differential Equations	3	1*	2*	4	50	50	100	BS
22PHT22	Physics for Computer Systems	3	0	0	3	40	60	100	BS
22ADC11	C Programming	3	0	2	4	100	0	100	ES
22ADC12	Essentials of Information Technology	2	0	2	3	50	50	100	ES
22TAM01	Heritage of Tamils	1	0	0	1	100	0	100	HS
Practical / Employability Enhancement									
22PHL22	Physics Laboratory for Computer Systems	0	0	2	1	60	40	100	BS
22GCL11	Foundation Laboratory- Manufactoring, Design and Robotics	0	0	6	3	100	0	100	ES
22VEC11	Yoga and Values for Holistic Development	--	--	--	1	100	0	100	HS
22MNT11	Student Induction Program #	--	--	--	0	100	0	100	MC
Total Credits to be earned					23				

Student Induction Program will be conducted at the beginning of the semester for 3 weeks

SEMESTER – II

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22EGT21	Communication Skills – II	3	0	0	3	40	60	100	HS
22MAC24	Probability Theory and Inferential Statistics	3	1*	2*	4	50	50	100	BS
22CYT12	Chemistry for Computer Systems	3	0	0	3	40	60	100	BS
22ADC21	Data Structures	3	0	2	4	50	50	100	PC
22ADC22	Python Programming	3	0	2	4	100	0	100	ES
22TAM02	Tamils and Technology	1	0	0	1	100	0	100	HS
Practical / Employability Enhancement									
22CYL12	Chemistry Laboratory for Computer Systems	0	0	2	1	60	40	100	BS
22GCL12	Foundation Laboratory- Electrical ,IoT and Web	0	0	6	3	100	0	100	ES
Total Credits to be earned					23				

*Alternate weeks

B.TECH. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING CURRICULUM – R2022
(For the students admitted from the academic year 2023-24 onwards)

SEMESTER – III									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22MAT33	Discrete Mathematics and Linear Algebra	3	1	0	4	40	60	100	BS
22ADC31	Data Processing and Visualization	3	0	2	4	50	50	100	PC
22ALT31	Machine Learning	3	1	0	4	40	60	100	PC
22ALT32	Java Programming	3	0	0	3	40	60	100	ES
22ALT33	Design and Analysis of Algorithms	3	1	0	4	40	60	100	PC
22MNT31	Environmental Science	2	0	0	0	100	0	100	MC
Practical / Employability Enhancement									
22ALL31	Machine Learning Laboratory	0	0	2	1	60	40	100	PC
22ALL32	Java Programming Laboratory	0	0	2	1	100	0	100	ES
22EGL31	Communication Skills Development Laboratory	0	0	2	1	60	40	100	HS
Total Credits to be earned					22				

SEMESTER – IV									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22ALT41	Database Management Systems	3	1	0	4	40	60	100	PC
22ALT42	Computer Organization	3	0	0	3	40	60	100	ES
22ALT43	Operating Systems	3	1	0	4	40	60	100	PC
22ALC41	Deep Learning	3	0	2	4	50	50	100	PC
22ADC41	Web Technology	3	0	2	4	50	50	100	PC
Practical / Employability Enhancement									
22ALL41	Database Management Systems Laboratory	0	0	2	1	60	40	100	PC
22GCL41 / 22GCI41	Professional Skills Training I / Industrial Training I*	--	--	--	2	100	0	100	EC
Total Credits to be earned					22				

*80 hours of training

B.TECH. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING CURRICULUM – R2022
(For the students admitted from the academic year 2023-24 onwards)

SEMESTER – V

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22ADT51	Big Data Analytics	3	0	0	3	40	60	100	PC
22ALC51	Natural Language Processing	3	0	2	4	50	50	100	PC
22ALC52	Computer Vision	3	0	2	4	50	50	100	PC
22ADT52	Computer Networks	3	0	0	3	40	60	100	PC
	Professional Elective – I	3	0	0	3	40	60	100	PE
	Open Elective – I	3	0/1	2/0	4	50/ 40	50/ 60	100	OE
Practical / Employability Enhancement									
22ADL51	Big Data Analytics Laboratory	0	0	2	1	60	40	100	PC
22GCL51/ 22GCI51	Professional Skills Training II/Industrial Training II*	--	--	--	2	100	0	100	EC
Total Credits to be earned					24				

*80 hours of training

SEMESTER – VI

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22ALT61	Transfer Learning	3	0	0	3	40	60	100	PC
22ADT61	Data Modeling and Business Intelligence	3	0	0	3	40	60	100	PC
	Professional Elective – II	3	0	0	3	40	60	100	PE
	Open Elective - II	3	1/0	0/2	4	50/ 40	50/ 60	100	OE
Practical / Employability Enhancement									
22ALL61	Transfer Learning Laboratory	0	0	2	1	60	40	100	PC
22ALP62	Project Work I	0	0	10	5	50	50	100	EC
22GET31	Universal Human Values	2	0	0	2	100	0	100	HS
22GEP61	Comprehensive Test and Viva	--	--	--	2	100	0	100	EC
Total Credits to be earned					23				

B.TECH. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING CURRICULUM – R2022
(For the students admitted from the academic year 2023-24 onwards)

SEMESTER – VII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22GCT71	Engineering Economics and Management	3	0	0	3	40	60	100	HS
22ADT71	Agile Methodologies	3	0	0	3	40	60	100	PC
	Professional Elective – III	3	0	0	3	40	60	100	PE
	Professional Elective – IV	3	0	0	3	40	60	100	PE
	Open Elective - III	3	0	0	3	40	60	100	OE
Practical / Employability Enhancement									
22ALP72	Project Work II Phase I	0	0	12	6	50	50	100	EC
Total Credits to be earned					21				

SEMESTER – VIII									
Course Code	**Course Title**	**Hours / Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
	Professional Elective - V	3	0	0	3	40	60	100	PE
	Open Elective - IV	3	0	0	3	40	60	100	OE
Practical / Employability Enhancement									
22ALP82	Project Work II Phase II	-	-	8	4	50	50	100	EC
Total Credits to be earned					10				

Total Credits: 168

B.TECH. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING CURRICULUM – R2022
(For the students admitted from the academic year 2023-24 onwards)

LIST OF PROFESSIONAL ELECTIVES (PEs)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Domain/ Stream**
Semester – V							
Elective – I							
1.	22ALE01	Theory of Computation	3	0	0	3	SD
2.	22ADE01	Design Thinking	3	0	0	3	SD
3.	22ALE02	Multicore Architecture	3	0	0	3	SD
4.	22ADE02	Soft Computing Techniques	3	0	0	3	SD
5.	22ADF01	Data Analysis	2	0	2	3	AI
Semester – VI							
Elective – II							
6.	22ADE05	Communication Networks	3	0	0	3	NS
7.	22ADF02	R Programming for Machine Learning	2	0	2	3	AI
8.	22ADE06	Modeling and Simulation	3	0	0	3	AI
9.	22ALE03	Nature Inspired Optimization Techniques	3	0	0	3	AI
10.	22ALF01	Design Patterns and Principles	2	0	2	3	SD
Semester – VII							
Elective – III							
11.	22ADE09	Reinforcement Learning	3	0	0	3	AI
12.	22ADE10	Agile Methodologies for Software Development	3	0	0	3	SDE
13.	22ADE11	Information Retrieval Techniques	3	0	0	3	AI
14.	22ADE12	Search Methods in Artificial Intelligence	3	0	0	3	AI
15.	22ALE04	Graph Theory and its Applications	3	0	0	3	AI
Elective – IV							
16.	22GEE01	Fundamentals of Research	3	0	0	3	GE
17.	22ALE05	Numerical Methods	3	0	0	3	AI
18.	22ALF02	Mobile Application Development	2	0	2	3	SD
19.	22ALE06	Cyber Security	3	0	0	3	NS
20.	22ADE15	Ethics of Artificial Intelligence	3	0	0	3	AI

21.	22ADE18	Quantum Computing	3	0	0	3	AI
22.	22ADF05	Robotic Process Automation	2	0	2	3	AI
23.	22ADE16	Cloud Computing	3	0	0	3	SD
24.	22ALE07	Neural Machine Translation	3	0	0	3	AI
25.	22ALF03	Game Development	2	0	2	3	AI
Semester – VIII							
Elective – V							
26.	22ADE20	Software Quality Assurance	3	0	0	3	SDE
27.	22ALE08	Software Defined Networks	3	0	0	3	NS
28.	22ADE21	Software Testing	3	0	0	3	SDE
29.	22ADE22	Software Project Management	3	0	0	3	SDE
Total Credits to be earned						**15**	

OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE)
(Offered by Department of Artificial Intelligence and Machine Learning)

S. No.	Course Code	Course Name	L	T	P	C	Pre-requisites	Sem
1	22ALO01	Business Intelligence	3	1	0	4	Nil	V
2	22ALX01	Data Exploration and Visualization Techniques	3	0	2	4	Python Programming	VI
3	22ALO02	Industrial Machine Learning	3	0	0	3	Nil	VII
4	22ALO03	Machine Learning for Smart Cities	3	0	0	3	Nil	VIII

OPEN ELECTIVE COURSES OFFERED BY OTHER DEPARTMENTS (OE)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**OFFERED BY**
		SEMESTER V					
1.	22CEX01	Remote Sensing and its Applications	3	0	2	4	CIVIL
2.	22MEX01	Renewable Energy Sources	3	0	2	4	MECH
3.	22MTO01	Design of Mechatronics Systems	3	1	0	4	MTS
4.	22MTX01	Data Acquisition and Virtual Instrumentation	3	0	2	4	MTS
5.	22MTX02	Factory Automation	3	0	2	4	MTS
6.	22AUX01	Automotive Engineering	3	0	2	4	AUTO
7.	22ECX01	Basics of Electronics in Automation Appliances	3	0	2	4	ECE
8.	22ECX02	Image Processing	3	0	2	4	ECE
9.	22EEO01	Solar and Wind Energy Systems	3	1	0	4	EEE
10.	22EEO02	Electrical Wiring and Lighting	3	1	0	4	EEE
11.	22EEO03	Programmable Logic Controller and SCADA	3	1	0	4	EEE
12.	22EEO04	Analog and Digital Electronics	3	1	0	4	EEE
13.	22EEO05	Power Electronics and Drives	3	1	0	4	EEE
14.	22EEO06	Sensors and Actuators	3	1	0	4	EEE
15.	22EIO01	Measurements and Instrumentation	3	1	0	4	EIE
16.	22EIO02	Biomedical Instrumentation and Applications	3	1	0	4	EIE
17.	22EIO03	Industrial Automation	3	1	0	4	EIE
18.	22CSX01	Fundamentals of Databases	3	0	2	4	CSE
19.	22CSX02	Data science for Engineers	3	0	2	4	CSE
20.	22CSX03	Enterprise Application Development Using Java	3	0	2	4	CSE
21.	22CSO01	Computational science for Engineers	3	1	0	4	CSE
22.	22CSO02	Formal Languages and Automata Theory	3	1	0	4	CSE
23.	22ITO01	Artificial Intelligence	3	1	0	4	IT
24.	22ITX01	Next Generation Databases	3	0	2	4	IT
25.	22GEX02	NCC Studies (Air Wing) - 1	3	0	2	4	IT
26.	22CDO01	Fundamentals of User Experience Design	3	1	0	4	CSD

27.	22ADO01	Data Warehousing and Data Mining	3	1	0	4	AIDS
28.	22CHO01	Industrial Enzymology	3	1	0	4	CHEM
29.	22CHO02	Waste to Energy Conversion	3	1	0	4	CHEM
30.	22CHO03	Applied Nanotechnology	3	1	0	4	CHEM
31.	22FTX01	Baking Technology	3	0	2	4	FT
32.	22FTO01	Food Processing Technology	3	1	0	4	FT
33.	22MAO01	Mathematical Foundations for Machine Learning	3	1	0	4	MATHS
34.	22MAO02	Numerical Computing	3	1	0	4	MATHS
35.	22MAO03	Stochastic Processes and Queuing Theory	3	1	0	4	MATHS
36.	22MAO04	Statistics for Engineers	3	1	0	4	MATHS
37.	22PHO01	Thin Film Technology	3	1	0	4	PHYSICS
38.	22PHO02	High Energy Storage Devices	3	1	0	4	PHYSICS
39.	22PHO03	Structural and Optical Characterization of Materials	3	1	0	4	PHYSICS
40.	22CYO01	Instrumental Methods of Analysis	3	1	0	4	CHEMISTRY
41.	22CYO02	Chemistry Concepts for Competitive Examinations	3	1	0	4	CHEMISTRY
42.	22CYO03	Organic Chemistry for Industry	3	1	0	4	CHEMISTRY
		SEMESTER VI					
43.	22CEO01	Disaster Management	3	1	0	4	CIVIL
44.	22MEX02	Design of Experiments	3	0	2	4	MECH
45.	22MTO02	Robotics	3	1	0	4	MTS
46.	22MTO03	3D Printing and Design	3	1	0	4	MTS
47.	22AUO01	Automotive Electronics	3	1	0	4	ECE
48.	22ECX03	PCB Design and Fabrication	3	0	2	4	ECE
49.	22EEO07	Energy Conservation and Management	3	1	0	4	EEE
50.	22EEO08	Microprocessors and Microcontrollers Interfacing	3	1	0	4	EEE
51.	22EEO09	Electrical Safety	3	1	0	4	EEE
52.	22EEO10	VLSI System Design	3	1	0	4	EEE
53.	22EEO11	Automation for Industrial Applications	3	1	0	4	EEE
54.	22EIO04	PLC Programming with High Level Languages	3	1	0	4	EIE
55.	22EIO05	Virtual Instrumentation	3	1	0	4	EIE

56.	22CSX04	Foundations of Machine Learning	3	0	2	4	CSE
57.	22CSX05	Web Engineering	3	0	2	4	CSE
58.	22ITX02	Advanced Java Programming	3	0	2	4	IT
59.	22ITO02	Internet of Things	3	1	0	4	IT
60.	22ITO03	Fundamentals of Software Development	3	1	0	4	IT
61.	22ITO04	Mobile Application Development	3	1	0	4	IT
62.	22CDX01	Fundamentals of User Interactive Design	3	0	2	4	CSD
63.	22ADX01	Data Visualization	3	0	2	4	AIDS
64.	22CHO04	Air Pollution Monitoring and Control	3	1	0	4	CHEM
65.	22CHO05	Paints and Coatings	3	1	0	4	CHEM
66.	22CHO06	Powder Technology	3	1	0	4	CHEM
67.	22FTX02	Processing of milk and milk products	3	0	2	4	FT
68.	22FTX03	Processing of Fruits and Vegetables	3	0	2	4	FT
69.	22MAO05	Graph Theory and its Applications	3	1	0	4	MATHS
70.	22MAX01	Data Analytics using R Programming	3	0	2	4	MATHS
71.	22MAO06	Operations Research	3	1	0	4	MATHS
72.	22MAO07	Number Theory and Cryptography	3	1	0	4	MATHS
73.	22PHO04	Synthesis, Characterization and Biological Applications of Nanomaterials	3	1	0	4	PHYSICS
74.	22PHO05	Techniques of Crystal Growth	3	1	0	4	PHYSICS
75.	22CYO04	Corrosion Science and Engineering	3	1	0	4	CHEMISTRY
76.	22CYO05	Chemistry of Cosmetics in Daily Life	3	1	0	4	CHEMISTRY
77.	22CYO06	Nanocomposite Materials	3	1	0	4	CHEMISTRY
		SEMESTER VII					
78.	22CEO02	Introduction to Smart Cities	3	0	0	3	CIVIL
79.	22CEO03	Environmental Health and Safety	3	0	0	3	CIVIL
80.	22MEO01	Fundamentals of Ergonomics	3	0	0	3	MECH
81.	22MEO02	Principles of Management and Industrial Psychology	3	0	0	3	MECH
82.	22MEO03	Waste Heat Recovery System and Storage	3	0	0	3	MECH
83.	22MTO04	Drone System Technology	3	0	0	3	MTS
84.	22AUO02	Vehicle Maintenance	3	0	0	3	AUTO
85.	22ECO01	Wearable Devices	3	0	0	3	ECE

86.	22ECX04	Electronic Hardware and Troubleshooting	2	0	2	3	ECE
87.	22EEO12	Electric Vehicle	3	0	0	3	EEE
88.	22EEO13	E-Waste Management	3	0	0	3	EEE
89.	22EEO14	Embedded System Design	3	0	0	3	EEE
90.	22EEO15	Energy Storage Systems and Controllers	3	0	0	3	EEE
91.	22EEO16	AI Techniques for Engineering Applications	3	0	0	3	EEE
92.	22EIO06	Introduction to Distributed Control Systems	3	0	0	3	EIE
93.	22EIO07	Instrumentation in Aircraft Navigation and Control	3	0	0	3	EIE
94.	22EIO08	Industry 4.0 with Industrial IoT	3	0	0	3	EIE
95.	22EIO09	Industrial Data Communication	3	0	0	3	EIE
96.	22EIO10	Wireless Instrumentation	3	0	0	3	EIE
97.	22EIO11	Instrumentation Techniques in Agriculture	3	0	0	3	EIE
98.	22CSO03	Nature Inspired optimization techniques	3	0	0	3	CSE
99.	22ITO05	Fundamentals of Cloud Computing	3	0	0	3	IT
100.	22CDO02	Introduction to Mobile Game Design	3	0	0	3	CSD
101.	22CDO03	Introduction to Graphics Design	3	0	0	3	CSD
102.	22ADO02	Neural Networks and Deep Learning	3	0	0	3	AIDS
103.	22CHO07	Hydrogen Energy	3	0	0	3	CHEM
104.	22CHO08	Rubber Technology	3	0	0	3	CHEM
105.	22FTO02	Principles of Food safety	3	0	0	3	FT
106.	22FTO03	Fundamentals of Food Packaging and Storage	3	0	0	3	FT
107.	22MAO08	Non-Linear Optimization	3	0	0	3	MATHS
108.	22MAO09	Optimization for Engineers	3	0	0	3	MATHS
109.	22CYO07	Waste and Hazardous Waste Management	3	0	0	3	CHEMISTRY
110.	22CYO08	Chemistry in Every day Life	3	0	0	3	CHEMISTRY
		SEMESTER VIII					
111.	22CEO04	Infrastructure Planning and Management	3	0	0	3	CIVIL
112.	22CEO05	Environmental Laws and Policy	3	0	0	3	CIVIL
113.	22MEO04	Safety Measures for Engineers	3	0	0	3	MECH
114.	22MEO05	Energy Conservation in Thermal Equipments	3	0	0	3	MECH

115.	22MEO06	Climate Change and New Energy Technology	3	0	0	3	MECH
116.	22MTO05	Micro and Nano Electromechanical Systems	3	0	0	3	MTS
117.	22AUO03	Public Transport Management	3	0	0	3	ECE
118.	22AUO04	Autonomous Vehicles	3	0	0	3	ECE
119.	22ECO02	Optical Engineering	3	0	0	3	EEE
120.	22EEO17	Smart Grid Technologies	3	0	0	3	EEE
121.	22EEO18	Biomass Energy Systems	3	0	0	3	EEE
122.	22EIO12	Environmental Sensors	3	0	0	3	EIE
123.	22EIO13	Pollution Control and Management	3	0	0	3	EIE
124.	22CSO04	Machine Translation	3	0	0	3	CSE
125.	22CSO05	Fundamentals of Blockchain	3	0	0	3	CSE
126.	22ITO06	Introduction to Ethical Hacking	3	0	0	3	IT
127.	22ITO07	Business Continuity Planning	3	0	0	3	IT
128.	22CDX02	Virtual Reality and Augmented Reality	3	0	0	3	CSD
129.	22ADO03	Business Analytics	3	0	0	3	AIDS
130.	22CHO09	Industrial Accident Prevention and Management	3	0	0	3	CHEM
131.	22CHO10	Electrochemical Engineering	3	0	0	3	CHEM
132.	22CHO11	Smart and Functional Materials	3	0	0	3	CHEM
133.	22FTO04	Food Ingredients	3	0	0	3	FT
134.	22FTO05	Food and Nutrition	3	0	0	3	FT
135.	22CYO09	Chemistry of Nutrition for Women Health	3	0	0	3	CHEMISTRY

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

SNo	Course Code	**Course Title**	L	T	P	C	Offering Department	Semester
1.	22GEO01	German Language Level 1	4	0	0	4	ECE	ALL
2.	22GEO02	Japanese Language Level 1	4	0	0	4	ECE	ALL
3.	22GEO03	Design Thinking for Engineers	3	1	0	4	CSE	5
4.	22GEO04	Innovation and Business Model Development	3	1	0	4	MTS	6
5.	22GEO05	German Language Level 2	4	0	0	4	ECE	ALL
6.	22GEO06	German Language Level 3	3	0	0	3	ECE	ALL
7.	22GEO07	German Language Level 4	3	0	0	3	ECE	ALL
8.	22GEO08	Japanese Language Level 2	4	0	0	4	ECE	ALL
9.	22GEO09	Japanese Language Level 3	3	0	0	3	ECE	ALL
10.	22GEO10	Japanese Language Level 4	3	0	0	3	ECE	ALL
11.	22GEO11	French Language Level 1	4	0	0	4	ECE	ALL
12.	22GEO12	French Language Level 2	4	0	0	4	ECE	ALL
13.	22GEO13	French Language Level 3	3	0	0	3	ECE	ALL
14.	22GEO14	Spanish Language Level 1	4	0	0	4	ECE	ALL
15.	22GEO15	Spanish Language Level 2	4	0	0	4	ECE	ALL
16.	22GEO16	Spanish Language Level 3	3	0	0	3	ECE	ALL
17.	22GEO17	Entrepreneurship Development	3	0	0	3	MTS	7
18.	22GEX01	NCC Studies (Army Wing) - I	3	0	2	4	EEE	5 / 6
19.	22GEX02	NCC Studies (Air Wing) - 1	3	0	2	4	IT	5 / 6
20.	22MBO01	Cost Accounting for Engineers	3	1	0	4	MBA	5
21.	22MBO02	Economic Analysis for Decision Making	3	1	0	4	MBA	6
22.	22MBO03	Marketing Analytics	3	1	0	4	MBA	7

22EGT11 - COMMUNICATION SKILLS I							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All B.E./B.Tech. Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**I**	**HS**	**3**	**0**	**0**	**3**

Preamble	This course is designed to impart required levels of Communication Skills and Proficiency in English language necessary for different professional contexts.	
Unit – I	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**
Grammar: Parts of speech **-** Tenses **-** Types of sentences**:** Assertive, Imperative, Interrogative & Exclamatory **–** Affirmative & Negative **-** Gerunds & Infinitives **- Vocabulary:** Affixes **-** Synonyms & Antonyms **- Listening:** Types of listening **-** Barriers to listening **-** Listening to short talks **-** TV shows **- Speaking:** Verbal & Non-verbal communication **-** Pair conversation **-** Role play **- Reading:** Types of Reading **–** Intensive: scanning, word by word, survey **- Writing:** Dialogue writing, Informal Letters **-** Paragraph writing		
Unit – II	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**
Grammar: Voices **-** Impersonal passives **- Vocabulary:** Homonyms, Homophones & Homographs **- Listening:** Importance of listening **-** Listening to announcements & radio broadcasts **- Speaking:** Persuasive & Impromptu talks **-** Narrating a story **- Reading:** Reading comprehension **-** Articles from Newspapers/Magazines **-** Cloze exercises **- Writing:** Essay writing, Jumbled sentences		
Unit – III	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**
Grammar: Prepositions **- Vocabulary:** Compound Nouns **- Listening:** Listening to TED Talks, Commentaries **- Speaking:** Self Introduction **- Reading:** Extensive: speed, skimming **-** Identifying lexical & contextual meanings **- Writing:** Instructions & Warnings **-** Formal letters: Seeking permission for Industrial visits & Inviting guests		
Unit – IV	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**
Grammar: Articles & Determiners **- Vocabulary:** Technical Vocabulary **-** Analogy **-** Unscrambling words **-** Logical reasoning **- Listening:** Listening to conversations - **Speaking:** Tongue twisters **-** Skill Sharing **-** Note-taking **- Reading:** Note making **-** Paraphrasing & Summarizing **- Writing:** Recommendations & Suggestions **-** Business letters: Enquiry, Calling for quotations & placing orders		
Unit – V	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**
Grammar: Cause and effect expressions **- Vocabulary:** Abbreviations & acronyms, Definitions **Listening:** Listening to eminent personalities **- Speaking:** Commonly mispronounced words **-** Welcome address, Chief guest address & Vote of thanks **- Reading -** IELTS type passages **- Writing:** Preparing transcript for a speech **-** Interpreting news articles & advertisements		
		Total:45

TEXT BOOK:

1.	Sanjay Kumar & Pushp Lata, “Communication Skills”, 2nd Edition, Oxford University Press, New Delhi, 2018.

REFERENCES:

1.	Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw-Hill India, 2017.
2.	S. P. Dhanavel, "English and Communication Skills for Students of Science and Engineering", Orient BlackSwan Publishers, Hyderabad, 2009.
3.	Jack C. Richards and Chuck Sandy, “Passages” Student’s Book 1, 3rd Edition, Cambridge University Press, New York, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	use language effectively by acquiring vocabulary and syntax in context	Applying (K3)
CO2	listen and comprehend different spoken discourses from a variety of situations	Applying (K3)
CO3	speak confidently in different professional contexts and with peers	Creating (K6)
CO4	comprehend different genres of texts by adopting various reading strategies	Understanding (K2)
CO5	write legibly and flawlessly at varied professional contexts proficiently with appropriate choice of words and structures	Creating (K6)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						2			1	3	1	1
CO2									2	3		1
CO3									2	3		2
CO4						1				3	1	1
CO5										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		37	30			33	100
CAT2		30	30			40	100
CAT3		33	34			33	
ESE		17	63			20	100

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

22MAC11 - MATRICES AND ORDINARY 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 ordinary differential equations.	
Unit – I	**Matrices:**	**9+3**
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 – Applications of Eigen values and Eigen vectors: Stretching of an elastic membrane.		
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 - Applications: Law of natural growth and decay.		
Unit – III	**Ordinary Differential Equations of Higher Order:**	**9**
Linear differential equations of second and higher order with constant coefficients - Particular Integrals for the types: e^{ax} – cosax / sinax – x^n – $e^{ax}x^n$, e^{ax} sinbx and e^{ax} cosbx – x^n sinax and x^n cosax – Differential Equations with variable coefficients: Euler-Cauchy's equation – Legendre's equation.		
Unit – IV	**Applications of Ordinary Differential Equations:**	**9**
Method of variation of parameters – Simultaneous first order linear equations with constant coefficients – Applications of differential equations: Simple harmonic motion – Electric circuits (Differential equations and associated conditions need to be given).		
Unit – V	**Laplace Transform:**	**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) – Applications: Solution of linear ODE of second order with constant coefficients.		

LIST OF EXPERIMENTS / EXERCISES:

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

Lecture:45, Tutorials and Practical:15, Total:60

TEXT BOOK:

1.	Ramana B V, "Higher Engineering Mathematics", 1st Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2018.

REFERENCES/ MANUAL / SOFTWARE:

1.	Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2016.
2.	Kandasamy P., Thilagavathy K. and Gunavathy K., “Engineering Mathematics For First Year B.E/B.Tech”, Reprint Edition 2014, S.Chand and Co., New Delhi.
3.	Duraisamy C., Vengataasalam S., Arun Prakash K. and Suresh M., "Engineering Mathematics - I", 2nd Edition, Pearson India Education, New Delhi, 2018.
4.	Grewal B.S., “Higher Engineering Mathematics" 44thEdition, Khanna Publishers, New Delhi, 2018.
5.	Matrices and Ordinary Differential Equations Laboratory 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), Manipulation (S2)
CO2	identify the appropriate method for solving first order ordinary differential equations.	Applying (K3), Manipulation (S2)
CO3	solve higher order linear differential equations with constant and variable coefficients.	Applying (K3), Manipulation (S2)
CO4	apply the concept of ordinary differential equations for modeling and finding solutions to engineering problems.	Applying (K3), Manipulation (S2)
CO5	apply Laplace Transform to find solutions of Linear Ordinary Differential Equations	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		3									
CO2	3	3	2		3									
CO3	3	3	2		3									
CO4	3	3	2		3									
CO5	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)

*Alternate week

22ADT11 - FOUNDATIONS OF INFORMATION TECHNOLOGY							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**PC**	**3**	**0**	**0**	**3**
Preamble	The course focuses on the basic concepts of Linux Shell Scripting, designing a simple web application and hosting in Github platform.						
Unit – I	**Introduction:**						**9**
Overview of Linux File Systems – Listing Files and Directories – Managing Directories – Managing Process – Disk Statistics – Working with Data Files – Searching for Data – Compressing Data – Archiving Data – Environment Variables – Global – Local – User Defined Variable – Setting and Removing Environment Variables.							
Unit – II	**Shell Scripting:**						**9**
Shell Scripting Basics – Input and Output Redirection – Pipes – Structured Commands – Decision Making – Looping constructs – Functions- String operations.							
Unit – III	**UI Design:**						**9**
HTML 5 – Basic Tags – Input Tags – Page structured element – Introduction to Cascading Style Sheet– Types of Style Sheet - padding-Flexbox- grid.							
Unit – IV	**Responsive Web Design:**						**9**
Introduction – Bootstrap - Grid basics – Tables – Images – Jumbotron – Button – Pagination – List – Drop down – Navs – Nav Bar – Carousel – Forms – Input – checkbox – radiobutton.							
Unit – V	**Introduction to Github:**						**9**
Introduction – Installation Git – Basic concepts – File management – commits – branches – merges.							
							Total:45

TEXT BOOK:

1.	Richard Blum and Christine Bresnahan, “Linux Command Line and Shell Scripting Bible”, 4th Edition, Wiley Publications, 2021 for Units I & II.
2.	Infosys campus connect material shared by Infosys for Units III & IV. Jon Loeliger and Matthew Mccullough., “Version control with Git”, 2nd Edition, O’Reilly Media Inc., 2012 for Unit V.

REFERENCES:

1.	Clif Flynt, Sarath Lakshman, Shantanu Tushar, “Linux Shell Scripting Cookbook”, 3rd Edition, Packt Publishing Ltd, 2017.
2.	Jacob Lett, “Boostrap Reference Guide”, Bootstrap Creative, 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	demonstrate the various shell commands, processing data files and setting environment variables for software installation	Understanding (K2)
CO2	apply decision making and looping constructs in shell scripts	Applying (K3)
CO3	design a webpage using HTML and CSS	Applying (K3)
CO4	design responsive web pages using Bootstrap	Applying (K3)
CO5	create and manage repository using Github	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1										2	1
CO2	3	2	1										2	1
CO3	3	2	1	1									2	1
CO4	3	2	1	1	1								2	1
CO5	3	2	1	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	45	45				100
CAT2	10	20	70				100
CAT3	10	40	50				100
ESE	5	45	50				100

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

22CYT12 – CHEMISTRY FOR COMPUTER SYSTEMS							
(Common to CSE, CSD, AIDS and AIML branches)							
Programme & Branch	**B.E & Computer Science and Engineering & Computer Science and Design, BTech – Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1 / 2****	**BS**	**3**	**0**	**0**	**3**

Preamble	This course aims to equip the engineering students to realize the importance of chemistry in electrochemistry, corrosion and its control methods, electrochemical storage devices, insulating materials and the need for e-waste management.	
Unit – I	**ELECTROCHEMISTRY**	**9**
Introduction - cells - types - representation of galvanic cell – electrode potential – Nernst equation (derivation of cell EMF) – calculation of cell EMF from single electrode potential – reference electrodes: construction, working and applications of standard hydrogen electrode, standard calomel electrode, glass electrode – EMF series and its applications - potentiometric titrations (redox) – conductometric titrations – mixture of weak and strong acid vs strong base.		
Unit – II	**CORROSION AND ITS CONTROL METHODS**	**9**
Corrosion: Introduction - chemical corrosion – Pilling-Bedworth rule - electrochemical corrosion and it's types – galvanic corrosion – differential aeration corrosion with examples - galvanic series - factors influencing rate of corrosion – measurement of corrosion (wt. loss method only). **Control methods** – sacrificial anodic protection method - corrosion inhibitors - protective coatings - pretreatment of metal surface – metallic coating: electroplating, electroless plating and hot dipping (tinning and galvanizing) methods – non-metallic coating: anodizing - organic coating: paints, constituents and functions - ceramic coatings.		
Unit – III	**ELECTROCHEMICAL STORAGE DEVICES**	**9**
Batteries: Introduction**-** types of batteries - discharging and charging of battery - characteristics of battery - battery rating - various tests on battery -– primary battery: silver button cell - secondary battery: Ni-Cd battery -modern battery: lithium-ion battery - maintenance of batteries - choice of batteries for electric vehicle applications. **Fuel Cells:** Introduction-Importance and classification of fuel cells - description, principle, components and applications of fuel cells: H_2-O_2 fuel cell, alkaline fuel cell, molten carbonate fuel cell and direct methanol fuel cell.		
Unit – IV	**INSULATING MATERIALS**	**9**
Introduction - requirements - classification (solid, liquid & gas) - preparation, properties and applications of : solid inorganic insulators: glass, ceramic products - solid organic insulator: epoxy resin - liquid insulator: transformer oil - gas insulator: SF_6 - electrical resistivity - factors influencing electrical resistivity of materials - composition, properties and applications of high resistivity materials: constantan, molybdenum disilicide and nichrome - polymers as electrical insulators - non-polar polymers - polar polymers - polarization of polymers.		
Unit – V	**E-WASTE AND ITS MANAGEMENT**	**9**
Introduction-E- Waste – definition - sources of e-waste– hazardous substances in e-waste - effects of e-waste on environment and human health- need for e-waste management– e-waste handling rules - waste minimization techniques for managing e-waste – recycling of e-waste - disposal treatment methods of e- waste- mechanism of extraction of precious metal from leaching solution – global scenario of E-waste – E-waste in India- case studies.		
		Total:45

TEXT BOOK:

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

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, 2018.

**** for 2022 batch 1st sem for CSE, CSD, AIML & AIDS, for 2023 batch 1st sem for CSE & CSD & 2nd sem for AIML & AIDS**

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply the principle of electrochemistry for various applications	Applying (K3)
CO2	make use of corrosion control methods to solve corrosion related issues.	Applying (K3)
CO3	use the concepts of batteries, fuel cells and their applications in various fields.	Applying (K3)
CO4	apply the knowledge of insulators to make different insulating materials for various applications	Applying (K3)
CO5	utilize the knowledge to handle the e-waste and reduce its impacts on environment	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN – THEORY

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

22ADC11 - C PROGRAMMING							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech – Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**ES**	**3**	**0**	**2**	**4**

Preamble	This course provides the necessary skills required to solve problems using C programming language.	
Unit – I	**Introduction to Problem Solving and C:**	**9**
Problem solving techniques: Algorithms – Flowcharts – Pseudo codes – 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.		
Unit – II	**Control Statements and Arrays:**	**9**
Control Structures : decision making and looping statements – Input and output functions – Arrays : Declaring and initializing 1D array – Two dimensional arrays – Multidimensional arrays.		
Unit – III	**Functions and Strings:**	**9**
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 – Strings : Basics, declaring and initializing string – string handling functions : standard and user defined functions – character oriented functions, Two dimensional array of strings		
Unit – IV	**Pointers:**	**9**
Pointers: Memory access and pointers, pointer basics, declaring, initializing and dereferencing a pointer, parameter passing mechanisms , operations on pointers – pointers for string manipulation.		
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.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Programs for demonstrating the use of different types of operators like arithmetic, logical, relational and ternary operators (Sequential structures).
2.	Programs to Illustrate the different formatting options for input and output.
3.	Programs using decision making statements like ‘if’, ‘else if’, ‘switch’, conditional and unconditional ‘goto’ (Selective structures).
4.	Programs for demonstrating repetitive control statements like ‘for’, ‘while’ and ‘do-while’ (Iterative structures).
5.	Programs for demonstrating one-dimensional and two-dimensional numeric array.
6.	Programs to demonstrate modular programming concepts using functions (Using built-in and user-defined functions).
7.	Programs to implement various character and string operations with and without built-in library functions.
8.	Programs to demonstrate the use of pointers.
9.	Programs to illustrate the use of user-defined data types.

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Sumitabha Das, “Computer Fundamentals and C Programming”, 1st Edition, McGraw Hill, 2020.

REFERENCES/ MANUAL / SOFTWARE:

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.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	apply problem solving techniques to express the solution for the given problem and understand the basic concepts in C	Applying (K3)
CO2	select the appropriate control statements and arrays for developing simple applications in C	Applying (K3)
CO3	develop solutions for the given problem using strings and functions	Applying (K3)
CO4	apply the concept of pointers to solve problems	Applying (K3)
CO5	make use of user defined data types to solve given problems	Applying (K3)
CO6	demonstrate the application of sequential, selective and repetitive control structures	Applying (K3) Precision (S3)
CO7	demonstrate the use of derived data types	Applying (K3) Precision (S3)
CO8	implement solutions to the given problem using 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			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
CO6	3	2	1	1	1								1	2
CO7	3	2	1	1	1								1	2
CO8	3	2	1	1	1								1	2

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

ASSESSMENT PATTERN – THEORY

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

22EEC11 - BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING							
(Common to Computer Science and Engineering, Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.E & Computer Science and Engineering, Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**ES**	**3**	**0**	**2**	**4**

Preamble	To provide comprehensive ideas about power Systems, AC and DC circuits, 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 - Renewable and Non-Renewable sources of Energy - Structure of Electric Power System - Comparison of Overhead and Underground Systems - Electrical Safety Aspects - Principles of Earthing-Classification.		
UNIT – II	**DC Circuits and AC Circuits:**	**9**
Resistance: Resistors in Series and Parallel - Network Reduction - Star to Delta and Delta to Star Transformations - Ohm's Law - Kirchoff's laws-Voltage and Current Division Rule. **AC Circuits:** Alternating (Sinusoidal) Voltage and Current, R.M.S and Average Value, Power Factor, Form Factor and Peak Factor.		
UNIT – III	**DC Machines**	**9**
Construction, Principle of Operation of DC generator and DC motor, DC Generators: EMF equation, Types and applications, DC Motor: Torque Equation, types and Applications. Need for starter – DC motor Starter types and construction.		
UNIT – IV	**AC Machines and Transformers**	**9**
Construction and Working Principle of Single Phase Transformer, AC Generator, Single Phase Induction Motor (Split Phase and Capacitor Start Induction Motor), Three Phase Induction Motor - DOL and Star-Delta starter- Applications.		
UNIT – V	**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 - UPS and SMPS (Block Diagram approach).		

LIST OF EXPERIMENTS / EXERCISES:

1.	Verification of Ohm's Law
2.	Verification of Kirchoff's Current Law
3.	Verification of Kirchoff's Voltage Law
4.	Measurement of real power, reactive power of RC and RL circuits.
5.	Load test on DC shunt motor
6.	Load test on DC series motor
7.	Load test on single phase induction motor
8.	VI characteristics of PN junction diode
9.	VI characteristics of Zener diode
10.	Voltage Regulator using Zener diode

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/ MANUAL / SOFTWARE:

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.	SmarajitGhosh, "Fundamentals of Electrical and Electronics Engineering", 2nd Edition, PHI Learning, 2007.
4.	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 and Identify the various electrical parameters in circuits	Applying (K3), Manipulation (S2)
CO2	analyze the DC and AC circuits	Analyzing (K4)
CO3	interpret the construction and working of different types of DC machines	Applying (K3)
CO4	illustrate the working of different types of AC machines and transformers	Applying (K3)
CO5	demonstrate the basic functions of semiconductor devices and analyze the characteristics of semiconductor devices	Applying (K3), Precision (S3)
CO6	test basic electrical machines like DC motors, induction motor and transformers	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									2	1
CO2	3	1	2										2	1
CO3	3	1	2										2	1
CO4	3	2	2										2	1
CO5	3	1	2	1									2	1
CO6	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	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)

22CYL12 – CHEMISTRY LABORATORY FOR COMPUTER SYSTEMS							
(Common to CSE, CSD, IT, AIDS and AIML branches)							
Programme & Branch	**B.E & Computer Science and Engineering & Computer Science and Design, BTech – Information Technology, Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1 / 2****	**BS**	**0**	**0**	**3**	**1**

Preamble	This course aims to impart the basic concepts of volumetric, conductometric, potentiometric, spectrophotometric and pH metry experiments for the estimation of given samples and thereby, to improve the analytical capability. It also aims to impart the knowledge on importance of water quality parameters (Ca, Mg & alkalinity) and the toxic substances (Cu, Cr) that we come across in day to day life.

LIST OF EXPERIMENTS / EXERCISES:

1.	Determination of strength of an unknown solution using pH meter.
2.	Analysis and comparison of the strength of acids in the given mixture using conductivity meter.
3.	Potentiometric approach using a Pt electrode for the estimation of iron in the given sample.
4.	Spectrophotometric method for the determination of nickel.
5.	Iodometric analysis of Cu content from discarded PCBs.
6.	Volumetric analysis of chromium prepared from electroplating sludge.
7.	Determination of Dissolved Oxygen in the given wastewater sample.
8.	Assessment of the given water sample for the suitability of drinking / industrial purpose by estimating the calcium, magnesium and total hardness by EDTA method.
9.	Estimation of alkalinity of river and borewell water collected from different places.
10.	Determination of molecular weight of a polymer / liquid by Ostwald viscometer.
11.	Construction and working of Zinc -Copper Electrochemical Cell (Demonstration).
12.	Electroplating process (Demonstration).

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Palanisamy P.N., Manikandan P., Geetha A. and Manjula Rani K., "Chemistry Laboratory Manual", 1st Edition, Rajaganapathy Publishers, Erode, 2022.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	demonstrate the conductivity meter and pH meter to analyze the strength of the given solution.	Applying (K3), Precision (S3)
CO2	analyze the amount of Cu, Cr, DO, hardness and alkalinity present in the given sample.	Applying (K3), Precision (S3)
CO3	demonstrate the potentiometric and spectrophotometric method for the estimation of Fe & Ni and Viscometer for the determination of molecular weight of a polymer.	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			3							
CO2	3	2	1	3			3							
CO3	3	2	1	3			2							

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

**** for 2022 batch 1st sem for CSE, CSD, AIML & AIDS & 2nd sem for IT,**
for 2023 batch 1st sem for CSE, CSD, IT & 2nd sem for AIML & AIDS

22ADL11 - OPEN SOURCE AND WEB DESIGNING LABORATORY							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech - Artificial Intelligence and Data Science & B.Tech - Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Sem.**	**1**	**ES**	**0**	**0**	**2**	**1**

Preamble	This course provides knowledge about basic Linux commands, shell script programming and designing a web page using HTML, CSS and Bootstrap and version control using Github.

LIST OF EXPERIMENTS / EXERCISES:	
1.	Working with Linux Commands
2.	Working with Environment variables
3.	Implementation of Shell programming for constructs like loops and patterns
4.	Implementation of Shell programming for string operations
5.	Design a static webpage using HTML and CSS
6.	Design a responsive webpage using Bootstrap
7.	Design a responsive website with Navigation bar using Bootstrap
8.	Experiment on Git Installation, Git Commands and Creation of Local and Remote repository
9.	Creation and merging of branches in Git Hub
10.	Working with multiple repositories, rebasing and configuration files
11.	Working with Patches, Hooks and Git graph model
	Total:30

REFERENCES/ MANUAL /SOFTWARE:	
1.	Operating System : Windows/Linux
2.	Software : GEdit, Visual Studio Code, Github, Bash Shell
3.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	demonstrate linux commands and shell script.	Applying (K3), Precision (S3)
CO2	design static webpage using HTML, CSS and Bootstrap	Applying (K3), Precision (S3)
CO3	deploy the static webpage in Github with version control	Applying (K3), Precision (S3)

Mapping of Cos with POs and PSOs

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

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

22ADC12 - ESSENTIALS OF INFORMATION TECHNOLOGY							
(**Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches**)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**PC**	**2**	**0**	**2**	**3**

Preamble	The course focuses on the basic concepts of Problem Solving, Linux commands, designing a simple web application and hosting in the GitHub platform.	
Unit – I	**Problem Solving:**	**6**
Problem solving: Planning the computer program – Flowcharts - Pseudocode - Structuring the logic. Flowchart, and Pseudo code for the problems: Exchanging the values of two variables - Finding the biggest number - Summation of numbers - Factorial computation - Fibonacci series - Reversing the digits of an Integer		
Unit – II	**Linux basics:**	**6**
Introduction to shell – Navigation of Linux File System – Listing Files and Directories – Managing Directories - Shell Commands – Disk Statistics – Working with Data Files – Searching for Data – Compressing Data – Archiving Data – Environment Variables – Global – Local – User Defined Variable – Setting and Removing Environment Variables		
Unit – III	**UI Design:**	**6**
HTML 5 – Basic Tags – Input Tags – Page structured element – Introduction to Cascading Style Sheet– Types of Style Sheet - padding-Flexbox- grid.		
Unit – IV	**Responsive Web Design:**	**6**
Introduction – Bootstrap - Grid basics – Tables – Images – Button – Pagination – List – Drop down – Navs – Nav Bar – Carousel – Forms – Input – checkbox – radio button.		
Unit – V	**GitHub:**	**6**
Introduction – version control – GIT: Installation and configuration - creating and managing repository – copy repository - starting a project – local changes – push - pull - commit – revert - branches – merges - merge conflicts – fork and clone		

Lecture:30, Practical:30, Total:60

LIST OF EXPERIMENTS / EXERCISES:

1.	Implement sequential and selective structure using Raptor Tool
2.	Draw flowcharts using Raptor Tool for problems in repetitive structures
3.	Explore basic Linux commands
4.	Execute files, directories and environmental variables commands in Linux
5.	Design a static webpage using HTML and CSS
6.	Design a responsive website with Navigation bar using Bootstrap
7.	Experiment on Git installation, Git Commands, and creation of a local and remote repository
8.	Create and merge branches in the GitHub.

Lecture:30, Practical:30, Total:60

TEXT BOOK:

1.	S.Kuppuswami, S.Malliga, C.S.Kanimozhi Selvi and K.Kousalya "Problem Solving and Programming", 1st Edition, Tata McGraw Hill, 2019 for Unit 1.
2.	Richard Blum and Christine Bresnahan, “Linux Command Line and Shell Scripting Bible”, 4th Edition, Wiley Publications, 2021 for Unit II.
3.	Infosys campus connect material shared by Infosys for Units III & IV.
4.	Jon Loeliger and Matthew Mccullough., “Version control with Git”, 2nd Edition, O’Reilly Media Inc., 2012 for Unit V.

REFERENCES/ MANUAL / SOFTWARE:	
1.	Jacob Lett, “Boostrap Reference Guide”, Bootstrap Creative, 2018.
2.	https://git-scm.com/docs/gittutorial

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	make use of Flow charts and pseudocode to find the solution for the given real-world problems	Applying (K3) Precision(S3)
CO2	demonstrate the various shell commands, processing data files, and setting environment variables for software installation	Applying (K3) Precision(S3)
CO3	design a static webpage using HTML and CSS	Applying (K3) Precision(S3)
CO4	design responsive web pages using Bootstrap	Applying (K3) Precision(S3)
CO5	create and manage repository using GitHub	Applying (K3) Precision(S3)

Mapping of COs with POs and PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom’s1111 Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	50	30				100
CAT2	20	40	40				100
CAT3	20	40	40				100
ESE	5	50	45				100

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

22EGT21 - COMMUNICATION SKILLS II							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All B.E./B.Tech. Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Communication Skills I**	**2**	**HS**	**3**	**0**	**0**	**3**

Preamble	This course is designed to equip students with the necessary skills to listen, read, write and speak so as to develop their linguistic and communicative competencies.	
Unit – I	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**
Grammar: Sentence Patterns **-** Simple, Compound & Complex sentences **- Vocabulary:** Portmanteau words **-** One word substitution **- Listening:** Speeches from company CEOs **-** TV debates **Speaking:** Just-a-minute talk **-** Group discussion **- Reading:** Reading for Gist **- Writing:** Job application letter with resume **–** Transcoding		
Unit – II	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**
Grammar: Concord **- Vocabulary:** Phrasal verbs **-** Idioms & Phrases - **Listening:** Listening to celebrity talks - **Speaking:** Talking about celebrities - Practicing Pronunciation through web tools - **Reading:** Company correspondence, technical texts/working principles of a machine - **Writing:** Description: Person, Place**,** Process, Product and Picture		
Unit – III	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**
Grammar: Discourse markers **-** Transitional words and phrases **- Vocabulary:** Commonly confused words **- Listening:** Listening to guest lectures **- Speaking:** Technical & Non-technical presentations **-** Workshop presentations **- Reading:** Reputed company profiles, Business Plans **- Writing:** a dream job/company **-** Letter to the Editor **–** Biography & Autobiography **-** Checklist		
Unit – IV	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**
Grammar: Degrees of Comparison **-** Punctuations **–** Fragments & run**-**ons **- Vocabulary:** British & American **-** Spelling & words **- Listening:** Listening to global accents **-** listening to motivational speeches **-** S**peaking:** Narrating personal milestones **-** Sports commentaries **-** Movie Enactment **- Reading:** Narrative passages **- Writing:** E mail **-** Agenda & Minutes of Meeting **-** Special & Technical reports		
Unit – V	**Grammar, Vocabulary, Listening, Speaking, Reading & Writing**	**9**
Grammar: Purpose and Function **-** If clause **-** Error detection **- Vocabulary:** Coding & Decoding **-** Alphabet test **- Listening:** Listening to sample HR Interviews **- Speaking:** Introduction to phonetics - Stress, rhythm & Intonation **–** Guided & unguided speeches/conversations **-** Giving feedback **–** Debate **- Reading:** Key Note speeches **-** Newspaper reports **-** short technical texts from journals **Writing:** Circulars **-** Critical Appreciation of a non-detailed text **-** Technical proposals		
		Total:45

TEXT BOOK:

1.	Sanjay Kumar & Pushp Lata, “Communication Skills”, 2nd Edition, Oxford University Press, New Delhi, 2018.

REFERENCES:

1.	Meenakshi Raman and Sangeeta Sharma. “Technical Communication- Principles and Practice”. 4th Edition, Oxford University Press, New Delhi, 2022.
2.	Murphy Raymond, "English Grammar in Use", 5th Edition, Cambridge University Press, New York, 2019.
3.	Jack C. Richards and Chuck Sandy, “Passages” Student’s Book 2, 3rd Edition, Cambridge University Press, New York, 2014.

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 accents and infer implied meanings	Applying (K3)
CO3	speak clearly, initiate and sustain a discussion and negotiate using appropriate communicative strategies	Creating (K6)
CO4	read different genres of texts, infer implied meanings and critically analyze and evaluate them	Understanding (K2)
CO5	produce different types of narrative, descriptive expository texts and understand creative, critical, analytical and evaluative writing	Creating (K6)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						2			1	3	1	1
CO2									2	3		1
CO3									2	3		2
CO4						1				3	1	1
CO5										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		37	30			33	100
CAT2		7	50			43	100
CAT3		17	50			33	100
ESE		15	45			40	100

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

22MAC24 - PROBABILITY THEORY AND INFERENTIAL STATISTICS							
(Common to Artificial Intelligence and Data Science and Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**BTech - Artificial Intelligence and Data Science and Artificial Intelligence and Machine Learning branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**BS**	**3**	**1***	**2***	**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**
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**
Discrete Distributions: Binomial distribution – Poisson distribution – Geometric distribution – Continuous Distributions: Uniform distribution – Exponential distribution – Gaussian distribution		
Unit – III	**Correlation and Estimation Theory:**	**9**
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**
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**
Analysis of variance – One way classification: Completely Randomized Design – Two way classification: Randomized Block Design – Three way classification: Latin Square Design.		

LIST OF EXPERIMENTS / EXERCISES:	
1.	Introduction to R studio.
2.	Identifying Mean and Variance for discrete and continuous random variables.
3.	Computation of probability using Binomial, Poisson and Normal distributions.
4.	Computation of correlation coefficient for the given data.
5.	Determining model coefficients using Maximum Likelihood Estimation.
6.	Testing significance of means by student's t – test.
7.	Testing the independence of attributes by Chi-square test.
8.	Analyze whether the difference in means is statistically significant by completely randomized design.
	Lecture:45, Tutorials and Practical:15, Total:60

TEXT BOOK:	
1.	Veerarajan, T, "Probability and Statistics, Random Processes and Queuing Theory", 1st Edition, McGraw Hill Education, Chennai, 2019.
REFERENCES/ MANUAL / SOFTWARE:	
1.	William Mendenhall, Robert J. Beaver and Barbara M. Beaver, "Introduction to Probability and Statistics", 14th Edition, Cengage Learning, USA, 2013.
2.	Jay L. Devore., "Probability and Statistics for Engineering and the Sciences", 9th Edition, Cengage Learning,

	USA, 2016
3.	Johnson. R.A., Miller. I and Freund. J., "Miller and Freund's Probability and Statistics for Engineers", 9th Edition, Pearson Education, India, 2018.
4.	S.C.Gupta, V.K.Kapoor, "Fundamentals of Mathematical Statistics", 12th Edition, Sultan Chand & Sons, New Delhi, 2022.
5.	Probability Theory and Inferential Statistics Laboratory Manual.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the concept of random variables and use R studio to find the statistical measures.	Applying (K3) Manipulation (S2)
CO2	apply the standard probability distributions in engineering problems.	Applying (K3) Manipulation (S2)
CO3	utilize the concepts of correlation and point estimation in intelligent systems	Applying (K3) Manipulation (S2)
CO4	apply statistical tests for solving engineering problems involving small and large samples.	Applying (K3) Manipulation (S2)
CO5	apply the concepts of analysis of variance to experimental data.	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	1		3								1	
CO2	3	3	2		3								2	
CO3	3	3	2	3	3								2	
CO4	3	3	3	3	3								3	
CO5	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	10	15	75				100
CAT2	10	15	75				100
CAT3	10	15	75				100
ESE	10	15	75				100

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

*Alternate Week

22PHT22 – PHYSICS FOR COMPUTER SYSTEMS							
(Common to CSE, CSD, AIML & AIDS branches)							
Programme & Branch	**BE/B.Tech - CSE, CSD, AIML and AIDS branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**BS**	**3**	**0**	**0**	**3**
Preamble	This course aims to impart the knowledge on oscillations & waves, acoustics, ultrasonics, laser, fiber optics, semiconductors and smart materials. It also describes the applications of aforementioned topics in computer sciences.						
Unit – I	**Oscillations and Waves:**						**9**
Periodic motion – Oscillations – Simple harmonic motion – Differential equation of simple harmonic motion – Forced oscillations – Damped oscillations – Application of simple harmonic motion in torsional pendulum, cantilever and LC circuit – Resonance – Waves – Equation of plane progressive wave – Types of progressive waves – Reflection and transmission of waves at a boundary (qualitative) – Energy transport of progressive waves.							
Unit – II	**Acoustics and Ultrasonics:**						**9**
Classification of sound – Characteristics of sound – Reverberation and reverberation time – Growth and decay of sound – Sabine's formula for reverberation time – Determination of sound absorption coefficient – Factors affecting acoustics of buildings and their remedies – Ultrasonics – Properties of ultrasonic waves – Generation of ultrasonic waves – Magnetostrictive generator and Piezoelectric generator – Non-destructive testing – Flaw detection.							
Unit – III	**Laser and Fiber Optics:**						**9**
Stimulated absorption – Spontaneous emission – Stimulated emission – Einstein's coefficients and their relations – Population inversion – Pumping – CO_2 laser – Holography – Fiber optics – Numerical aperture and acceptance angle – Classification of optical fibers based on refractive index, modes and materials – Fiber optics communication system (qualitative) –Temperature and displacement sensors.							
Unit – IV	**Semiconductors:**						**9**
Intrinsic semiconductor – Carrier concentration – Fermi level – Variation of conductivity with temperature – Determination of band gap – Extrinsic semiconductors – Carrier concentration in n-type and p-type semiconductors – Hall effect – Determination of Hall coefficient – Applications – Solar Cell: Principle, construction and working.							
Unit – V	**Smart Materials:**						**9**
Metallic glasses: Properties, preparation and applications – Shape memory alloys: Characteristics and applications – Nanostructure – Surface-to-volume ratio – Quantum confinement – Nanomaterials synthesis: Top-down and bottom-up approaches – Electron beam lithography – Physical vapour deposition – Carbon nanotubes: Structures, properties, synthesis by laser ablation method – Applications.							
							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. Hitendra K. Malik and A.K. Singh, "Engineering Physics", 2nd Edition McGraw-Hill Education , New Delhi, 2018
2. Pandey B.K.and Chaturvedi S., "Engineering Physics" 2nd Edition, Cengage, New Delhi, 2022.
3. Tamilarasan K. and Prabu K., "Materials Science", 1st Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2019.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	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 and to recognize the requirements of acoustically good buildings and also to describe the production of ultrasonic wave and the testing materials by non-destructive method.	Applying (K3)
CO3	apply the concepts of stimulated emission of radiation to explain the working and the applications of laser in engineering and technology. To apply the principle of propagation of light through optical fiber to compute acceptance angle and numerical aperture and to comprehend the loss in optical fiber and also to explain fiber optic communication system and the working of fiber optic sensors.	Applying (K3)
CO4	use the concept of density of states to compute the carrier concentration, electrical conductivity and band gap of intrinsic semiconductors and to compute the carrier concentration of extrinsic semiconductors, and also to explain the Hall Effect and the working of solar cell.	Applying (K3)
CO5	utilize appropriate methods to prepare metallic glasses, shape memory alloys, nanomaterials and carbon nano tubes and also to comprehend their properties and applications.	Applying (K3)

Mapping of Cos with POs and PSOs

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2						2	2		1	3	1
CO2	3	2	2						2	2		1	3	1
CO3	3	2	2						2	2		1	3	1
CO4	3	2	2						2	2		1	3	1
CO5	3	2	2						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	40	45				100
CAT2	15	40	45				100
CAT3	20	45	35				100
ESE	10	40	50				100

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

22ECC21 - DIGITAL PRINCIPLES AND DESIGN							
(Common to Artificial Intelligence and Machine Learning & Artificial Intelligence and Data Science 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**	**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 EXPERIMENTS / EXERCISES:

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/ MANUAL / SOFTWARE:

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	understand the number systems and apply Boolean Algebra for logic minimization	Applying (K3)
CO2	apply K-Map and tabulation method for gate level logic minimization	Applying (K3)
CO3	design combinational logic circuits	Applying (K3)
CO4	design synchronous sequential logic circuits	Applying (K3)
CO5	understand asynchronous sequential logic and realize Boolean functions using PLDs	Applying (K3)
CO6	verify Boolean theorems and implement combinational logic circuits using basic gates	Applying (K3) Precision(S3)
CO7	verify the truthtable of Flipflops using basic logic gates	Applying (K3) Precision(S3)
CO8	implement sequential logic circuits using Flipflop IC	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	2		2						2	2	2
CO2	3	2	3	2	2	2			2	2		2	3	2
CO3	3	2	3	2	2	2			2	2		2	3	2
CO4	3	2	3	2	2	2			2	2		3	3	2
CO5	3	2	3	2		2						3	3	2
CO6	3	2	3	2		2						3	3	2
CO7	3	2	3	2		2						3	3	2
CO8	3	2	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	10	20	70				100
CAT2	10	20	70				100
CAT3	5	15	80				100
ESE	5	20	75				100

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

22ADC21 - DATA STRUCTURES							
(Common to Artificial Intelligence and Machine Learning & Artificial Intelligence and Data Science 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**	**2**	**PC**	**3**	**0**	**2**	**4**

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: Bubble sort – Shell sort – Bucket sort – Hashing: Hash Functions – Separate Chaining – Open Addressing: Linear Probing – Quadratic Probing – Double Hashing – Rehashing – Extendible Hashing.		

LIST OF EXPERIMENTS / EXERCISES:

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.	Implementation of binary search tree traversals
9.	Implementation of graph traversal techniques
10.	Implementation of linear and binary search algorithms
11.	Implementation of sorting algorithms

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Weiss M. A., "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2016.

REFERENCES/ MANUAL / SOFTWARE:

1.	Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, McGraw Hill, 2009.
2.	Narasimha Karumanchi, "Data Structures and Algorithms Made Easy", Career Monk Publications, 2016.

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)
CO6	implement linear and non linear data structures to solve the given problem.	Applying (K3), Precision (S3)
CO7	use a data structure to implement another data structure.	Applying (K3), Precision (S3)
CO8	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										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
CO6	3	2	2	2	2							2	3	2
CO7	3	2	2	2	2							2	3	2
CO8	3	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	30	60				100
CAT3	10	30	60				
ESE	5	35	60				100

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

22ADC22 – PYTHON PROGRAMMING							
(Common to Artificial Intelligence and Machine Learning & Artificial Intelligence and Data Science 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**	**2**	**ES**	**3**	**0**	**2**	**4**

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 – operators – Flow control statements – Calendars and clocks.		
Unit – II	**Functions and Data Structures:**	**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.		
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 – 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.		
Unit – V	**Databases and Web Frameworks:**	**9**
Connecting with databases – Database operations – Web Frameworks: Web servers – Introduction to web server frameworks – Creating and running a flask application.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Demonstrate the use of control structures
2.	Demonstrate tuple, list and dictionary operations
3.	Demonstrate the use of constructors
4.	Implement different types of inheritance
5.	Demonstrate the usage of exception handling
6.	Explore string manipulation functions
7.	Use file concepts to perform operations
8.	Perform validation of inputs using Regular Expressions
9.	Develop a web application using Flask

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Anurag Gupta, G P Biswas. “Python Programming”, 1st Edition, McGraw Hill Education, 2020 for Units I,II,III,IV.
2.	https://www.javatpoint.com/flask-app-routing for Unit V.

REFERENCES/ MANUAL / SOFTWARE:

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”, 1st Edition, Packt Publisher, 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	use functions and data structures to solve problems	Applying (K3)
CO3	apply the OOP concepts in Python	Applying (K3)
CO4	perform string, file and Regular expression operations	Applying (K3)
CO5	demonstrate the use of database operations	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 a web application using Flask	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	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	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	10	80				100
CAT2	10	10	80				100
CAT3	10	10	80				100
ESE	10	10	80				100

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

22PHL22 - PHYSICS LABORATORY FOR COMPUTER SYSTEMS							
(Common to CSE, CSD, AIDS and AIML branches)							
Programme & Branch	**BE/B.Tech- CSE, CSD, AIDS and AIML branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**BS**	**0**	**0**	**2**	**1**

Preamble	This course aims to impart hands on training in the determination of parameters such as rigidity modulus, AC frequency, velocity of ultrasound, compressibility of a liquid, wavelength of laser, particle size, acceptance angle and numerical aperture of an optical fiber, band gap, Hall coefficient, thickness of a thin film and knowledge on the working of UJT, and also to impart skills on writing coding / developing project / product related to societal requirement.

LIST OF EXPERIMENTS / EXERCISES:

1.	Determination of the rigidity modulus of a metallic wire using torsional pendulum.
2.	Studying the variation of current and voltage in a series LCR circuit / Determination of the frequency of alternating current using electrically vibrating tuning fork (Melde's apparatus).
3.	Determination of the velocity of ultrasonic waves in a liquid and the compressibility of the liquid using ultrasonic interferometer.
4.	(i) Determination of the wavelength of a semiconductor laser. (ii) Determination of the particle size of the given powder using semiconductor laser.
5.	Determination of the acceptance angle and the numerical aperture of the given optical fiber.
6.	Determination of the band gap of a given semiconducting material using post-office box.
7.	Determination of the specific resistance of the material of a given coil of wire using Carey-Foster's bridge.
8.	Observation of the I-V characteristics of a uni junction transistor / Determination of the Hall coefficient of a material using Hall effect arrangement.
9.	Determination of the thickness of a thin film by air-wedge arrangement.
10.	Writing coding for any one of the above experiments / developing a project / a product.

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Physics Laboratory Manual / Record, Department of Physics, 1st Edition, 2020.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	determine the rigidity modulus of a wire using the concept of twisting couple. To study the variation of current in a series LCR circuit or to determine the velocity of ultrasound in a liquid and the frequency of AC using electrically vibrating rod by means of formation of standing waves.	Applying (K3), Precision (S3)
CO2	determine the wavelength of a laser and the particle size of a powder material using the concept of diffraction of light. To compute the acceptance angle and the numerical aperture of an optical fiber using the concepts of total internal reflection and to determine the band gap of semiconductor using the concept of variation of resistance with temperature.	Applying (K3), Precision (S3)
CO3	determine the specific resistivity of a given wire using the principle of Wheatstone bridge. To obtain the I-V characteristics of a UJT using the concept of region with negative resistance or to determine the Hall coefficient of a material by means of Hall effect. To determine the thickness of a thin film using the concept of interference and also to write coding / do project / develop product.	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	3					2	2		2	3	1
CO2	3	2	2	3					2	2		2	3	1
CO3	3	2	2	3					2	2		2	3	1

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

22MEL11 - ENGINEERING PRACTICES LABORATORY							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1/ 2**	**ES**	**0**	**0**	**2**	**1**

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

LIST OF EXPERIMENTS / EXERCISES:

	PART A – MECHANICAL ENGINEERING
1.	Prepare a Square / Rectangular / V-Shape Projection with its Counterpart for Mating and Perform the Drilling, Tapping, and Assembling Tasks from the given Square / Rectangular MS Plates using Modern Power Tools.
2.	Prepare T / L / Lap Joint from given Wooden Work Piece and Make a Box / Tray out of Plywood using Modern Power Tools.
3.	Perform the Thread Formation on a GI/PVC Pipe and Prepare a Water Line from the Overhead Tank that is Leak-Proof.
4.	Make a Butt / Lap / Tee Joint of MS Plate using Arc Welding Process and Welding Simulator.
5.	**Activity:** Prepare an Innovative Model with the Knowledge from Fitting / Carpentry / Plumbing / Welding Involving Modern Power Tools.
	PART B – ELECTRICAL AND ELECTRONICS ENGINEERING
6.	Wiring circuit for fluorescent lamp and Stair case wiring
7.	Wiring Circuit of Incandescent lamp using Impulse Relay
8.	Measurement of Earth Resistance
9.	Soldering of Simple Circuits and trouble shooting
10.	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) Manipulation (S2)
CO2	identify and use appropriate modern power tools and complete the exercises/models accurately	Applying (K3) Manipulation (S2)
CO3	perform house wiring and realize the importance of earthing	Applying (K3), Manipulation (S2)
CO4	soldering with simple electronics circuits	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	1	3	1			3	3		3		
CO2	3		3	1	3				3	3		3		

CO3	3		3	2	1				2	2		3	3	2
CO4	3		2	1	1				2	3		3	3	2
CO5	3		3	2	1				2	2		3	3	2
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

22VEC11 - YOGA AND VALUES FOR HOLISTIC DEVELOPMENT							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All B.E./B.Tech. Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1 / 2**	**HS**	**1**	**0**	**1**	**1**

Preamble	Yoga or yogasanas are considered as art and science of healthy living by our ancient gurus. It is method to bring harmony of body and mind for general wellbeing. Yoga is considered as one of the greatest gifts to the world by Indians for healthy living. Students in particular are benefitted by learning yoga.	
Unit – I	**Introduction:**	**2**
The Origins of Yoga – Definitions - Concepts - Aims and objectives of Yoga – Yoga is a Science and Art – Rules and Regulations of Asanas – Classifications of Yogasanas – Patanjali's Ashtanga Yoga – Pranayama – Mudras & Bandhas - Shatkarma (Cleansing Practice) - Streams of Yoga – Modern Trends in yoga.		
Unit – II	**Yoga and Mind:**	**2**
The Nature of Mind - Five Elements and the Mind - Meditation and the Mind - Functions of the Mind - Role of Yoga in Psychological problems: Mood Disorders, Major Depressive Disorder, Cyclothymic Disorder.		
Unit – III	**Yoga and Values, Diet:**	**2**
Human Values – Social Values – Role of Yoga in Personality Integration - Concepts of Natural Diet - Naturopathy Diet – Eliminative Diet – Soothing Diet – Constructive Diet.		
Unit – IV	**Asanas:**	**2**
Prayer - Starting & Closing - Preparatory practices – Loosening Practices – Meaning, Definitions and Objectives of Asanas - Principles of Practicing Asanas. Asanas: Standing – Sitting – Prone – Supine – Suryanamaskar.		
Unit – V	**Pranayama and Meditation:**	**2**
Breathing Practices for awareness - Definitions and Objectives of Pranayama - Principles of Practicing Pranayama. Pranayama: Nadi Shuddhi - Kapalabathi – Sitali – Sitkari – Bhranari – Ujjayi – Relaxation Techniques – Meditation.		
Lecture: 10, Practical: 10, Total:20		

TEXT BOOK:

1.	Swami satyananda saraswathi, "Asana pranayama mudra bandha", Bihar school of yoga, 4th Edition, 1969.
2.	Swami mukthi Bodhanandha, "Hatha yoga pradipika", Bihar school of yoga, 4th Edition, 1985.

REFERENCES:

1.	B.K.S. Iyenkar, "Yoga the path of holistic health", DK Limited, 2nd Edition, 1969.
2.	Selvarasu, "Kriya cleansing in yoga", Aruvi yoga, 3rd Edition, 2002.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	realize the importance of yoga in physical health.	Applying (K3)
CO2	realize the importance of yoga in mental health.	Applying (K3)
CO3	realize the role of yoga in personality development and diet.	Applying (K3)
CO4	do the loosening practices, Asanas and realize its benefits.	Applying (K3)
CO5	do the practice of Pranayama, meditation and realize its benefits	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						3		2	1			
CO2						3		2				
CO3						3		3				
CO4						3		2	3			
CO5						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	-	-	-	-	-	-	-
CAT2	-	-	-	-	-	-	-
CAT3	20	30	50	-	-	-	100
ESE	-	-	-	-	-	-	-

* ±3% may be varied (CAT3 – 100 marks)

22TAM01 - தமிழர் மரபு							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE / BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1 / 2**	**HS**	**1**	**0**	**0**	**1**

Preamble	தமிழர்களின் மொழி, இலக்கியம், ஓவியங்கள், சிற்பக்கலைகள், நாட்டுப்புறக் கலைகள், வீர விளையாட்டுக்கள், திணைக் கோட்பாடுகள், இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பைப் பற்றிய அறிவை வழங்குவதே இந்த பாடத்தின் நோக்கமாகும்.	
அலகு – I	**மொழி மற்றும் இலக்கியம்**	**3**
இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.		
அலகு – II	**மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை**	**3**
நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.		
அலகு – III	**நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுக்கள்**	**3**
தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.		
அலகு – IV	**தமிழர்களின் திணைக் கோட்பாடுகள்**	**3**
தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு- சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும் கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.		
அலகு – V	**இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு**	**3**
இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறபகுதிகளில் தமிழ் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.		
		Total: 15

TEXT BOOK:

1.	ஆ. பூபாலன், தமிழர் மரபு, VRB Publishers Pvt Ltd, 2022.

REFERENCES:

1.	தமிழக வரலாறு- மக்களும் பண்பாடும்- கே கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2.	கணினித்தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3.	கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்.(தொல்லியல் துறை வெளியீடு)
4.	பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

COURSE OUTCOMES: படிப்பை முடித்தவுடன், மாணவர்கள்		**BT Mapped (Highest Level)**
CO1	தமிழ் மொழி மற்றும் இலக்கியத்தில் மதிப்புமிக்க கருத்துக்களை விளக்க முடியும்.	Understanding (K2)
CO2	தமிழர்களின் சிற்பம் மற்றும் அவர்களின் ஓவியங்கள் பற்றி விளக்க முடியும்.	Understanding (K2)
CO3	தமிழர்களின் நாட்டுப்புற மற்றும் தற்காப்புக் கலைகளைப் பற்றி சுருக்கமாகக் கூற முடியும்.	Understanding (K2)
CO4	தமிழர்களின் திணைக் கோட்பாடுகளைப் பற்றி விளக்க முடியும்.	Understanding (K2)
CO5	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு பற்றி விளக்க முடியும்.	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	2	2		3		
CO2						3		3	2	2		3		
CO3						3		3	2	2		3		
CO4						3		3	2	2		3		
CO5						3		3	2	2		3		

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

ASSESSMENT PATTERN – THEORY

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

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

22TAM01 - HERITAGE OF TAMILS							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE / BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1 / 2**	**HS**	**1**	**0**	**0**	**1**

Preamble	The objective of this course is to impart knowledge about Tamil language, literature, paintings, sculptures, folk arts, heroic games, doctrines, contribution of Tamils to Indian culture.	
UNIT I	**Language and Literature**	**3**
Language families in india - dravidian languages – tamil as a classical language - classical literature in tamil – secular nature of sangam literature – distributive justice in sangam literature - management principles in thirukural - tamil epics and impact of buddhism & jainism in tamil land - bakthi literature azhwars and nayanmars - forms of minor poetry - development of modern literature in tamil - contribution of bharathiyar and bharathidhasan.		
UNIT II	**Heritage - Rock Art Paintings to Modern Art – Sculpture**	**3**
Hero stone to modern sculpture - bronze icons - tribes and their handicrafts - art of temple car making - - massive terracotta sculptures, village deities, thiruvalluvar statue at kanyakumari, making of musical instruments - mridhangam, parai, veenai, yazh and nadhaswaram - role of temples in social and economic life of tamils.		
UNIT III	**Folk and Martial Arts**	**3**
Therukoothu – karagattam - villu pattu - kaniyan koothu – oyillattam - leather puppetry – silambattam – valari - tiger dance - sports and games of tamils.		
UNIT IV	**Thinai Concept of Tamils**	**3**
Flora and fauna of tamils & aham and puram concept from tholkappiyam and sangam literature - aram concept of tamils - education and literacy during sangam age - ancient cities and ports of sangam age - export and import during sangam age - overseas conquest of cholas.		
UNIT V	**Contribution of Tamils to Indian National Movement and Indian Culture**	**3**
Contribution of tamils to indian freedom struggle - the cultural influence of tamils over the other parts of india – self-respect movement - role of siddha medicine in indigenous systems of medicine – inscriptions & manuscripts – print history of tamil books.		
		Total: 15

TEXT BOOK:

1.	S.Muthuramalingam, M.Saravanakumar, Heritage of Tamils, Yes Dee Publishing Pvt Ltd, 2023.

REFERENCES:

1.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukarasu) (Published by : International Institute of Tamil Studies).
2.	The Contribution of Tamil of the Tamils to Indian Culture(Dr.M.Valarmathi)(Puplished by International Institute of Tamil Studies).
3.	Keeladi – 'Sangam City C ivilzation on the banks of river Vaigai; (Jointly Published by: Department of Archaeology & Tamilnadu Text Book and Educational Services Corporation, Tamilnadu).

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped** **(Highest Level)**
CO1	explain valuable concepts in language and literature of tamils.	Understanding (K2)
CO2	illustrate about the tamils sculpture and their paintings.	Understanding (K2)
CO3	summarize about the tamils folk and martial arts.	Understanding (K2)
CO4	explain the thinai concept of tamils.	Understanding (K2)
CO5	explain the contribution of Tamils to the Indian National Movement and Indian culture.	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	2	2		3		
CO2						3		3	2	2		3		
CO3						3		3	2	2		3		
CO4						3		3	2	2		3		
CO5						3		3	2	2		3		

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

ASSESSMENT PATTERN – THEORY

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

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

22TAM02 – தமிழரும் தொழில்நுட்பமும்							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2 / 3**	**HS**	**1**	**0**	**0**	**1**

முன்னுரை	தமிழ் கலாச்சாரத்தோடு ஒன்றிய தொழில் நுட்பங்களை பற்றிப் எடுத்துரைத்தல்	
அலகு – I	**நெசவு மற்றும் பானை தொழில்நுட்பம்**	**3**
சங்க காலத்தில் நெசவு தொழில் – பானைத் தொழில்நுட்பம் கருப்பு சிவப்பு பாண்டங்கள் – பாண்டகளில் கீறல் குறியீடுகள்		
அலகு – II	**வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்**	**3**
சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு – சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச்சிற்பங்களும், கோவில்களும் – சோழர் காலத்து பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் – மாதிரிகட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னை இந்தோ-சாரோசெனிக் கட்டிடக் கலை.		
அலகு – III	**உற்பத்தித் தொழில்நுட்பம்**	**3**
கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச்சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள் – கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.		
அலகு – IV	**வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்**	**3**
அணை, ஏரி, குளங்கள், மதகு – சோழர்கால குமிழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.		
அலகு – V	**அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்**	**3**
அறிவியல் தமிழின் வளர்ச்சி – கணினிதத்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் சொற்குவைத் திட்டம்.		
		Total:15

TEXT BOOK:

1.	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியில் பணிகள் கழகம்), உலகத் தமிழாராய்ச்சி நிறுவனம், சென்னை, 2002
2.	கணினித்தமிழ் முனைவர் இல. சுந்தரம், விகடன் பிரசுரம், 2016

REFERENCES:

1.	கீழடி-வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்.(தொல்லியல் துறை வெளியீடு)
2.	பொருநை-ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

3.	Social Life of Tamils (Dr.K.K.Pillay) A joint Publication of TNTB & ESC and RMRL – (in print)
4.	Social Life of the Tamils – The Classical Period (Dr.S.Sigaravelu) (Published by: International Institute of Tamil Studies).
5.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukarasu) (Published by : International Institute of Tamil Studies)
6.	The Contribution of the Tamil to Indian Culture (Dr.M.Valarmathi) (Puplished by International Institute of Tamil Studies).
7.	Keeladi – 'Sangam City Civilzation on the banks of river Vaigai; (Jointly Published by: Department of Archaeology & Tamilnadu Text Book and Educational Services Corporation, Tamilnadu)
8.	Studies in the History of India with Special Reference to Tamilnadu (Dr.K.K.Pillay) (Published by: The Author)
9.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu)
10.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

COURSE OUTCOMES: படிப்பை முடித்தவுடன், மாணவர்கள்		BT Mapped (Highest Level)
CO1	தமிழ் **கலாச்சாரம்** மற்றும் தமிழ் **சமூகத்தினுடைய நெசவு மற்றும் பானை தொழில்நுட்பம் பற்றி** விளக்க முடியும்.	Understanding (K2)
CO2	தமிழர்களின் **வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்ப ஆற்றல்** பற்றி விளக்க முடியும்.	Understanding (K2)
CO3	தமிழர்களின் **உற்பத்தித் தொழில்நுட்பம்** பற்றி சுருக்கமாகக் கூற முடியும்.	Understanding (K2)
CO4	தமிழர்களின் **வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்** பற்றி விளக்க முடியும்.	Understanding (K2)
CO5	தமிழர்களின் **அறிவியல் தமிழ் மற்றும் கணினித்தமிழ் பற்றி விளக்க முடியும்.**	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	2	2		3		
CO2						3		3	2	2		3		
CO3						3		3	2	2		3		
CO4						3		3	2	2		3		
CO5						3		3	2	2		3		

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

ASSESSMENT PATTERN – THEORY

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

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

22TAM02 - TAMILS AND TECHNOLOGY							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2 / 3**	**HS**	**1**	**0**	**0**	**1**

Preamble	This course aims to impart the essential knowledge on the tamil culture and related technology	
UNIT – I	**WEAVING AND CERAMIC TECHNOLOGY**	**3**
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.		
UNIT – II	**DESIGN AND CONSTRUCTION TECHNOLOGY**	**3**
Designing and Structural construction House & Designs in household materials during Sangam Age – Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other worship places – Temples of Nayaka Period – Type study (Madurai Meenakshi Temple) – Thirumalai Nayakar Mahal – Chetti Nadu Houses, Indo – Saracenic architecture at Madras during British Period.		
UNIT – III	**MANUFACTURING TECHNOLOGY**	**3**
Art of Ship Building – Metallurgical studies – Iron industry – Iron smelting, steel – Copper and gold – Coins as source of history – Minting of Coins – Beads making – industries Stone beads – Glass beads –Terracotta beads –Shell beads/ bone beats – Archeological evidences – Gem stone types described in Silappathikaram.		
UNIT – IV	**AGRICULTURE AND IRRIGATION TECHNOLOGY**	**3**
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry – Wells designed for cattle use – Agriculture and Agro Processing – Knowledge of Sea – Fisheries – Pearl – Conche diving – Ancient Knowledge of Ocean – Knowledge Specific Society.		
UNIT – V	**SCIENTIFIC TAMIL & TAMIL COMPUTING**	**3**
Development of Scientific Tamil – Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.		
		Total:15

TEXT BOOK:

1.	Social Life of Tamils (Dr.K.K.Pillay) A joint Publication of TNTB & ESC and RMRL – (in print)
2.	Social Life of the Tamils – The Classical Period (Dr.S.Sigaravelu) (Published by: International Institute of Tamil Studies).

REFERENCES:

1.	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியில் பணிகள் கழகம்), உலகத் தமிழாராய்ச்சி நிறுவனம், சென்னை, 2002
2.	கணினித்தமிழ் முனைவர் இல. சுந்தரம், விகடன் பிரசுரம், 2016
3.	கீழடி வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்.(தொல்லியல் துறை வெளியீடு)
4.	பொருநை ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு
5.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukarasu) (Published by : International Institute of Tamil Studies)
6.	The Contribution of the Tamils to Indian Culture (Dr.M.Valarmathi)(Puplished by International Institute of Tamil Studies).
7.	Keeladi – 'Sangam City Civilzation on the banks of river Vaigai; (Jointly Published by: Department of Archaeology & Tamilnadu Text Book and Educational Services Corporation, Tamilnadu)
8.	Studies in the History of India with Special Reference to Tamilnadu (dr.K.K.Pillay) (Published by : The Author)
9.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu)

10.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain weaving and ceramic technology in tamil culture and tamil society.	Understanding (K2)
CO2	Illustrate about the design and construction technology.	Understanding (K2)
CO3	summarize about the manufacturing technology.	Understanding (K2)
CO4	explain the agriculture and irrigation technology.	Understanding (K2)
CO5	explain the significance of tamil in scientific and computing.	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	2	2		3		
CO2						3		3	2	2		3		
CO3						3		3	2	2		3		
CO4						3		3	2	2		3		
CO5						3		3	2	2		3		

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

ASSESSMENT PATTERN – THEORY

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

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

22GCL11 – FOUNDATION LABORATORY – MANUFACTURING, DESIGN AND IOT							
(Common to All BE/BTech branches)							
Programme& Branch	**All BE/BTech branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1 / 2**	**ES**	**0**	**0**	**6**	**3**

Preamble	This course is designed to provide foundational knowledge on engineering with hands-on experience on developing a prototype model with the basic knowledge of Computer-aided Design, Manufacturing Processes, 3D Printing Technology, Robotics and Embedded Control.

LIST OF EXPERIMENTS / EXERCISES:

	PART A – Manufacturing (30 Hours)
1.	Selection of product, free hand sketching and detailing
2.	Construction of model using Arc/TIG/MIG/Gas/Spot welding operations
3.	Enhancing the model with sheet metal
4.	Creating the parts of the model using lathe
5.	Creating the parts of the model using milling and drilling machines
	PART B – Product Design and Development (30 Hours)
1.	Free hand sketching and detailing of the component
2.	3D part modelling of the component using CAD software
3.	Engineering Analysis of the component model
4.	Generate the component using 3D printer
5.	Value addition to the produced component using CNC milling machine, CNC laser cutting machine and CNC router
	PART C – Robotics (30 Hours)
1.	Design of electronic circuit and its debugging
2.	Interfacing of sensors, actuators and wireless communion modules with microcontroller
3.	Assembly of Tracker Robot with accessories
4.	Development of control strategies for motion control, path planning and obstacle avoidance
5.	Demonstration and testing of Robot in static environment
	Total:90

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	AutoCAD 2020 and SOLID WORKS 2018 Software

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	develop the prototype model using mechanical operations like welding, forming and machining processes	Applying (K3), Precision (S3)
CO2	sketch 3D model and enhance the prototype using modern machines like 3D printer, CNC milling machine, CNC Laser cutter and CNC Router	Applying (K3), Precision (S3)
CO3	design and develop the autonomous robot for real-time 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	3	3		2				3	2		2		
CO2	3	3	3		3				3	2		2		
CO3	3	3	3		2				3	2		2		

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

22GCL12 – FOUNDATION LABORATORY – ELECTRICAL, IOT AND WEB							
(Common to all BE/BTech branches)							
Programme& Branch	**All BE/BTech branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1 /2**	**ES**	**0**	**0**	**6**	**3**

Preamble	This course is designed to provide a foundational knowledge on engineering with hands-on experience on the house wiring, Internet of Things and Web Technologies.

LIST OF EXPERIMENTS / EXERCISES:

	PART A – Electrical Installation (30 Hours)
1.	Develop wiring diagrams using software tools.
2.	Identify and select suitable components for Energy Measurement and Circuit Protection
3.	Design a wiring circuit integrating Energy Meter, MCB and RCCB
4.	Develop a wiring circuit for incandescent lamp and fluorescent lamp
5.	Develop and Investigate Simple and Staircase Wiring for Residential Applications
6.	Design the Wiring Circuits for Calling Bell System and Dimmable Light
7.	Create wiring circuits for power loads
8.	Measurement of Earth Resistance and its connections.
	PART B – Internet of Things (30 Hours)
1.	Design a Single layer PCB layout designing
2.	Fabricate Single layer PCB printing
3.	Assembling, soldering and desoldering practice on single layer PCB
4.	GPIO programming in ESP8266
5.	Sensor and actuator interfacing with internet enabled microcontroller device
6.	Sensor and actuator calibration
7.	Integration of microcontroller based system with Cloud platform
	PART C – Web Technologies (30 Hours)
1.	Design a website for an application using HTML and CSS.
2.	Convert the designed website into responsive website using Bootstrap.
3.	Add dynamism to the website by using JavaScript and embed the Social Media components to the website.
4.	Incorporate database interaction to the website.
5.	Deploy the developed website in the server.
	Total:90

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual

2.	Eric T.Freeman,Elisabeth Robson, ”Head First JavaScript Programming A Brain-Friendly Guide”, 1st Edition, O’Reilly , 2014.
3.	Eric T.Freeman,Elisabeth Robson, ”Head First HTML and CSS”,2nd Edition, O’Reilly , 2012
4.	Lynn Beighley,”Head First SQL”,1st Editin, O’Reilly,2007.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	design electrical wiring circuits for buildings based on their requirement	Applying(K3), Precision (S3)
CO2	develop IoT based solutions and PCB for real world use cases.	Applying (K3), Precision (S3)
CO3	design and host an interactive dynamic website.	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					
CO2	3	2	2	1					1					
CO3	3	2	2	1					1					

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

22MAT33 - DISCRETE MATHEMATICS AND LINEAR ALGEBRA							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**BTech - Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3/4**	**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 science and 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 – Types of relations and their properties – Equivalence relation – Partial ordered relation – Poset – Hasse diagram – Lattices – Properties of lattices. 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 and Fields (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**
Vector spaces – Subspaces – Linear combinations and Span – Linear independence – Bases and dimension – Row space, Column space and Null Space – Rank and nullity.		
Unit – V	**Inner Product Spaces:**	**9+3**
Inner products – Inner Product Spaces – Angle and Orthogonality in inner product spaces – Orthonormal vectors – Gram Schmidt orthonormalization process – QR 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 for Units I, II, III.
2.	Howard Anton, Chris Rorres, "Elementary Linear Algebra", 11th Edition, John Wiley & Sons, 2015 for Units IV, V.

REFERENCES:

1.	Kenneth H. Rosen, "Discrete Mathematics and its Applications", 8th Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2012.
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	30	60				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)

22ADC31 - DATA PROCESSING AND VISUALIZATION							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PC**	**3**	**0**	**2**	**4**

Preamble	This course provides exposure to foundation of data, data cleaning, data manipulation and visualizing data.	
Unit – I	**Data Foundations and Manipulation:**	**9**
Introduction to Data – Universal data structure – Types of data values – Information vs Pattern - Introduction to Database – Types – Connecting and Pulling. Numpy Core Modules – Pandas Core Modules.		
Unit – II	**Data Cleaning:**	**9**
Levels, Tools and Purpose of data cleaning – Cleaning up the table – Unpacking columns and reformulating table – restructuring – Example.		
Unit – III	**Data Preprocessing:**	**9**
Dealing with missing values, outliers and errors – Data Fusion - Data Integration – Direction of data integration – Challenges – Examples.		
Unit – IV	**Data Reduction, Transformation and Massaging:**	**9**
Data reduction vs data redundancy – Types of data reduction – Dimensionality data reduction. Introduction to data transformation and Massaging – Normalization and Standardization – Binary Coding – Attribute Construction – Feature Extraction – Log Transformation – Smoothing – Aggregation – Binning.		
Unit – V	**Data Visualization:**	**9**
Matplotlib: Drawing main plots – Modifying the visuals –Subplots – Resizing Visuals – Assisting Data preprocessing. Data Visualization: Summarization – Comparison – Relationship between two attributes – Visual Dimensions – Trend Comparison.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Perform operations using Numpy
2.	Perform operations using Pandas
3.	Implement python code to find and impute the missing values and deal with outliers
4.	Implement Data Fusing and Integration
5.	Perform Data Reduction
6.	Perform normalization and standardization operations
7.	Demonstrate Data Transformation and Massaging
8.	Visualize data using Matplotlib

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Roy Jafari, “Hands-On Data Preprocessing in Python: Learn how to effectively prepare data for successful data analytics”, 1st Edition, Packt Publishing Limited, 2022.

REFERENCES/ MANUAL / SOFTWARE:

1.	Matthew O. Ward. , Georges Grinstein and Daniel Keim., “Interactive Data Visualization: Foundations, Techniques and Applications”, 2nd Edition, CRC Press, 2015.
2.	Michael Walker, “Python Data Cleaning Cookbook”, 1st Edition, Packt Publishing Limited, 2020.

3.	Laboratory Manual
4.	Software: Python

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped** **(Highest Level)**
CO1	identify various types of data and perform data processing	Applying (K3) Precision (S3)
CO2	make use of data cleaning approaches to fix erroneous data	Applying (K3) Precision (S3)
CO3	apply preprocessing methods to different types of data	Applying (K3) Precision (S3)
CO4	perform transformation, reduction and Massaging on data	Applying (K3) Precision (S3)
CO5	visualize data in different formats	Applying (K3) Precision (S3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	40	50				100
CAT2	10	40	50				100
CAT3	5	45	50				100
ESE	5	45	50				100

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

22ALT31 - MACHINE LEARNING							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PC**	**3**	**1**	**0**	**4**

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+3**
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.		
Unit – II	**Similarity based Learning and Regression Analysis:**	**9+3**
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+3**
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+3**
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+3**
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.		
Lecture:45, Tutorial:15, Total:60		

TEXT BOOK:

1. S.Sridhar, M.Vijayalakshmi, “Machine Learning”, 1st Edition, Oxford University Press, 2021.

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	extrapolate basic concepts of machine learning data, concept learning and life cycle	Applying (K3)
CO2	apply similarity based learning and regression analysis	Applying (K3)
CO3	examine decision tree learning and rule-based learning concepts	Applying (K3)
CO4	construct bayesian learning, probabilistic and support vector machine models	Applying (K3)
CO5	demonstrate ensemble learning, clustering algorithms and working with machine learning pipeline	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)

22ALT32 - JAVA PROGRAMMING							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**ES**	**3**	**0**	**0**	**3**
Preamble	This course provides a concise introduction to Java programming including inheritance, interfaces, exception handling, threads and database connectivity.						
Unit - I	**Introduction to OOP and Java:**						**9**
Overview of OOP – Object oriented programming paradigms – Features of Object Oriented Programming – Java Buzz words – Evolution of Java – Overview of Java–Data Types, Variables and Arrays – Operators – Control Statements							
Unit - II	**Classes and Objects:**						**9**
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:**						**9**
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:**						**9**
Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in Exceptions – User defined Exception. Multithreaded Programming: Java Thread Model–Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread Communication- Suspending –Resuming, and Stopping Threads –Multithreading - I/O Basics – Reading and Writing Console I/O – Reading and Writing Files.							
Unit - V	**String Handling, Generics, Collections:**						**9**
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.							
							Total :45
TEXT BOOK:							
1.	Herbert Schildt., "Java: The Complete Reference", 11th Edition, McGraw Hill Education, 2019.						
REFERENCE:							
1.	Cay S.Horstmann, "Core Java Fundamentals", Volume 1, 11th Edition, Prentice Hall, 2018.						

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	solve simple problems using classes and objects	Applying (K3)
CO2	employ the features such as inheritance, packages and interfaces in various applications	Applying (K3)
CO3	make use of exception handling mechanisms and multithreaded model to solve real world problems	Applying (K3)
CO4	build Java applications with I/O packages, string classes, and generics concepts	Applying (K3)
CO5	apply the concepts of collection frame works and database connection to access 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	1								3	1
CO2	3	2	2	2	1								3	1
CO3	3	2	2	2	1								3	1
CO4	3	2	2	2	1								3	1
CO5	3	2	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	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)

22ALT33 - DESIGN AND ANALYSIS OF ALGORITHMS							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PC**	**3**	**1**	**0**	**4**

Preamble	This course focuses on various algorithm design techniques and methods for analyzing the performance of algorithms.	
Unit – I	**Introduction:**	**9+3**
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+3**
Brute Force: Selection sort– Sequential search and String Matching – closest pair and convex hull problem – Divide and Conquer: 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+3**
Decrease and Conquer: Insertion sort – Topological Sorting – Fake coin problem – Computing a Median and the Selection Problem – Transform and conquer: Presorting – Balanced search trees – AVL trees – 2 – 3 Trees – Heaps and Heap sort.		
Unit – IV	**Dynamic Programming & Greedy technique:**	**9+3**
Dynamic Programming: Warshall's and Floyd's algorithm – Optimal Binary Search Trees – Knapsack Problem and Memory functions – Greedy Technique: Prim's algorithm – Kruskal's Algorithm – Dijkstra's Algorithm – Huffman Trees.		
Unit – V	**Backtracking & Branch and Bound:**	**9+3**
Backtracking: n-Queens problem – Hamiltonian Circuit Problem – Subset Sum Problem – Branch and Bound: Assignment problem – Knapsack Problem – Traveling Salesman Problem – Overview of P, NP and NP-Complete Problems – Randomized algorithms.		
Lecture:45, Tutorial:15, Total:60		

TEXT BOOK:

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

REFERENCES:

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

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	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)

Mapping 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	1
CO2	3	3	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	10	30	40	20			100
CAT2	10	30	50	10			100
CAT3	10	30	60				100
ESE	5	20	55	20			100

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

22ALL31 - MACHINE LEARNING LABORATORY							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Python Programming**	**3**	**PC**	**0**	**0**	**2**	**1**

Preamble	This course provides hands-on experience in applying machine learning algorithms for real world problems.

LIST OF EXPERIMENTS / EXERCISES:

1.	Create a sample dataset and explore statistical operations using Pandas and visualize the results through plots.
2.	Implement K-Nearest Neighbor Algorithm.
3.	Implement linear regression and multiple linear regression algorithms.
4.	Implement and demonstrate decision tree based ID3 algorithm.
5.	Implement and demonstrate the working of Naive Bayesian classifier.
6.	Implement and compare the working of Random Forest classifier with Adaboost model.
7.	Implement K-Means clustering algorithm.
8.	Develop mini project by collecting the real time dataset, preprocessing the data, applying different machine learning algorithms and evaluate the performance of each algorithm. Prepare the mini project report.

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 explore statistical operations	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

22ALL32 - JAVA PROGRAMMING LABORATORY							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**ES**	**0**	**0**	**2**	**1**

Preamble	This course provides hands-on experience in developing application using java programming language

LIST OF EXPERIMENTS / EXERCISES:

1.	Write simple Java programs using operators, arrays and control statements.
2.	Demonstrate the concepts of inheritance & polymorphism.
3.	Develop an application using interfaces by accessing super class constructors and methods.
4.	Develop an employee payroll application using packages.
5.	Implement exception handling and creation of user defined exception.
6.	Implement program to demonstrate multithreading and inter thread communication.
7.	Write a program to perform file operations.
8.	Develop applications to demonstrate the features of generics classes and interfaces.
9.	Implement the concepts of collection frameworks.
10.	Develop application to demonstrate database connectivity

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	Software : JDK, Eclipse IDE, MySQL

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	design and develop java programs using object oriented programming concepts	Applying (K3), Precision (S3)
CO2	develop simple applications using package, exceptions and multithreading.	Applying (K3), Precision (S3)
CO3	develop a solution for real world problems using i/o operations, 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	2	2	1				1				3	2
CO2	3	2	2	2	1				1				3	2
CO3	3	2	2	2	1				1				3	2

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

22EGL31 - COMMUNICATION SKILLS DEVELOPMENT LABORATORY							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All B.E./B.Tech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**HS**	**0**	**0**	**2**	**1**

Preamble	This course is designed to impart necessary skills to listen, speak, read and write in order to obtain better professional communication skills.

LIST OF EXPERIMENTS / EXERCISES:

1.	Self Introduction & Mock Interview
2.	Job Application letter with Resume
3.	Presentation: A Technical topic / Project report & a Case study
4.	Situational Dialogues / Telephonic Conversations
5.	Group Discussion
6.	Reading Aloud
7.	Listening Comprehension
8.	Writing Company Profiles
9.	Preparing reviews of a book/product/movie
10.	Pronunciation Test

Total: 30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	Orell Digital Language Lab Software

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	enhance effective listening and reading skills	Understanding (K2), Imitation (S1)
CO2	acquire professional skills required for workplace/higher education	Applying (K3), Naturalization (S5)
CO3	use English language skills effectively in various situations	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**
CO1									2	3		3
CO2									2	2		2
CO3									2	2		2

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

22MNT31 - ENVIRONMENTAL SCIENCE							
(Common to All BE/BTech branches)							
Programme & Branch	**All B.E/B.Tech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**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- Values 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, for Unit-I, II, III, IV.						
2.	Rastogi.SC, “Cells and Molecular Biology”, 2nd Edition, reprint, New Age International (P) Limited Publishers, New Delhi, 2008, for Unit-V.						
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.	Mukhtar Ahmad, “Text book of modern biochemistry", Volume I & II, Oxford & IBH Publishing Co. Pvt. LTD, Delhi, 1995.						

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	35	40				100
CAT2	25	35	40				100
CAT3	NA						
ESE	NA						

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

22TAM02 - தமிழரும் தொழில்நுட்பமும்							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**HS**	**1**	**0**	**0**	**1**

முன்னுரை	தமிழ் கலாச்சாரத்தோடு ஒன்றிய தொழில் நுட்பங்களை பற்றிப் எடுத்துரைத்தல்
அலகு – I	**நெசவு மற்றும் பானை தொழில்நுட்பம்** **3**
சங்க காலத்தில் நெசவு தொழில் – பானைத் தொழில்நுட்பம் கருப்பு சிவப்பு பாண்டங்கள் – பாண்டகளில் கீறல் குறியீடுகள்	
அலகு – II	**வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்** **3**
சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு – சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச்சிற்பங்களும், கோவில்களும் – சோழர் காலத்து பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் –மாதிரிகட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னை இந்தோ-சாரோசெனிக் கட்டிடக் கலை.	
அலகு – III	**உற்பத்தித் தொழில்நுட்பம்** **3**
கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச்சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள் – கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.	
அலகு – IV	**வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்** **3**
அணை, ஏரி, குளங்கள், மதகு – சோழர்கால குமிழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.	
அலகு – V	**அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்** **3**
அறிவியல் தமிழின் வளர்ச்சி – கணினிதத்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் சொற்குவைத் திட்டம்.	
	Total:15

TEXT BOOK:

1.	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியில் பணிகள் கழகம்), உலகத் தமிழாராய்ச்சி நிறுவனம், சென்னை, 2002
2.	கணினித்தமிழ் முனைவர் இல. சுந்தரம், விகடன் பிரசுரம், 2016

REFERENCES:

1.	கீழடி-வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்.(தொல்லியல் துறை வெளியீடு)
2.	பொருநை-ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
3.	Social Life of Tamils (Dr.K.K.Pillay) A joint Publication of TNTB & ESC and RMRL – (in print)
4.	Social Life of the Tamils – The Classical Period (Dr.S.Sigaravelu) (Published by: International Institute of Tamil Studies).
5.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukarasu) (Published by : International Institute of Tamil Studies)

6.	The Contribution of the Tamil to Indian Culture (Dr.M.Valarmathi) (Puplished by International Institute of Tamil Studies).
7.	Keeladi – 'Sangam City Civilzation on the banks of river Vaigai; (Jointly Published by: Department of Archaeology & Tamilnadu Text Book and Educational Services Corporation, Tamilnadu)
8.	Studies in the History of India with Special Reference to Tamilnadu (Dr.K.K.Pillay) (Published by: The Author)
9.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu)
10.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

COURSE OUTCOMES: படிப்பை முடித்தவுடன், மாணவர்கள்		BT Mapped (Highest Level)
CO1	தமிழ் கலாச்சாரம் மற்றும் தமிழ் சமூகத்தினுடைய நெசவு மற்றும் பானை தொழில்நுட்பம் பற்றி விளக்க முடியும்.	Understanding (K2)
CO2	தமிழர்களின் வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்ப ஆற்றல் பற்றி விளக்க முடியும்.	Understanding (K2)
CO3	தமிழர்களின் உற்பத்தித் தொழில்நுட்பம் பற்றி சுருக்கமாகக் கூற முடியும்.	Understanding (K2)
CO4	தமிழர்களின் வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் பற்றி விளக்க முடியும்.	Understanding (K2)
CO5	தமிழர்களின் அறிவியல் தமிழ் மற்றும் கணினித்தமிழ் பற்றி விளக்க முடியும்.	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	2	2		3		
CO2						3		3	2	2		3		
CO3						3		3	2	2		3		
CO4						3		3	2	2		3		
CO5						3		3	2	2		3		

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

ASSESSMENT PATTERN – THEORY

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

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

22TAM02 - TAMILS AND TECHNOLOGY							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**HS**	**1**	**0**	**0**	**1**

Preamble	This course aims to impart the essential knowledge on the tamil culture and related technology	
UNIT – I	**WEAVING AND CERAMIC TECHNOLOGY**	**3**
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.		
UNIT – II	**DESIGN AND CONSTRUCTION TECHNOLOGY**	**3**
Designing and Structural construction House & Designs in household materials during Sangam Age – Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other worship places – Temples of Nayaka Period – Type study (Madurai Meenakshi Temple) – Thirumalai Nayakar Mahal – Chetti Nadu Houses, Indo – Saracenic architecture at Madras during British Period.		
UNIT – III	**MANUFACTURING TECHNOLOGY**	**3**
Art of Ship Building – Metallurgical studies – Iron industry – Iron smelting, steel – Copper and gold – Coins as source of history – Minting of Coins – Beads making – industries Stone beads – Glass beads –Terracotta beads –Shell beads/ bone beats – Archeological evidences – Gem stone types described in Silappathikaram.		
UNIT – IV	**AGRICULTURE AND IRRIGATION TECHNOLOGY**	**3**
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry – Wells designed for cattle use – Agriculture and Agro Processing – Knowledge of Sea – Fisheries – Pearl – Conche diving – Ancient Knowledge of Ocean – Knowledge Specific Society.		
UNIT – V	**SCIENTIFIC TAMIL & TAMIL COMPUTING**	**3**
Development of Scientific Tamil – Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.		
		Total:15

TEXT BOOK:

1.	Social Life of Tamils (Dr.K.K.Pillay) A joint Publication of TNTB & ESC and RMRL – (in print)
2.	Social Life of the Tamils – The Classical Period (Dr.S.Sigaravelu) (Published by: International Institute of Tamil Studies).

REFERENCES:

1.	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியில் பணிகள் கழகம்), உலகத் தமிழாராய்ச்சி நிறுவனம், சென்னை, 2002
2.	கணினித்தமிழ் முனைவர் இல. சுந்தரம், விகடன் பிரசுரம், 2016
3.	கீழடி வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்.(தொல்லியல் துறை வெளியீடு)
4.	பொருநை ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு
5.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukarasu) (Published by : International Institute of Tamil Studies)
6.	The Contribution of the Tamils to Indian Culture (Dr.M.Valarmathi)(Puplished by International Institute of Tamil Studies).
7.	Keeladi – 'Sangam City Civilzation on the banks of river Vaigai; (Jointly Published by: Department of Archaeology & Tamilnadu Text Book and Educational Services Corporation, Tamilnadu)
8.	Studies in the History of India with Special Reference to Tamilnadu (dr.K.K.Pillay) (Published by : The Author)
9.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu)
10.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain weaving and ceramic technology in tamil culture and tamil society.	Understanding (K2)
CO2	Illustrate about the design and construction technology.	Understanding (K2)
CO3	summarize about the manufacturing technology.	Understanding (K2)
CO4	explain the agriculture and irrigation technology.	Understanding (K2)
CO5	explain the significance of tamil in scientific and computing.	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	2	2		3		
CO2						3		3	2	2		3		
CO3						3		3	2	2		3		
CO4						3		3	2	2		3		
CO5						3		3	2	2		3		

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

ASSESSMENT PATTERN – THEORY

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

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

22ALT41 - DATABASE MANAGEMENT SYSTEMS							
(Common to Artificial Intelligence and Machine Learning & Artificial Intelligence and Data Science 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**	**4**	**PC**	**3**	**1**	**0**	**4**

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+3**
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.		
Unit – II	**SQL and Database Design:**	**9+3**
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+3**
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+3**
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+3**
Transaction concept – Transaction model –Storage structure – Transaction atomicity and durability – Isolation – Serializability– Concurrency control: Lock-based Protocols – Deadlock Handling.		
Lecture:45, Tutorial:15, Total:60		

TEXT BOOK:

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

REFERENCES/ MANUAL / SOFTWARE:

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	2	2							1	3	1
CO2	3	2	2	2	2							1	3	1
CO3	3	2	2	2	2							1	3	1
CO4	3	2	2	2	2							1	3	1
CO5	3	2	2	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	35	50				100
CAT2	10	30	60				100
CAT3	10	35	55				100
ESE	5	35	60				100

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

22ALT42 - COMPUTER ORGANIZATION							
(Common to Artificial Intelligence and Machine Learning & Artificial Intelligence and Data Science 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**	**4**	**ES**	**3**	**0**	**0**	**3**

Preamble	This course provides knowledge on basics of computer organization, introduces various arithmetic operationsand 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		
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.
3.	M. Morris Mano,” Computer System Architecture”, 3rd Edition, Pearson Education, New Delhi, 2012.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped** **(Highest Level)**
CO1	make use of the basic structure, arithmetic and memory operations of a digital computer and addressing modes.	Applying (K3)
CO2	select the appropriate algorithms for performing different arithmetic operations.	Applying (K3)
CO3	make use of the data path to process the given instruction and apply the concepts of pipelining to handle the hazards.	Applying (K3)
CO4	utilize the concept of memory to distinguish between main memory and cache memory	Applying (K3)
CO5	demonstrate about I/O operations and interrupts.	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										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	60	30				100
ESE	10	50	40				100

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

22ALT43 - OPERATING SYSTEMS							
(Common to Artificial Intelligence and Machine Learning & Artificial Intelligence and Data Science 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**	**4**	**PC**	**3**	**1**	**0**	**4**

Preamble	This course provides basic operating system abstractions, system call interface, process, threads, and inter-process communication. Various management functions of an operating system will also be explored.	
Unit – I	**Operating Systems Overview:**	**9+3**
Introduction – Computer System Organization – Computer System Architecture – Operations – Resource Management – Security and Protection – Virtualization – Computing Environments. Operating Systems Structures: Services – User and OS Interface – System Calls.		
Unit – II	**Process Management:**	**9+3**
Process Concept – Process Scheduling – Operations on Processes – Interprocess Communication – IPC in Shared Memory and Message Passing Systems. CPU Scheduling: Scheduling Criteria – Scheduling Algorithms. Multithreaded Programming: Threads Overview – Multicore Programming – Multithreading Models.		
Unit – III	**Process Synchronization:**	**9+3**
The Critical Section Problem - Peterson's solution – Hardware support for Synchronization – Mutex Locks – Semaphores – Monitors. Deadlocks: Deadlock Characterization – Methods for handling deadlocks - Deadlock Prevention and Avoidance – Deadlock Detection – Recovery from Deadlock.		
Unit – IV	**Memory Management:**	**9+3**
Main Memory: Background – Contiguous Memory Allocation – Segmentation – Paging – Swapping. Virtual Memory: Background – Demand Paging – Page Replacement.		
Unit – V	**Storage Management:**	**9+3**
Mass Storage Structure: Overview – HDD Scheduling. File System: File Concept – Access Methods – Directory Structure – Protection. File System Implementation: File System Structure – File System Operations – Directory Implementation – Allocation Methods - Free Space Management.		
Lecture:45, Tutorial:15, Total:60		

TEXT BOOK:

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

REFERENCES:

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

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain operating system structure, services, and system calls and identify appropriate system calls for a given service	Understanding (K2)
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	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	15	65	20				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)

22ALC41 - DEEP LEARNING							
(Common to Artificial Intelligence and Machine Learning & Artificial Intelligence and Data Science 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**	**4**	**PC**	**3**	**0**	**2**	**4**

Preamble	This course is designed to impart the skills required to build different deep neural network architectures.	
Unit – I	**Neural Networks:**	**9**
Introduction on Neural Networks – Types of Machine Learning : classification Problem - The regression Problem - Over fitting and under fitting – Bias and Variance – Overview of Artificial Neural Networks : Biological Neuron – Types of Artificial Neural Network- Optimization techniques – Vanishing Gradient Problem – Exploding gradient Problem – Weight Initialization –Introduction to Deep Learning		
Unit – II	**Autoencoder:**	**9**
Introduction to Autoencoder – Features of Autoencoder - Tpes of Auto Encoder: Vanilla Autoencoder – Multilayer Autoencoder – Stacked Autoencoder – Deep Autoencoder –DenoisingAutoencoder - Convolutional Autoencoder – Regularization in Autoencoder		
Unit – III	**Boltzmann Machines:**	**9**
Boltzmann Machine: Relation to Hopfield Networks. RBM Architecture : Energy Based Model – Gibbs Distribution – Gibbs Sampler – Contrastive Divergence – Example – Types of RBM		
Unit – IV	**Convolution Neural Networks:**	**9**
Convolutional Network – Components of CNN Architecture - Rectified Linear Unit(ReLU)Layer- Exponential Linear Unit (ELU or SELU) - Unique Propertied of CNN - Architectures of CNN – Application of CNN –Image Classification using CNN - Visual Speech Recognition using 3D-CNN		
Unit – V	**Recurrent Neural Networks:**	**9**
RNN versus CNN – Feedforward Neural Network versus RNN. - Simple Recurrent Neural Network : training an RNN – Backpropagation Through time (BPTT) – RNN Topology – Challenges with Vanishing Gradients – Bidirectional and Stateful RNNs – Long Short term memory(LSTM) – LSTM Implementation – Gated Recurrent Unit (GRU) – Deep Recurrent Neural Network.-Stock Market Prediction Using RNN – Next Word Prediction Using RNN-LSTM.- Tamil Handwrittern Character Optical Recognition Using CRNN		

LIST OF EXPERIMENTS / EXERCISES:	
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

Lecture:45, Practical:30, Total:75

TEXT BOOK:	
1.	Lovelyn, S., Rose, L. Ashok kumar, D. KarthikaRenuka, Deep Learning using Python, Wiley India Pvt. Ltd., First Edition, 2019.

REFERENCES/MANUAL/SOFTWARE:	
1.	Aggarwal, Charu C,"Neural Networks and Deep learning",1st Edition, Springer Cham,2018.
2.	Ian Goodfellow, Yoshua Bengio,and Aaron Courvill,"Deep Learning",1st Edition, MITPress,USA,2016.
3.	Josh Patterson and Adam Gibson,"Deep Learning–A Practitioner"s Approach",1stEdition,O"ReillySeries,August2017.
4..	Operating System : Windows / Linux
5.	Software : Python

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) Precision (S3)
CO2	solve simple real world problems using autoencoders	Applying (K3) Precision (S3)
CO3	demonstrate the concepts Boltzmann machines to solve real world problems	Applying (K3) Precision (S3)
CO4	exemplify the concepts of CNN models and apply it for solving computer vision related problems	Applying (K3) Precision (S3)
CO5	explicate the concepts of RNN models and apply it for solving Natural Language problems	Applying (K3) Precision (S3)

Mapping of COs with POs and PSOs

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

22ADC41 - WEB TECHNOLOGY							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	**PC**	**3**	**0**	**2**	**4**

Preamble	This course provides an introduction to Client-Side JS and Server Side JS Frameworks. The course also addresses the web application development using React JS	
Unit – I	**JavaScript:**	**9**
Introduction – Operators – Control Structures – Repetition – break and continue. Functions: Function Definition – Scope Rules – Recursion. Array: Basics – Growing Arrays – Passing Arrays to Function –map-filter - reducer- Event Handling – DOM – Local Storage.		
Unit – II	**Advanced JavaScript:**	**9**
Error handling – try -catch –finally -Callback – Callback hell – promises – await and async – Deconstructing objects- OOPS- this keyword – closures- Lexical scope - API Integration with AXIOS.		
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 – Express: Routing – Middleware – Error Handling. MongoDB: Basics- Connect to NoSQL Database using Node JS – Implementation of CRUD operations.		
Unit – IV	**ReactJS – Features:**	**9**
React: Introduction – Installation – createReact app - components –– importing and exporting components - props - props validation – conditional rendering - managing state - component Life cycle -– Events - React Router -– map -List – keys.		
Unit – V	**ReactJS - Hooks:**	**9**
Introduction to hooks - Rules of hook - Building hooks- useState – useEffect – useReducer – userefs - usecontext -– Forms – controlled and uncontrolled component - Hooks API integration.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Perform form validation using JavaScript.
2.	Integrate API in a webpage using JavaScript.
3.	Design a web application using HTTP Request and HTTP Response.
4.	Develop an application using GET and POST method in NodeJS.
5.	Implement CRUD operations using MongoDB and NodeJS.
6.	Design a web application using components, modules and router in React.
7.	Mini Project: Design and develop web application using client-side framework react and host it free hosting service.

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Paul Deitel, Harvey M.Deitel and Abbey Deitel, “Internet and World Wide Web - How To Program”, 5th Edition, Prentice Hall, 2011 for Unit I.
2.	https://developer.mozilla.org/en-US/docs/Web/JavaScript for Unit II.
3.	Infosys campus connect material shared by infy for Unit III.
4.	https://react.dev/learn for Units IV and V.

REFERENCE/ MANUAL /SOFTWARE:

1.	Wieruch, Robin, “The Road to Learn React: Your Journey to Master Plain Yet Pragmatic React. Js.”, 1st Edition, Germany, Lean Publishing, 2017.
2.	Operating System : Windows/Linux
3.	Software : MongoDB, NodeJS, Express and React
4.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	develop an interactive and dynamic web pages using JavaScript.	Applying (K3) Precision (S3)
CO2	apply JavaScript features and integrate API in a website.	Applying (K3) Precision (S3)
CO3	create a web application using NodeJS with database connectivity.	Applying (K3) Precision (S3)
CO4	Make use of react features to create components, modules and state management.	Applying (K3) Precision (S3)
CO5	Build a web application for real world problems using React Library.	Applying (K3) Precision (S3)

Mapping of COs with POs and PSOs

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

22ALL41 – DATABASE MANAGEMENT SYSTEMS LABORATORY							
(Common to Artificial Intelligence and Machine Learning & Artificial Intelligence and Data Science 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**	**4**	**PC**	**0**	**0**	**2**	**1**

Preamble	This course provides hands-on experience in applying machine learning algorithms for real world problems.

LIST OF EXPERIMENTS / EXERCISES:

1.	Demonstrate Data Definition Language and integrity constraints.
2.	Demonstrate Data Manipulation Language commands.
3.	Demonstrate Data Control Language and Transaction Control Language commands.
4.	Execute nested and sub queries in SQL.
5.	Demonstrate Join operations in SQL.
6.	Create Views and index and perform SQL operations in it.
7.	Implement Cursors and its types
8.	Implement Triggers and its operations.
9.	Demonstrate the concept of looping using PL/SQL statements.
10.	Develop Procedures and Functions to perform operations in SQL.

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 SQL commands to create and manipulate databases	Applying (K3) Precision (S3)
CO2	execute queries using concepts of PL/SQL	Applying (K3) Precision (S3)
CO3	execute queries using the concepts of triggers and cursors in PL/SQL	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

22GCL41 - PROFESSIONAL SKILLS TRAINING - I							
(Common to All BE/ BTech Engineering and Technology branches)							
Programme & Branch	**All BE/ BTech Engineering and Technology 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 and 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 -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:45

TEXT BOOK:

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

REFERENCES:

1.	Stephen Bailey, “Academic Writing: A practical guide for students”, Routledge, New York, 2011.
2.	Meenakshi Raman and Sangeeta Sharma. “Technical Communication- Principles and Practice”. 4th Edition, Oxford University Press, New Delhi, 2022.

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 individualand 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						100

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

22ADT51 - BIG DATA ANALYTICS							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PC**	**3**	**0**	**0**	**3**

Preamble	This course focuses on real-world practical aspects of big data using spark and build scalable application using machine learning model	
Unit – I	**Bigdata, Apache Hadoop and Spark:**	**9**
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**
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 DataFrame Functions – PySpark Datasources		
Unit – III	**Pyspark SQL:**	**9**
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**
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 MLlib:**	9
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		
		Total:45

TEXT BOOK:

1.	Anil Maheshwari, “Big Data”. 1st Edition, McGraw Hill Education, 2017 for Unit 1.
2.	https://sparkbyexamples.com/pyspark-tutorial/ https://www.tutorialspoint.com/apache_kafka/apache_kafka_quick_guide.htm https://sparkbyexamples.com/pyspark/pyspark-sql-with-examples/ for Units 2,3,4 and 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.	Ankam, V, “Big data analytics”. 1st Edition, Packt Publishing Ltd, 2016.
4.	https://www.projectpro.io/hadoop-tutorial/pyspark-machine-learning-tutorial

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	demonstrate real time stream 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)

22ALC51 - NATURAL LANGUAGE PROCESSING							
Programme & Branch	**B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PC**	**3**	**0**	**2**	**4**

Preamble	This course focuses on natural language text processing, text classification, text summarization and clustering.	
Unit – I	**Introduction to NLP:**	**9**
Introduction – 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	**Text processing:**	**9**
Processing and Understanding Text – 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 – Key Phrase Extraction – Topic Modeling – Automated Document Summarization – Text Similarity and Clustering – Analyzing Term Similarity – Analyzing Document Similarity		
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		

LIST OF EXPERIMENTS / EXERCISES:

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.	Perform text summarization for sample dataset
7.	Work with topic modelling
8.	Analyze text similarity using various measures

Lecture:45, Practical:30, Total:75

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/ MANUAL / SOFTWARE:

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.
3.	Python
4.	Laboratory Manual

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) Precision (S3)
CO2	apply various text processing techniques	Applying (K3) Precision (S3)
CO3	build text classification model	Applying (K3) Precision (S3)
CO4	perform automatic text summarization	Applying (K3) Precision (S3)
CO5	perform text similarity and clustering	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										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	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)

22ALC52- COMPUTER VISION							
Programme & Branch	**B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PC**	**3**	**0**	**2**	**4**

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 – Image Classification: Training the MINIST Model in Tensorflow and Keras – Deep Learning Models: AlexNet – VGG 16 – Google Inception V3 – ResNet 50 – SqueezeNet - Spatial Transformer – DenseNet – Implementation of Image Classification Applications.		
Unit – II	**Object Detection & Segmentation**	**9**
Object Detection : Detecting Objects in an Image – ImageNet- Localizing Algorithms – Detecting Objects – Object Detection API – YOLO Object Detection Semantic Segmentation: Predicting Pixels – Algorithms for Semantic Segmentation – Satellite Image Segmentation – Segmenting Instances		
Unit – III	**Similarity Learning and Image Captioning:**	**9**
Similarity Learning: Siamese Networks- FaceNet – DeepNet – DeepRank – Visual Recommendation Systems – Face Detection – Face Landmarks and Attributes – Face Recognition – Face Clustering. Image Captioning: NLP for Image Captioning- Approaches for Image Captioning – Implementing attention-based Image Captioning.		
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		

List of Exercises / Experiments:

1	Build a CNN model to perform Image Classification
2	Experiment the model performance using the available CNN models.
3	Build R-CNN, Faster R-CNN models to perform object detection
4	Apply YOLO object Detection Algorithm for a real world problem
5	Build a Face Recognition Application
6	Build an Image Captioning Application for a given image.
7	Experiment image to image translation using GAN
8	Perform video classification using deep learning techniques.

Lecture: 45, Practical: 30, Total: 75

TEXT BOOK:

1.	Rajalingappaa Shanmugamani, “Deep Learning for Computer Vision”, Packt Publishing, UK, 2018

REFERENCES/MANUAL/SOFTWARE:

1.	D. L. Baggio et al., “Mastering OpenCV with Practical Computer Vision Projects”, Packt Publishing, UK, 2012
2.	Jan Erik Solem, “Programming Computer Vision with Python: Tools and algorithms for analyzing images”, O'Reilly Media, USA, 2012.
3.	Mohit Sewak, Md. Rezaul Karim and Pradeep Pujari, “Practical Convolutional Neural Networks, Packt Publishing, India, 2018
4	Windows/Linux
5	Tensorflow/OpenCV
6.	Matlab/Python
7	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply the various deep learning models to perform image classification	Applying (K3) Precision (S3)
CO2	use various image segmentation and object detection algorithms to perform image analytics	Applying (K3) Precision (S3)
CO3	apply the various similarity learning models for face detection and other related problems and perform image captioning task	Applying (K3) Precision (S3)
CO4	make use of the GAN model to solve the real world problems.	Applying (K3) Precision (S3)
CO5	predict reliable video analytic solutions for real time problems.	Applying (K3) Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	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	5	45	50				100

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

22ADL51 - BIG DATA ANALYTICS LABORATORY							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. 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 EXPERIMENTS / EXERCISES:	
1.	Perform transformations and actions in RDD using PySpark
2.	Perform data processing from different data sources
3.	Perform data analysis using dataframes in PySpark
4.	Find the minimum temperature in a city using PySpark
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 algorithms using PySparkMLib
	Total:30

REFERENCES/ MANUAL /SOFTWARE:	
1.	Hadoop, Spark, PySpark, Kafka, PySparkSQL, Mlib
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

22GCL51 - PROFESSIONAL SKILLS TRAINING - II							
(Common to All BE/ BTech Engineering and Technology branches)							
Programme & Branch	**All BE/ BTech Engineering and Technology 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 and 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:45

TEXT BOOK:

1.	Edgar Thorpe and Showick 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, New Delhi, 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 individualand 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		2	0	0	0	3	3	0	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	20	40	40				100
CAT2		50	50				100
CAT3		50	50				100
ESE	NA						

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

22ADT52- COMPUTER NETWORKS							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PC**	**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	understand 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)

22ALT61 – TRANSFER LEARNING							
(Common to Artificial Intelligence and Machine Learning & Artificial Intelligence and Data Science branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Machine Learning & B.Tech. Artificial Intelligence and Data Science**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Machine Learning and Deep Learning**	**6**	**PC**	**3**	**0**	**0**	**3**
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 pre-trained 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 – Post-processing – Training and results – Challenges.							
							Total:45

TEXT BOOK:

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

REFERENCES:

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.

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)

Mapping 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	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)

22ADT61- DATA MODELING AND BUSINESS INTELLIGENCE							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Machine Learning and Deep Learning**	**6**	**PC**	**3**	**0**	**0**	**3**

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		
		Total:45

TEXT BOOK:

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

REFERENCES:

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

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)

Mapping 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	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)

22ALL61 – TRANSFER LEARNING LABORATORY							
(Common to Artificial Intelligence and Machine Learning & Artificial Intelligence and Data Science 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**	**6**	**PC**	**0**	**0**	**2**	**1**

Preamble	This course focuses on applying transfer learning techniques to real time applications.

LIST OF EXPERIMENTS / EXERCISES:

1.	Build CNN model for sample dataset
2.	Implement transfer learning with pre-trained CNN model
3.	Implement transfer learning for image 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.	Build multiclass classification with CNN model
9.	Perform audio event classification with transfer learning
10.	Build a coloring deep neural network

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Python, Keras Framework
2.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply transfer learning for image dataset	Applying (K3) Precision (S3)
CO2	apply transfer learning for text data and document summaries	Applying (K3) Precision (S3)
CO3	apply transfer learning for audio data and to perform image colorization	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

22ADL61- DATA MODELING AND BUSINESS INTELLIGENCE LABORATORY							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. 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 loading, transforming and handling of data. Also it provides Knowledge about analyzing, reporting results for better decision making.

LIST OF EXPERIMENTS / EXERCISES:	
1.	Installation and Configuration of tableau.
2.	Collecting, Cleaning and Connecting to data.
3.	Perform ETL process for the given data source.
4.	Create charts like bubble, bar, map using 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 Tableau.
8.	Collect appropriate data, Perform ETL process and develop Dashboard for Health Care using Tableau.
9.	Managing live data for scorecard using tableau.
10.	Application project on design and implementation of a dashboard.
	Total:30

REFERENCES/ MANUAL /SOFTWARE:	
1.	Operating System : Windows / Linux
2.	Software : Tableau
3.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	experiment various data preprocessing operations	Applying (K3) Precision (S3)
CO2	use ETL Tools for preprocessing the data	Applying (K3) Precision (S3)
CO3	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	PO7	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	2	3	3				2	2		2	3	1

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

22ALP61 - PROJECT WORK I							
Programme & Branch	**B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**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 synthesize 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

22GET31- UNIVERSAL HUMAN VALUES							
(Common to All Engineering and Technology Branches)							
Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**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 Being 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:30

TEXT BOOK:

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

REFERENCES:

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

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	restate the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society	Applying (K3)
CO2	distinguish between the Self and the Body, understand the meaning of Harmony in the Self, the Co–existence of Self and Body	Applying (K3)
CO3	infer the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human–human relationships and explore their role in ensuring a harmonious society	Applying (K3)
CO4	transform themselves to co-exist with nature by realising interconnectedness and four order of nature	Applying (K3)
CO5	distinguish between ethical and unethical practices, and extend ethical and moral practices for a better living	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1										
CO2	3	2	1	1										
CO3	3	2	1	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	25	75					100
CAT2	25	75					100
ESE	NA						100

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

22GEP61 - 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**	**-**	**-**	**-**	**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

22ALP62 - PROJECT WORK I							
Programme & Branch	**B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**EC**	**0**	**0**	**10**	**4**
							Total:150

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 synthesize 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

22GCT71 - ENGINEERING ECONOMICS AND MANAGEMENT							
(Common to All BE/BTech branches)							
Programme & Branch	**All BE/BTech branches**	**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		
CO2		1	2			2	2	2	2	2	3	2		
CO3	1	2	1			2		2	2	2	3	2		
CO4	1	2	1			2		2	2	2	3	2		
CO5	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	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)

22ALP71- PROJECT WORK II PHASE I							
Programme & Branch	**B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**EC**	**0**	**0**	**10**	**5**
							Total:150

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 synthesize 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

22ALP72- PROJECT WORK II PHASE I							
Programme & Branch	**B.Tech. 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 synthesize 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

22ADT71 - AGILE METHODOLOGIES							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PC**	**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 %**
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)							

22ALP81- PROJECT WORK II PHASE II							
Programme & Branch	**B.Tech. 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 synthesize 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

22ALP82- PROJECT WORK II PHASE II							
Programme & Branch	**B.Tech. 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 synthesize 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

22ALE01- THEORY OF COMPUTATION							
Programme & Branch	**B.Tech. 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", 3rdEdition, Pearson Education, New Delhi, 2008.

REFERENCES:

1.	Martin J., "Introduction to Languages and the Theory of Computation", 4thEdition, Tata McGraw-Hill, NewDelhi, 2010.
2.	Linz P., "Introduction to Formal Language and Computation", 4thEdition, 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)

22ADE01 - DESIGN THINKING							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PE**	**3**	**0**	**0**	**3**
Preamble	Design Thinking is human-centered problem solving tool which emphasize on empathy, collaboration, co-creation and stakeholder feedback to unlock creativity and innovation, to devises feasible and viable idea/solutions.						
Unit – I	**Design Thinking and Explore:**						**9**
Design Thinking: Key Principles and Mindset – Five Phases, Methods and Tools of Design Thinking – User Guide – Foundation Building for Design Thinking – **Explore:** Methods & Tools – STEEPAnalysis – Strategic Priorities – Activity System – Stakeholder Mapping – Opportunity Framing.							
Unit – II	**Empathize:**						**9**
Empathize: Methods & Tools – Field Observation – Deep User Interview – Empathy Map – User Journey Map - Need Finding – User Insights - User Persona Development.							
Unit – III	**Experiment:**						**9**
Experiment: Methods & Tools – Ideation – SCAMPER – Analogous Inspiration – Deconstruct & Reconstruct – User Experience Journey – Prototyping– Idea Refinement.							
Unit – IV	**Engage:**						**9**
Engage: Methods & Tools – Story Telling – Art of Story Telling – Storyboarding – Co-Creation with Users – Collect Feedback from Users.							
Unit – V	**Evolve:**						**9**
Evolve: Methods & Tools – Concept Synthesis – Strategic Requirements –EvolvedActivity Systems – Activity System Integration – Viability Analysis – Innovation Tools using User Needs, CAP, 4S – Change Management - Quick Wins.							
							Total:45

TEXT BOOK:

1.	Lee Chong Hwa, "Design Thinking The Guidebook", Design Thinking Master Trainers of Bhutan, 2017. (E-Book)

REFERENCES:

1.	Jeanne Liedtka and Tim Ogilvie, "Designing for Growth: A Design Thinking Tool Kit for Managers", Columbia University Press, 2011.
2.	Jeanne Liedtka, Tim Ogilvie, and Rachel Brozenske, "The Designing for Growth 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	construct design challenge and reframe the design challenge into design opportunity.	Applying (K3)
CO2	interview the user, and know the feelings of users to foster deep user understanding and be able to uncover the deep user insights and needs	Applying (K3)
CO3	develop ideas and prototypes by brain storming using the ideation tools.	Applying (K3)
CO4	organize the user walkthrough experience using ideal user experience journey.	Applying (K3)
CO5	develop smart strategies & implementation plan that will deliver/achieve the idea/solution deduced from earlier phases.	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

22ALE02 – MULTICORE ARCHITECTURE							
Programme & Branch	**B.Tech. 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.

REFERENCES:

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%maybe varied (CAT 1,2,3–50marks & ESE–100marks)

22ADE02 - SOFT COMPUTING TECHNIQUES							
(**Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)**							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. 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-Neural 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-Back propagation 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 state replacement.		
		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)

22ADF01 - DATA ANALYSIS							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**PE**	**2**	**0**	**2**	**3**

Preamble	This course provides a concise introduction to the fundamental concepts of data analysis using Power BI	
Unit - I	**Foundations of Power BI**	**6**
Introducing Power BI - Importing Data into Power BI Desktop - Data Munging with Power Query		
Unit - II	**Data Model and DAX**	**6**
Creating the Data Model - Creating Calculations with DAX - Creating Measures with DAX		
Unit - III	**Time Intelligence and Reports**	**6**
Incorporating Time Intelligence - Creating Reports with Power BI Desktop - Publishing Reports and Creating Dashboards in the Power BI Portal		
Unit - IV	**Power Pivot, Pivot Tables and Charts**	**6**
Introducing Power Pivot in Excel - Data Analysis with Pivot Tables and Charts - Creating a Complete Solution		
Unit - V	**Advanced Topics**	**6**
Advanced Topics in Power Query - Advanced Topics in Power BI Desktop - Advanced Topics in Power BI Data Modeling - Integrating Power BI with Other Applications		

LIST OF EXPERIMENTS / EXERCISES:

1.	Import data into power BI desktop and perform basic operations
2.	Develop data model for the given problem
3.	Create Calculations and measures with DAX
4.	Create and publish Power BI reports
5.	Create Power BI dashboards
6.	Demonstrate basic operations using Power Pivot in Excel
7.	Perform data Analysis with Pivot Tables and Charts
8.	Integrate Power BI with Other Applications

Lecture:30, Practical:30, Total:60

TEXT BOOK:

1.	Dan Clark. “Beginning Microsoft Power BI: A Practical Guide to Self-Service Data Analytics”. 3rd Edition, Apress, 2020.

REFERENCES

1.	Brett Powell. Microsoft Power BI Cookbook. 1st edition, Packt Publishing, 2017.

REFERENCES/ MANUAL / SOFTWARE:

1.	Power BI
2.	Linux / Windows
3.	Lab manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	install Power BI and implement the basic operations of Power BI	Applying (K3) Precision (S3)
CO2	understand and design data model and DAX applications	Applying(K3) Precision (S3)
CO3	interpret the concepts in developing Power BI reports and dashboards	Applying(K3) Precision (S3)
CO4	develop applications using Power Pivot, Pivot Tables and Charts	Applying(K3) Precision (S3)
CO5	implement advanced operations in Power BI	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	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	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)

22ADE05 - COMMUNICATION NETWORKS							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**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	understand 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)

22ADF02–R PROGRAMMING FOR MACHINE LEARNING							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**PE**	**2**	**0**	**2**	**3**

Preamble	To impart the basic knowledge in R and develop skills to apply the knowledge of R programming to Machine Learning	
Unit – I	**Introduction to R ProgrammingStructuresandFunctions:**	**6**
Overview ofRprogramming - Basicobjects:Vectors– Matrix–Array–Lists–Factors– Data frames. Basic expressions: Arithmetic expressions – Control Statements: if and if-else statements –– switch statement – Loops: for loop – while loop – Functions– Strings		
Unit – II	**Introduction to Data Science:**	**6**
Introduction – Roles of Data Science Projects – Data Collection and Management – Modeling – Model Evaluation and Critique – Determining lower and upper bounds – Loading Data into R – Working with data from files and relational database - Exploring data – Managing data: Missing values – cleaning data		
Unit – III	**Statistical Analysis:**	**6**
Frequency distribution - Measures of central tendency and dispersion – Hypothesis Testing: Test Statistics – ANOVA – F-Test – T-Test – U-Test – Fisher's Exact Test – Kruskal- Wallis Test – Bartlett's Test – Statistical Distribution: Binomial – Poisson – Normal – Chi-squared distribution		
Unit – IV	**Classification:**	**6**
Tests and Training splits- Building Single Variable Model: Categorical Features- Numerical Features – Cross Validation - Building Multi Variable Model: Variable Selection – Decision Trees – Nearest Neighbor Methods – Naïve Bayes		
Unit – V	**Regression and Clustering:**	**6**
Linear and Logistic Regression: Introduction – Building Model – Making Predictions – Characterizing Co-efficient quality – Un-supervised Methods: Cluster Analysis – Distance – Hierarchical Clustering – The K-means Algorithm		

LIST OF EXPERIMENTS / EXERCISES:	
1.	Implement simple programs in R
2.	Perform data preprocessing in R
3.	Perform statistical analysis for a given dataset
4.	Implement decision tree algorithm in R
5.	Implement K-Nearest Neighbor algorithm in R
6.	Implement Naive Bayesian classifier in R
7.	Implement linear regression in R
8.	Implement K-means clustering algorithm in R

Lecture:30, Practical:30, Total:60

TEXT BOOK:	
1.	Sandip Rakshit, "R for Beginners", McGraw Hill Education, 2017 for Units I and III.
2.	Nina Zumel, John Mount, "Practical Data Science with R",2nd Edition, Manning Publications, 2019 for Units II,IV and V.
REFERENCES/ MANUAL / SOFTWARE:	
1.	Laboratory Manual
2.	Software : R

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	solve problems using the fundamentals of R	Applying (K3) Precision (S3)
CO2	explore and manage data using R	Applying(K3) Precision (S3)
CO3	perform statistical analysis using R	Applying(K3) Precision (S3)
CO4	demonstrate Decision Tree, Nearest Neighbor, Naïve bayes classification algorithms	Applying(K3) Precision (S3)
CO5	apply regression and clustering algorithms for the sample dataset using R	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
CO4	3	2	2	2	2							2	3	2
CO5	3	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	20	70				100
CAT2	10	20	70				100
CAT3	10	20	70				100
ESE	5	35	60				100

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

22ADE06 – MODELING AND SIMULATION							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**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.

REFERENCES:

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

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	modelsystemdynamicswithandwithoutconstraints	Applying (K3)
CO2	constructmodels forsystemswith interactions	Applying (K3)
CO3	identify sources of computational error and make use of simulation techniques	Applying (K3)
CO4	makeuseofrandomness anddata for modeling	Applying (K3)
CO5	utilizecellularautomationformodelingnaturalprocessesandexplainconcurrentprocessingandparallel 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)

22ALE03- NATURE INSPIRED OPTIMIZATION TECHNIQUES							
Programme & Branch	**B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course provides an introduction to nature inspired techniques and applications.	
Unit – I	**Introduction:**	**9**
Algorithm – Newton's Method – Optimization – Gradient-Based Algorithms – Hill Climbing with Random Restart – Optimality Search – No-Free-Lunch Theorems – Nature-Inspired Metaheuristics – Metaheuristics History		
Unit – II	**Genetic Algorithms:**	**9**
Introduction – Genetic Algorithms – Genetic Operators Role – Choice of Parameters – GA Variants – Schema Theorem – Convergence Analysis		
Unit – III	**Particle Swarm Optimization:**	**9**
Swarm Intelligence – PSO Algorithm – Accelerated PSO – Implementation – Convergence Analysis – Dynamical System – Markov Chain Approach – Binary PSO		
Unit – IV	**Cuckoo Search:**	**9**
Cuckoo Breeding Behavior – Lévy Flights – Cuckoo Search –Cuckoo Search Special Cases – Lévy Flights Carry Out – Parameters Choice – Cuckoo Search Variants – Cuckoo Search Efficiency – Global Convergence: Brief Mathematical Analysis– Applications		
Unit – V	**Bat Algorithms:**	**9**
Bats Echolocation – Microbats Behavior – Acoustics Echolocation – Bat Algorithms –Virtual Bats Movement – Loudness and Pulse Emission – Implementation – Binary Bat Algorithms – Variants of the Bat Algorithm – Convergence Analysis –Bat Algorithm Efficiency – Applications – Continuous Optimization – Combinatorial Optimization and Scheduling – Inverse Problems and Parameter Estimation		
		Total:45

TEXT BOOK:

1. Xin-She Yang, "Nature-Inspired Optimization Algorithms", 1st Edition, Elsevier,Netherlands, 2014.

REFERENCES:

1. Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", 1st Edition, MIT Press, Cambridge, 2008.
2. Leandro Nunes de Castro, "Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", 1st Edition, Chapman & Hall/CRC, Taylor and Francis Group, USA, 2007.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped** **(Highest Level)**
CO1	apply the basic concepts of optimization techniques.	Applying (K3)
CO2	apply genetic algorithm for real time application	Applying (K3)
CO3	develop mathematical model of different swarm optimization algorithms	Applying (K3)
CO4	make use of the cuckoo search optimization algorithm for a real time application	Applying (K3)
CO5	make use of the bat algorithm optimization algorithm for a real time 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	20	50	30				100
CAT2	20	50	30				100
CAT3	20	50	30				100
ESE	5	55	40				100

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

22ALF01 - DESIGN PATTERNS AND PRINCIPLES							
Programme & Branch	**B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**PE**	**2**	**0**	**2**	**3**

Preamble	This course focuses on the principles and patterns to be applied for building reusable solutions in solving the real world problems	
Unit – I	**Introduction To UML:**	**6**
Overview of UML : Basics and Details : Diagram Types – Class Diagrams – Sequence Diagram – Use Cases – Object Diagrams – State Diagrams – Examples		
Unit – II	**Design Principles:**	**6**
Principles of OOD: SOLID Principles: The Single Responsibility Principle - The Open-Closed Principle - The Liskov Substitution Principle - The Interface Segregation Principle - The Dependency Inversion Principle – Implementation in Java		
Unit – III	**Creational Design Pattern:**	**6**
Design Pattern – Introduction - Classification of Design Patterns ; Creational Design Patterns – Factory Method – Abstract Factory – Builder – Prototype – Singleton		
Unit – IV	**Structural Design Pattern:**	**6**
Use and Solution of Structural Design Pattern : Adapter – Bridge – Composite – Decorator – Façade – Flyweight – Proxy – Examples – Implementations		
Unit – V	**Behavioral Design Pattern:**	**6**
Use and Solutions of Behavioral Patterns: Chain of Responsibility – Command – Iterator – Mediator – Memento – Observer – State – Strategy – Template Method – Visitor – Examples – Implementations		

LIST OF EXPERIMENTS / EXERCISES:

1.	Write a program to implement the following concepts in java a. Method overriding. b. Interface. c. Abstract class.
2.	Write programs to implement SOLID principles
3.	Write a Program to implement Factory pattern and abstract
4.	Write a Program to implement Singleton pattern and Composite design pattern
5.	Write a program to implement decorator pattern and proxy design pattern
6.	Write a Program to design chain of responsibility pattern and mediator pattern
7.	Write a program to implement visitor pattern
8.	Draw UML diagrams and develop an application

Lecture:30, Practical:30, Total:60

TEXT BOOK:

1.	Martin, Robert C. “UML for Java programmers,. Ist Edition, Prentice Hall PTR, 2003 for Unit 1.
2.	Vaskaran Sarkar, “Java Design Patterns”, Ist Edition, Apress, 2016 for Units 2, 3, 4 and 5.

REFERENCES/ MANUAL / SOFTWARE:

1.	Rohit Joshi, Java Design Patterns: Reusable Solutions to Common Problems, Java Code Geeks, 2021.
2.	https://refactoring.guru/design-patterns/
3.	Operating System : Windows
4.	Software : IBM Rational Suite, Java SDK
5.	Laboratory Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	design UML diagrams for a specified problem.	Applying (K3) Precision(S3)
CO2	apply design principles for designing the code for a problem	Applying (K3) Precision(S3)
CO3	use creational pattern to design the instantiation process	Applying (K3) Precision(S3)
CO4	use structural pattern to compose interfaces	Applying (K3) Precision(S3)
CO5	apply behavioral patterns to show communication between classes	Applying (K3) Precision(S3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

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

22ADE09 - REINFORCEMENT LEARNING							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**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.

REFERENCES:

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	elaborate the 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)

22ADE10 - AGILE METHODOLOGIES FOR SOFTWARE DEVELOPMENT							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & 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 %
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)

22ADE11 - INFORMATION RETRIEVAL TECHNIQUES							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course discusses the basics of information retrieval, search engine operations and web information retrieval techniques.	
Unit - I	**Introduction:**	**9**
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**
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**
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**
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**
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		
		Total:45

TEXT BOOK:

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

REFERENCES:

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)

22ADE12 - SEARCH METHODS IN ARTIFICIAL INTELLIGENCE							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**
Preamble	This course focuses on search methods, planning, game representation and Constraint Satisfaction problems in Artificial Intelligence						
Unit – I	**Introduction and StateSpace Search:**						**9**
Introduction – Intelligence –State Space Search: Generate and Test – Simple Search - Depth First Search - Breadth First Search - Comparison of DFS and BFS - Depth Bounded DFS(DBDFS) - Depth First Iterative Deepening(DFID)							
Unit – II	**Heuristic and Randomized Search:**						**9**
Heuristic Function - Best First Search - Hill Climbing – Local Maxima - Solution Space Search –Beam Search – Tabu Search - Escaping Local Maxima: Iterated Hill Climbing – Simulated Annealing - Genetic Algorithms							
Unit – III	**Finding Optimal Paths:**						**9**
Brute Force – Brand & Bound – Refinement Search - A* Algorithm - Admissibility of A* - Iterative Deepening A* - Recursive Best First Search – Pruning the CLOSED List – Pruning the OPEN List – Divide and Conquer Beam Stack Search.							
Unit – IV	**Planning and Game Playing:**						**9**
Planning: STRIPS Domain, Forward state space planning - Backward state space planning - Goal Stack Planning - Plan Space PlanningGame Playing: Introduction - Board Games – Game Playing Algorithms: Algorithm Minimax, AlphaBeta and SSS*, B* search – Limitations of search.							
Unit – V	**Constraint Satisfaction Problems:**						**9**
N-Queens – Constraint Propagation – Scene Labelling – Higher Order Consistency – Algorithm Backtracking – Lookahead Strategies: Forward Checking – Arc Consistency Lookahead – Value and Variable Ordering.							
							Total:45

TEXT BOOK:

1.	Deepak Khemani, “A First Course in Artificial Intelligence”, 1st Edition, Ninth reprint, McGraw Hill Education, India, 2019.

REFERENCES:

1.	Elaine Rich, Kevin Knight, “Artificial Intelligence”, 3rd Edition, Tata McGraw Hill, 2017.
2.	Dan W. Patterson, “Introduction to AI and ES”, Pearson Education, 2015.
3.	Stefan Edelkamp and Stefan Schroedl. Heuristic Search: Theory and Applications, Morgan Kaufmann, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply State Search Space Search Techniques to solve problem	Applying (K3)
CO2	explore the use of Heuristic and randomized search methods	Applying (K3)
CO3	utilize A* for identifying optimal Solutions	Applying (K3)
CO4	apply planning and game playing in problem solving	Applying (K3)
CO5	solveconstraint satisfaction problems for searching	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	45	50				100

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

22ALE04- GRAPH THEORY AND ITS APPLICATIONS							
Programme & Branch	**B.Tech. 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.

REFERENCES:

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	20	40	40				100
CAT2	20	30	50				100
CAT3	20	30	50				100
ESE	5	35	60				100

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

22GEE01 - FUNDAMENTALS OF RESEARCH							
(Common to All BE/BTech branches)							
Programme & Branch	**All BE/BTech branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**GE**	**3**	**0**	**0**	**3**
Preamble	This course familiarizes 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 - Outcomes 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 – Data Collection – Primary Data Analysis – Experimental Methods 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**
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”. 2nd edition, Routledge, 2017., for Units I, II, III, IV & V						
REFERENCES:							
1.	Mishra, S.B. and Alok, S. “Handbook of research methodology” Educreation Publishing, 2017						
2.	Kumar, Ranjit. “Research Methodology: A step-by-step guide for beginners”. SAGE Publications Limited, 2019.						
3.	Nayak, J.K. and Singh, P. “Fundamentals of Research Methodology Problems and Prospects”. SSDN Publishers & Distributors, 2021.						

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	Applying (K3)
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	2	1	1	3	3	1	1	3	3	3
CO2	3	3	3	3	2	1	1	3	3	3	3	3	3	3
CO3	3	3	3	3	3	1	1	3	3	3	1	3	3	3
CO4	3	2	1	1	2	1	1	3	2	1	1	3	3	3
CO5	3	3	2	2	3	1	1	3	3	3	1	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		30	50	10	10		100
CAT3		20	30	30	10	10	100
ESE		40	40	10	10		100

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

22ALE05 - NUMERICAL METHODS							
Programme & Branch	**BTech Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**GE**	**3**	**0**	**0**	**3**

Preamble	To impart knowledge in interpolation, numerical differentiation and integration. Also develop skills to apply numerical algorithms to identify roots of algebraic and transcendental equations, finding eigen values and solve linear system of equations, ordinary differential equations.	
Unit - I	**Solution to Algebraic and Transcendental Equations and Eigen value problems:**	9
Solution to Algebraic and Transcendental Equations: Bisection method - Iteration method – Method of false position – Newton-Raphson method -Iterative method for Eigen values: Power method – Jacobi's method.		
Unit - II	**Solution of Simultaneous Linear Algebraic equations:**	9
Introduction - Direct methods: Gauss elimination method – Gauss - Jordan method – LU decomposition method – Crout's method –Iterative methods: Gauss Jacobi and Gauss – Seidel methods – Inverse of a matrix by Gauss Elimination method.		
Unit - III	**Interpolation:**	9
Interpolation with equal intervals: Newton's forward and backward difference formulae – Central difference interpolation formulae: Gauss forward and backward interpolation formulae – Interpolation with unequal intervals: Lagrange's interpolation formula – Newton's divided difference formula.		
Unit - IV	**Numerical Differentiation and Integration:**	9
Differentiation using Newton's forward, backward and divided difference formulae – Numerical integration: Trapezoidal rule – Simpsons 1/3rd rule – Simpsons 3/8th rule – Double integrals using Trapezoidal and Simpson's rules.		
Unit - V	**Numerical Solution of First order Ordinary Differential Equations::**	9
Single step methods: Taylor series method – Euler method – Modified Euler method – Fourth order Runge-Kutta method – Multi step methods: Milne's predictor corrector method – Adam's Bashforth method.		
		Total:45

TEXT BOOK:

1.	Veerarajan T, Ramachandran T., "Numerical Methods", 1st Edition, Tata McGraw Hill Publishing Company, New Delhi, 2018.

REFERENCES:

1.	Kandasamy, P., Thilakavathy, K. and Gunavathy, K., "Numerical Methods", Reprint Edition, S.Chand & Co, New Delhi, 2016.
2.	Sankara Rao. K., "Numerical Methods for Scientists and Engineers", 3rd Edition, Prentice Hall of India Pvt. Ltd, , New Delhi, 2007.
3.	Steven C. Chapra, Raymond P. Canale., "Numerical Methods for Engineers", 7th Edition, McGraw-Hill Education, 2014.
4	Sastry, S.S, "Introductory Methods of Numerical Analysis", 5th Edition, PHI Learning Pvt. Ltd, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply various numerical techniques to solve algebraic and transcendental equations.	Applying (K3)
CO2	solve simultaneous linear equations by numerical methods.	Applying (K3)
CO3	compute intermediate values of given evenly (or) unevenly spaced data.	Applying (K3)
CO4	apply the concepts of numerical differentiation and integration in real time applications.	Applying (K3)
CO5	obtain the solution of first ordinary differential equations by numerical methods.	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	2											
CO3	3	3	2											
CO4	3	2	1											
CO5	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	15	75				100
CAT2	10	15	75				100
CAT3	10	15	75				100
ESE	10	15	75				100

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

22ALF02 - MOBILE APPLICATION DEVELOPMENT							
Programme & Branch	**BTech Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Java Programming and Web technology**	**7**	**PE**	**2**	**0**	**2**	**3**

Preamble	This course provides knowledge on developing mobile applications using Android.	
Unit – I	**Introduction to Android:**	6
Introduction – Android Architecture – Environmental setup – Develop simple Hello World application – App Folder structure - Android virtual device - Application Components –Toast message - Activity – Activity Life cycle – Log messages.		
Unit – II	**Layout and UI:**	6
Intent –types - Intent filters - Views – Layouts - UI components: Text View, Edit Text, Button, Toggle Button, Radio Group, Check Box, Progress Bar, Rating Bar – Event Listeners and Handlers		
Unit – III	**Resources, Alerts and Storage:**	6
Resources overview – Styles and Themes - Menu: Option menu, Context menu – Notification – Broadcast receivers - SQL Lite CRUD Operations.		
Unit – IV	**Introduction to React Native:**	6
Introduction: Introduction to Cross-platform applications – Native vs Cross-platform Applications – Need for Cross-platform Applications – Existing Cross-platform Application Development Frameworks. React Native: Why React? – Virtual DOM – Oneway Data Flow. Setting Up Your Environment - Creating a Simple React Native App.		
Unit – V	**Complex User Interfaces:**	6
Implementing Complex User Interfaces – Dealing with universal applications - Detecting orientation changes - Using a WebView to embed external websites – Linking to websites and other applications - Creating a form component Implementing Complex User Interfaces – Creating a map app with Google Maps - Creating an audio player – Creating an image carousel.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Installation of studio and emulator configuration
2.	Create application to display toast message and debug it using emulator and mobile device
3.	Demonstrate the activity life cycle using Log message
4.	Develop an application to use intent concept
5.	Explore different layouts of android application
6.	Create an application using various UI components
7.	Configure react native environment and create simple app.
8.	Develop an audio player app using react native

Lecture:30, Practical:30, Total:60

TEXT BOOK:

1.	https://www.tutorialspoint.com/android/index.htm for Unit I, II, III
2.	Dan Ward, “React Native Cookbook”, 2nd Edition, Packt Publishing, 2019 for Unit IV and V

REFERENCES/ MANUAL / SOFTWARE:

1.	K.L.James, “Android Applications Development in Java”, 1st Edition, Independently published, 2022.
2.	Jonathan Lebensold, “React Native Cookbook - Bringing the Web to Native Platforms”, 1st Edition, O’Reilly Media, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	illustrate the steps to create android application and discuss its activity life cycle	Applying (K3)
CO2	develop an Android application using Layouts, UI components with event handling	Applying (K3)
CO3	create menu, broadcast receiver and perform CRUD operations using SQLite	Applying (K3)
CO4	design a mobile application using the simple UI features in React Native	Applying (K3)
CO5	develop universal mobile applications that run on mobile phones and tablets	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2								2	2
CO2	3	2	1	1	2								2	2
CO3	3	2	1	1	2								2	2
CO4	3	2	1	1	2								2	2
CO5	3	2	1	1	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	30	50				100
CAT3	20	30	50				100
ESE	5	45	50				100

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

22ALE06– CYBER SECURITY							
Programme & Branch	**B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	The course focuses on mathematical concepts, implementation, real time applications, crimes, offenses, threats, vulnerability and its defensive mechanisms in cyber forensis	
Unit – I	**Introduction to Computer and Network Security:**	**9**
Computer security concepts - OSI security architecture - Security attack - Security Services - Security Mechanisms - Fundamental security design principles - Attack surface and attack trees - Model for security networks.		
Unit – II	**Classical Encryption Techniques:**	**9**
Symmetric cipher model - Cryptography - Cryptanalysis and Brute force attack - Substitution techniques - Caesar Cipher Monoalphabetic cipher - Playfair cipher - Hill Cipher - Polyalphabetic cipher - Transition techniques - Rotor machines - Stenography.		
Unit – III	**Block Cipher and Encryption Standard:**	**9**
Traditional Block cipher structure - Data Encryption Standard - DES example - Strength of DES - Finite Field Arithmetic - AES structure - AES transformation function - AES key expansion - AES example.		
Unit – IV	**Asymmetric Ciphers:**	**9**
Division Algorithm - Euclidean algorithm - Modular arithmetic - Prime number - Fermet's and Euler's Theorem - Chinese Remainder Theorem - Discrete Logarithms - Public key cryptosystem - Applications for Public key cryptosystem - Requirements for Public key cryptography - Public key cryptanalysis - RSA algorithm - Description of algorithm.		
Unit – V	**Cybercrimes:**	**9**
Cybercrime and Information security - Classification of cybercrimes - planning of attacks - Social engineering – Cyberstalking - Cybercafe and Cybercrime.		
		Total:45

TEXT BOOK:

1.	William Stallings, "Cryptography and Network security", 7th Edition, Pearson Education, England, 2016 for Units 1, 2, 3 and 4.
2.	Nina Godbole and Sunit Belapure, "Cyber Security, Understanding cyber crimes, computer forensics and legal perspectives", 1st Edition, Wiley Publications,USA Reprint 2018 for Unit 5.

REFERENCES:

1.	Brian Underdahl, "Cybersecurity for Dummies", 1st Edition, Wiley Publications, India 2011.
2.	Behrouz A. Forouzan and Debdeep Mukhopadhyay, "Cryptography and Network Security", 2nd Edition, McGraw Hill Education, India 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	know the fundamental mathematical concepts related to security	Applying (K3)
CO2	implement the cryptographic techniques to real time applications	Applying (K3)
CO3	comprehend the authenticated process and integrity, and its implementation	Applying (K3)
CO4	know the fundamentals of cybercrimes and cyber offenses.	Applying (K3)
CO5	realize the cyber threats, attacks, vulnerabilities and its defensive mechanism	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40				100
CAT2	20	40	40				100
CAT3	20	45	35				100
ESE	5	50	45				100

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

22ADE15 - ETHICS OF ARTIFICIAL INTELLIGENCE							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & 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 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”, 1st Edition, Springer, USA, 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	10	60	30				100

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

22ADE18- QUANTUM COMPUTING							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**

Preamble	Comprehensive understanding of computing's historical evolution, including classical and quantum computing backgrounds, delve into the foundational principles of quantum computation, explore the intersection of quantum mechanics with computer science, study the rudiments of quantum hardware and mathematical models for quantum computation, and grasp the essentials of quantum information theory.	
Unit – I	**QUANTUM COMPUTING BASIC CONCEPTS**	**9**
Complex Numbers –Vector Space- Dirac Notations- Basics of Quantum Mechanics -Limitations of Classical Physics-Photoelectric Effect- Rutherford's Model of the Atom- Global Perspectives Postulates of Quantum Mechanics- Matrices: Square Matrices- Diagonal Matrices – Operators: Rules of operators- Types of Operators.		
Unit – II	**QUANTUM GATES AND CIRCUITS**	**9**
Boolean Algebra - Classical Circuit Computation Model - Universal Logic Gates - Quantum Computation- The Quantum Bit and Its Representations - Superposition in Quantum Systems- Quantum Register - Quantum Gates: Types -Multi-Qubit Systems- Quantum Error correction: Classical Error Correction Codes – Quantum Error-Correcting Codes - Shor's 3-Qubit Bit-Flop Code- Shor's 9 Qubit Code – Error Correction.		
Unit – III	**QUANTUM ALGORITHMS**	**9**
Deutsch's algorithm - The Deutsch–Jozsa algorithm - Quantum Search Algorithms: Grover's Algorithm- Shor's Factoring Algorithm -Quantum Fourier transform and its applications – Phase Estimation- Order of finding and factoring – General applications of quantum Fourier transform.		
Unit – IV	**QUANTUM INFORMATION THEORY**	**9**
Data compression - Shannon's noiseless channel coding theorem - Schumacher's quantum noiseless channel coding theorem - Classical information over noisy quantum channels Communication over noisy classical channels- Communication over noisy quantum channels – Quantum Information Over noisy quantum channel – Entanglement as a physical Resources. .		
Unit – V	**QUANTUM CRYPTOGRAPHY**	**9**
Principles of Information Security - one Time Pad— Public Key Cryptography- Private Key Cryptography- Privacy amplification and information reconciliation- RSA coding scheme - Quantum Cryptography - Quantum Key Distribution - BB84 - Ekart 91		
		Total:45

TEXT BOOK:

1.	Parag K Lala, Mc Graw Hill Education, "Quantum Computing, A Beginners Introduction", First edition (1 November 2020) (Units – I,II,III(1st Half),V
2.	Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information", Tenth Edition, Cambridge University Press, 2010. Units- III(2nd Half),IV

REFERENCES:

1.	Chris Bernhardt, The MIT Press; Reprint edition (8 September 2020), "Quantum Computing for Everyone".
2.	Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013.
3.	N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge University Press, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explore the basics of Quantum Computing.	Understanding (K2)
CO2	make use of Quantum gates and circuits	Applying (K3)
CO3	implement various Quantum Algorithms	Applying (K3)
CO4	examine Quantum Information Theorems	Applying (K3)
CO5	articulate the concept of Quantum Cryptography	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**
CO2	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**
CO3	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**
CO4	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**
CO5	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**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	20	50	30				100
CAT2	20	50	30				100
CAT3	20	50	30				100
ESE	10	60	30				100

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

22ADF05- ROBOTICS PROCESS AUTOMATION							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**2**	**0**	**2**	**3**

Preamble	This course introduces Robotic Process Automation and tools to implement RPA operations, workflow, App Integration, web scraping and bot development for real time applications.	
Unit – I	**Introduction To Robotic Process Automation:**	**6**
Emergence of Robotic Process Automation (RPA), Evolution of RPA, Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms. Robotic Process Automation Tools - Templates, User Interface, Domains in Activities, Workflow Files.		
Unit – II	**Automation Process Activities:**	**6**
Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, and Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations Controls: Finding the control, waiting for a control, Act on a control, UiExplorer, Handling Events		
Unit – III	**App Integration, Recording And Scraping:**	**6**
App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard actions to perform operation, Scraping data from website and writing to CSV. Process Mining.		
Unit – IV	**Exception Handling And Code Management:**	**6**
Exception handling, Common exceptions, Logging- Debugging techniques, Collecting crash dumps, Error reporting. Code management and maintenance: Project organization, Nesting workflows, Reusability, Templates, Commenting techniques, State Machine.		
Unit – V	**Deployment And Maintenance:**	**6**
Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors - Open Source RPA, Future of RPA.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Download, Install and Activate Ui-Path Studio. Learn all the basics of RPA (Variables, Arguments and Control flow etc.)
2.	Write a program to i) empty the trash folder in Gmail ii) empty the Recycle Bin.
3.	Write a program to perform looping and control activity. (Suggested Hint: Find the smallest and biggest numbers in an array, how an integer variable will increase from 5 to 50 in increments of 5.)
4.	Write a program to i)build a data table(static) ii) build a data table using data scraping(Dynamically)
5.	Write a program i) to perform the following operations on an Excel file: Read cell, Write cell, Read range, Write range and Append range ii) to implement Arithmetic operations in 2 Excel files.
6.	Write a program for acting on controls using mouse and keyboard activities.
7.	Write a program to extract Email Address.
8.	Develop a bot for any of the following 2 applications: Find Movie Rating / Email Automation/ Password Generator/ Forms Processing/ Create and deliver invoices/ Extracting data from PDFs, scanned documents and other formats

Lecture:30, Practical:30,Total:60

TEXT BOOK:

1.	Alok Mani Tripathi ,"Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool – UiPath", Packt Publishing, 2018. (Unit:1,2,4,5)
2.	https://www.uipath.com/rpa/academy (Unit: 3)

REFERENCES/ MANUAL / SOFTWARE:

1.	A Gerardus Blokdyk, "Robotic Process Automation RPA A Complete Guide ", 2020
2.	Tom Taulli , "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", Apress publications, 2020.

3.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	Implement basic operations on different data types	Applying (K3) Precision(S3)
CO2	Apply Arithmetic operations different fields from an excel file	Applying (K3) Precision(S3)
CO3	Demonstrate App integration and automate web scraping applications	Applying (K3) Precision(S3)
CO4	Apply Exception handling and code management in RPA	Applying (K3) Precision(S3)
CO5	Develop bots for real time automation 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	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

1 – Slight, 2 – Moderate, 3 – Substantial, BT- 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)

22ADE16 - CLOUD COMPUTING							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**PE**	**3**	**0**	**0**	**3**
Preamble	The course focuses on cloud architecture models, virtualization, cloud architecture over virtualized data centers, cloud programming software environments, Ubiquitous Clouds and Internet of Things						
Unit – I	**CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE**						**9**
Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges							
Unit – II	**VIRTUALIZATION BASICS**						**9**
Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts – Virtualization structure – Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU, Memory and I/O devices.							
Unit – III	**CLOUD PLATFORM ARCHITECUTURE OVER VIRTUALIZED DATA CENTERS**						**9**
Cloud computing Service models-Data-Center Design and Interconnection Networks – Architectural Design of Compute and Storage Clouds – Public Cloud Platforms. Google App Engine – AWS – Azure – Inter-cloud Resource Management – Cloud Security – Trust Management.							
Unit – IV	**CLOUD PROGRAMMING AND SOFTWARE ENVIRONMENTS**						**9**
Cloud and Grid Platforms – Parallel and Distributed Programming Paradigms – Programming Support Google App Engine – Amazon AWS – Microsoft Azure – Cloud Frameworks : Eucalyptus – Nimbus – OpenNebula – Sector – Sphere – OpenStack – Manjrasoft Aneka Cloud and Appliances.							
Unit – V	**UBIQUITOUS CLOUDS AND THE INTERNET OF THINGS**						**9**
Cloud Trends in supporting Ubiquitous Computing Performance of Distributed Systems and the Cloud – Enabling technologies for the Internet of Things – Innovative Applications of the Internet of Things – Online Social and Professional Networking.							
							Total:45
TEXT BOOK:							
1.	Kai Hwang, Geoffrey C Fox & Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Reprint Edition, Morgan Kauffmann 2017.						

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand the design challenges in the cloud	Understanding(K2)
CO2	apply the concept of virtualization and its types	Applying (K3)
CO3	Know about the platform architectural design and resource management	Understanding (K3)
CO4	analyze the cloud software environment such as AWS , Microsoft Azure and cloud frameworks	Applying (K3)
CO5	demonstrate the use of cloud enabling technologies and internet of things for doing innovative 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	2	3	2	2	1									
CO2	2	3	2	2	1									
CO3	2	3	2	2	1									
CO4	2	3	3	3	2									
CO5	2	3	3	2	1									

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

ASSESSMENT PATTERN – THEORY

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

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

22ALE07 - NEURAL MACHINE TRANSLATION							
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 provides knowledge on training non-linear models, its architectures, solving practical issues in translation models and visualization.	
Unit – I	**Introduction to Machine Translation:**	**9**
Translation Problem: Goals of Translation – Ambiguity – The Linguistic View – The Data View – Practical Issues. Machine Translation Uses: Information Access – Aiding Human Translators – Communication – Natural Language Processing Pipelines – Multimodal Machine Translation. History: Neural Networks – Machine Translation. Evaluation: Task – Based Evaluation – Human Assessments – Automatic Metrics – Metrics Research		
Unit – II	**Networks and Computational Graphs:**	**9**
Linear Models – Multiple Layers – Nonlinearity – Inference – Back-Propagation Training – Exploiting Parallel Processing – Neural Networks as Computation Graphs – Gradient Computations		
Unit – III	**Neural Language and Translational Models:**	**9**
Feed-Forward Neural Language Models – Word Embeddings – Noise Contrastive Estimation – Recurrent Neural Language Models – Long Short -Term Memory Models – Gated Recurrent Units – Deep Models – Encoder-Decoder Approach – Adding an Alignment Model – Training – Deep Models. Decoding: Beam Search – Ensemble Decoding – Reranking		
Unit – IV	**Tricks and Architecture:**	**9**
Machine Learning Failures – Ensuring Randomness – Learning Rate Adjustment – Avoiding Local Optima – Addressing Vanishing and Exploding Gradients – Sentence-Level Optimization – Neural Networks Components – Attention Models – Convolutional Machine Translation – Convolutional Neural Networks with Attention – Self-Attention: Transformer		
Unit – V	**Adaption, Analysis and Visualization:**	**9**
Domains – Mixture Models – Subsampling – Fine-Tuning – Error Analysis – Visualization – Probing Representations – Identifying Neurons – Tracing Decisions Back to Inputs		
		Total:45

TEXT BOOK:

1. Philipp Koehn, “Neural Machine Translation”, 1st Edition, Cambridge University Press, United Kingdom, 2020.

REFERENCES:

1. Cyril Goutte, Nicola Cancedda, Marc Dymetman, George Foster, Masao Utiyama,“Learning Machine Translation”, MIT Press, United States, 2009.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	describe about problem of machine translation and technology	Applying (K3)
CO2	make use of Networks and Computational Graphs	Applying (K3)
CO3	make use of Neural Language and Translational Model	Applying (K3)
CO4	create and work with attention models	Applying (K3)
CO5	create an analysis and visualization report	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	10	55	35				100

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

22ALF03 - GAME DEVELOPMENT							
Programme & Branch	**BTech & Aritificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Python Programming**	**7**	**PE**	**2**	**0**	**2**	**3**

Preamble	This course provides knowledge about game development environment using Pygame.	
Unit – I	**Game Programming**	**6**
Game – Definition – Application Layer - Game Logic - Game Views - Managing Memory - Controlling the Main Loop - Loading and Caching Game Data - User Interface Management - Game Event Management.		
Unit – II	**Introduction To Pygame**	**6**
Introduction to Pygame-Installing Pygame – Using Pygame-Understanding Events-Opening a Display-Using the Font Module-Pygame in action-Working with color-Using Images-Drawing with Pygame.		
Unit – III	**Gaming Actions**	**6**
Understanding Frame rate-Moving in a straight line- understanding Vectors-Using Vectors to create Movement-Accepting User Input-Understanding Keyboard Control-Implementing Mouse Control-Implementing Joystick Control-Seeing Joysticks in Action.		
Unit – IV	**Artificial Intelligence in Games**	**6**
Creating Artificial Intelligence for Games–Exploring AI-Exploring AI-Creating the Illusion of Depth-Understanding 3D Space-Using 3D Vectors-Projecting 3D Points-A 3D World-Using the Matrix Class-Introducing OpenGL-Seeing OpenGL in Action.		
Unit – V	**Game Development Using Pygame**	**6**
Incorporating Music and Sound –Creating Sound Effects-Playing Sounds with Pygame-Playing Music with Pygame- Working with Textures- Working with Models- Understanding Lighting- Understanding Blending- Understanding Fog- Rendering the Backdrop.		
		Total:30

LIST OF EXPERIMENTS

1. Explore pygame and its features.
2. Draw basic shapes using Pygame.
3. Set up vertex and magnitude for your respective shapes.
4. Implement the joystick control.
5. Explore the 3d projections.
6. Create motions with sounds.
7. Create your actions with texture.
8. Mini Project using Pygame.

Lecture:30,Practical:30,Total:60

TEXT BOOK:

1. Mike Mc Shaffrfy and David Graham, “Game Coding Complete”, Fourth Edition, Course Technology PTR, 2012.(Unit I)
2. Will McGugan, “Beginning Game Development with Python and Pygame: From Novice to Professional”, Apress Publishers, 2007.(Unit II,III,IV,V)

REFERENCES:

1. Sanjay Madhav, “Game Programming Algorithms and Techniques: A Platform Agnostic Approach”, Addison-Wesley Professional, 1st Edition, 2013.
2. Ernest Adams, “Fundamentals of Game Design”, 3rd Edition, New Riders Press, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	make use of the general concepts for game programming	Applying (K3)
CO2	demonstrate the basics of pygame	Applying (K3)
CO3	apply the Pygame user controls and mouse control techniques	Applying (K3)
CO4	construct 3D postures and explore OpenGL	Applying (K3)
CO5	utilize various animation techniques in game development	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	20	40	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)

22ADE20-SOFTWARE QUALITY ASSURANCE							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Nil	**8**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course focuses on ensuring the quality of implementation of appropriate functionality that satisfies the requirements/needs of its targeted client/users for the intended software system, product, or service correctly and efficiently.	
Unit – I	**Software Quality in Business Context**	**9**
Defining Quality –Quality attributes– Quality Control Vs Quality assurance –Quality assurance at each phase of SDLC. 10Managing software Quality in an Organization: QMS – Need for SQA function in an organization. Managing SQA Operations: Software Quality assurance plans – Organizational level initiatives.		
Unit – II	**Product Quality and Process Quality**	**9**
Introduction – Product quality – Process quality aspects. Software Measurement and Metrics: Introduction – Measurement during software life cycle context – Defect metrics – Metrics for software maintenance – Classification of software metrics – Requirements related metrics – Metrics, measurements and process improvement		
Unit – III	**SCM and Review Techniques**	**9**
Software Configuration Management: Introduction- SCM Responsibility- Understanding Configuration Management in QA context- Need for SCM – SCM activities – Standards-Team. Review Techniques. Introduction – Structured walkthroughs – Inspections – Various roles and responsibilities involved in Reviews / Inspections – Templates and Formats useful for reviews		
Unit – IV	**Software Quality Assurance Standardization**	**9**
Introduction – Constitution of ISO 9001 – Origin of ISO 9000 – Work of ISO – ISO standards development process – Standards – ISO 9001: 2008 – Need of ISO 9000 – ISO 9001 and software development process – ISO Certification – Assessment / Audit preparation – Assessment process –Audits – ISO consulting services and consultants – Verification		
Unit – V	**Capability Maturity and Process Improvement Models**	**9**
Software Process Improvement Models – Understanding high maturity practices – The Capability Maturity Model for software – CMM-I and ISO 9001:2008: A comparative analysis		
		Total:45

TEXT BOOK:

1.	Nina S. Godbole, "Software Quality Assurance Principles and Practice", 2nd Edition, Narosa Publishing House, 2017.

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	apply quality assurance steps at each phase of SDLC and conduct reviews and inspections	Applying (K3)
CO2	apply the concepts to identify the product quality with defined metrics for software models	Applying (K3)
CO3	identify the managing components of software Configuration Management	Applying (K3)
CO4	evaluate the methodologies for SCM and SQA Standards	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	30	50	20				100
CAT2	20	50	30				100
CAT3	20	50	30				100
ESE	20	35	45				100
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)							

CO5	evaluate the methodologies of CMM for software	Applying (K3)

22ALE08- SOFTWARE DEFINED NETWORKS							
Programme & Branch	**B.Tech. Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**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)

22ADE21 - SOFTWARE TESTING

(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)

Programme & Branch	B.Tech. Artificial Intelligence and Data Science & B.Tech. Artificial Intelligence and Machine Learning	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**8**	**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 for Unit-1.
2..	Perry William, “Effective Methods for Software Testing”, 3rd Edition, Wiley India, Reprint 2013 for Units 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)

22ADE22 - SOFTWARE PROJECT MANAGEMENT							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech. Artificial Intelligence and Data Science & B.Tech. 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 softwareprojects – Stakeholders – Setting objectives – Business case – Project success and failure - Management and managementcontrol – Traditional vs. Modern project management practices. Project Evaluation: Introduction – A business case – ProjectPortfolio Management – Evaluation of Individual Projects – Cost Benefit Evaluation Techniques – Risk Evaluation – Programmemanagement – Managing the allocation of resources within programme– Strategic programme management – Creating aprogramme–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 –Problemswith over and under estimates –Basis –Techniques – Bottom-up Estimating – Top down approach and parametric models – Expert Judgement – Estimating by analogy –AlbrechtFP–FP MarkII- COSMICFFP–COCOMOII.

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 ProjectDuration – Identifying critical activities – Activity on Arrow Networks. Risk Management: Risk – Categories of Risk – Framework –RiskIdentification–RiskAssessment –RiskPlanning–Riskmanagement – ApplyingPERTTechnique– MonteCarloSimulation
– Criticalchainconcepts.

Unit- IV	**Monitoring and Control:**	**9**

CreatingFramework–CollectingTheData–Review-VisualizingProgress–CostMonitoring–EarnedValueAnalysis– PrioritizingMonitoring–GettingProjectBackToTarget–ChangeControl.ManagingContracts:Introduction–TypesofContract –StagesInContract Placement–TypicalTermsofAContract–ContractManagement–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 – CoordinationDependencies– Dispersedand virtualteams– Communication Generes–CommunicationPlans – Leadership.

Total:45

TEXT BOOK:

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

REFERENCES:

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

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Make use of process of software project management and apply evaluation technique to choose best project.	Applying(K3)
CO2	Prepare the project plan and calculate the efforts required.	Applying(K3)
CO3	plan,schedule and sequence the activities and determine the risks.	Applying(K3)
CO4	Develop visualization charts to monitor the progress of projects and to control the risks involved.	Applying(K3)
CO5	Apply the methods of managing people and 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	20	35	45				100

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

22ALO01- BUSINESS INTELLIGENCE							
(Offered by Department of Artificial Intelligence)							
Programme & Branch	**All BE/BTech Branches except AIDS and AIML**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**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.

REFERENCES:

1.	Ramesh Sharda, DursunDelen and Efraim Turban, "Business Intelligence, Analytics, and Data Science: A Managerial Perspective", 4th Edition, Pearson Education, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	demonstrate the enterprise view of IT applications and identify the different types of digital data	Applying (K3)
CO2	make use of BI concepts and techniques to experiment ETL process	Applying (K3)
CO3	compare OLTP with OLAP systems and design dimensional model	Applying (K3)
CO4	apply different 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)

22ALX01 - DATA EXPLORATION AND VISUALIZATION TECHNIQUES							
(Offered by Department of Artificial Intelligence)							
Programme & Branch	**All BE/BTech Branches except AIDS and AIML**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Python Programming**	**6**	**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 EXPERIMENTS / EXERCISES:

1.	Load data in different formats and apply preprocessing
2.	Perform grouping aggregating and transforming operations on data
3.	Design different types of 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:

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.

REFERENCES/ MANUAL / SOFTWARE:

1.	Python, Matplotlib, Seaborn, Plotly
2.	Linux / Windows
3.	Laboratory 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) Precision (K3)
CO2	make use of the features of data frames, panels and series data structure to analyze data	Applying (K3) Precision (K3)
CO3	apply the plotting techniques for efficient data visualization	Applying (K3) Precision (K3)
CO4	perform time series data analysis using appropriate methods	Applying (K3) Precision (K3)
CO5	implement suitable techniques to analyze categorical data and use libraries for modelling the data	Applying (K3) Precision (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	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)

22ALO02 - INDUSTRIAL MACHINE LEARNING							
(Offered by Department of Artificial Intelligence)							
Programme & Branch	**All BE/BTech Branches except AIDS and AIML**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**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 .

REFERENCES:

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)

22ALO03 - MACHINE LEARNING FOR SMART CITIES							
(Offered by Department of Artificial Intelligence)							
Programme & Branch	**All BE/BTech Branches except AIDS and AIML**	**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.

REFERENCES:

1. J. Joshua Thomas, Vasiliki Geropanta, Anna Karagianni, Vladimir Panchenko, "Smart Cities and Machine Learning in Urban Health", 1st Edition, IGIGlobal, US, 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	5	45	50				100

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

22MAO01 - MATHEMATICAL FOUNDATIONS FOR MACHINE LEARNING							
(Offered by Department of Mathematics)							
Programme & Branch	**All B.E/.BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**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**
Real Vector spaces (Definition & Problems) – Subspaces – Linear Combinations – Linear dependence and independence – Basis and dimension – Row space, Column space and Null Space.		
Unit – II	**Linear Transformations:**	**9+3**
Introduction – Rank and nullity. – Dimension theorem – Kernel and range – Change of basis – Composition and inverse transformations – Matrices of linear transformations.		
Unit – III	**Inner Product Spaces:**	**9+3**
Norms – Inner products – Length and Distance – Angle and Orthogonality – Orthonormal Basis – Gram-Schmidt Process – QR-Decomposition.		
Unit – IV	**Matrix Decomposition and Vector Calculus:**	**9+3**
Matrix Decomposition: Cholesky decomposition – Singular Value Decomposition. Vector Calculus: Differentiation of Univariate Functions – Partial Differentiation and Gradients – Gradients of Vector valued functions – Gradients of matrices – Useful Identities for Computing Gradients – Higher Order Derivatives – Linearization and Multivariate Taylor Series.		
Unit – V	**Optimization:**	**9+3**
Introduction – Classification of Optimization Problems – Constrained multivariable optimization with inequality constraints – Kuhn Tucker conditions – Lagrange's multiplier method –- Unconstrained optimization: Steepest descent method – Newton's method.		
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.	Ethem Alpaydin, "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	interpret the concepts of linear transformations.	Understanding (K2)
CO3	apply the concept of inner product space and decompose the given matrix by means of orthonormal vectors.	Applying (K3)
CO4	demonstrate the knowledge of factorisation of matrices and vectors in Machine learning.	Understanding (K2)
CO5	identify suitable optimization algorithms for machine learning applications.	Applying (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	3	1										
CO5	3	2	3	3										

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

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	65	20				100
CAT2	15	65	20				100
CAT3	15	50	60				100
ESE	10	40	50				100

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

22MAO02 - NUMERICAL COMPUTING							
(Offered by Department of Mathematics)							
Programme & Branch	**All B.E/.BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	To impart knowledge in interpolation, numerical differentiation and integration. Also develop skills to apply numerical algorithms to identify roots of algebraic and transcendental equations, finding eigen values and solve linear system of equations, ordinary differential equations.	
Unit – I	**Solution to Algebraic and Transcendental Equations and Eigen value problems:**	**9+3**
Solution to Algebraic and Transcendental Equations**:** Bisection method **-** Iteration method – Method of false position – Newton-Raphson method Iterative method for Eigen values: Power method – Jacobi's method.		
Unit – II	**Solution of Simultaneous Linear Algebraic equations:**	**9+3**
Introduction - Direct methods: Gauss elimination method – Gauss - Jordan method – LU decomposition method – Crout's method –Iterative methods: Gauss Jacobi and Gauss – Seidel methods.		
Unit – III	**Interpolation:**	**9+3**
Interpolation with equal intervals: Newton's forward and backward difference formulae – Central difference interpolation formulae: Gauss forward and backward interpolation formulae – Interpolation with unequal intervals: Lagrange's interpolation formula – Newton's divided difference formula.		
Unit – IV	**Numerical Differentiation and Integration:**	**9+3**
Differentiation using Newton's forward, backward and divided difference formulae – Numerical integration: Trapezoidal rule – Simpsons 1/3rd rule – Simpsons 3/8th rule – Double integrals using Trapezoidal and Simpson's rules.		
Unit – V	**Numerical Solution of First order Ordinary Differential Equations:**	**9+3**
Single step methods**:** Taylor series method – Euler method – Modified Euler method – Fourth order Runge-Kutta method – Multi step methods: Milne's predictor corrector method – Adam's Bashforth method.		
Lecture:45, Tutorial:15, Total:60		

TEXT BOOK:

1.	Veerarajan T, Ramachandran T., "Numerical Methods", 1st Edition, Tata McGraw Hill Publishing Company, New Delhi, 2018.

REFERENCES:

1.	Kandasamy, P., Thilakavathy, K. and Gunavathy, K., "Numerical Methods", Reprint Edition, S.Chand & Co, New Delhi, 2016.
2.	Sankara Rao. K., "Numerical Methods for Scientists and Engineers", 3rd Edition, Prentice Hall of India Pvt. Ltd, , New Delhi, 2007.
3.	Steven C. Chapra, Raymond P. Canale., "Numerical Methods for Engineers", 7th Edition, McGraw-Hill Education, 2014.
4.	Sastry, S.S, "Introductory Methods of Numerical Analysis", 5th Edition, PHI Learning Pvt. Ltd, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply various numerical techniques to solve algebraic and transcendental equations.	Applying (K3)
CO2	solve simultaneous linear equations by numerical methods.	Applying (K3)
CO3	compute intermediate values of given evenly (or) unevenly spaced data.	Applying (K3)
CO4	apply the concepts of numerical differentiation and integration in real time applications.	Applying (K3)
CO5	identify the solution of first ordinary differential equations by numerical methods.	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	2											
CO3	3	3	2											
CO4	3	2	1											
CO5	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	15	75				100
CAT2	10	15	75				100
CAT3	10	15	75				100
ESE	10	15	75				100

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

22MAO03 - STOCHASTIC PROCESSES AND QUEUING THEORY							
(Offered by Department of Mathematics)							
Programme & Branch	**All B.E/.BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	To provide an in-depth knowledge in random variables, random process, correlation and promote the ability to apply suitable queuing models to real time applications.	
Unit – I	**Random Variables:**	**9+3**
Discrete and Continuous random variables – Probability Mass and Probability density functions – Mathematical expectation and Variance – Moments – Moment generating functions.		
Unit – II	**Random processes:**	**9+3**
General concepts and definitions – Classification – Stationary process – Markov chains – Transition probabilities – Poisson process.		
Unit – III	**Correlation and Spectral densities:**	**9+3**
Auto Correlation – Cross Correlation – Properties (Without Proof) – Power spectral density – Cross spectral density – Properties (Without Proof) – Wiener- Khintchine relation – Relationship between cross power spectrum and cross correlation function.		
Unit – IV	**Queuing Theory:**	**9+3**
Characteristics of a queueing system – Kendall's notation – Queuing model I (Infinite capacity single server Poisson queue model) (M/M/1) : (∞/FIFO) – Little's formulae – Queuing model II (Infinite capacity multiple server Poisson queue model (M/M/C): (∞/FIFO) – Queuing model III (Finite capacity single server Poisson queue model) (M/M/1): (N/FIFO) – Queueing model IV (Finite capacity multiple server Poisson model) (M/M/C) : (N/ FIFO).		
Unit – V	**Non-Markovian Queues and Queue Networks:**	**9+3**
Introduction to Non-Markovian queues – M/G/1 queue – Pollaczek-Khintchine formula – Series queues – Open and Closed queuing networks		
		Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1. Veerarajan, T, "Probability and Statistics, Random Processes and Queuing Theory", 1st edition, McGraw-Hill Education, Chennai, 2019.

REFERENCES:

1. Athanasios Papoulis, S. Unnikrishna Pillai., "Probability, Random Variables and Stochastic Processes", 4th edition, McGraw Hill, New Delhi, 2017.
2. Allen A.O., "Probability, Statistics and Queuing Theory", 2nd Edition, Academic Press, New Delhi, 1990.
3. Roy D. Yates and David J. Goodman, "Probability and Stochastic Processes - A friendly Introduction for Electrical and Computer Engineers", 3rd edition, John Wiley & Sons, 2014.
4. John F. Shortle, James M. Thompson, Donald Gross and Carl M. Harris, "Fundamentals of Queuing Theory", 5th edition, John Wiley and Sons, New York, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply random variables suitably in practical problems.	Applying (K3)
CO2	apply the concept of random process in communication problems.	Applying (K3)
CO3	understand the concepts and properties of Spectral Density Function and Cross Correlation function.	Understanding (K2)
CO4	use the appropriate queuing model for a given practical application.	Applying (K3)
CO5	identify the real time queue in computer networks and take decision accordingly.	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												
CO3	3	2												
CO4	3	3	3										2	
CO5	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	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)

22MAO04 - STATISTICS FOR ENGINEERS							
(Offered by Department of Mathematics)							
Programme & Branch	**All B.E/.BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	To impart the basic knowledge in presentation of data, descriptive statistical measures and provide skills to apply correlation, suitable non- parametric tests and control charts to control the variations in real time applications.	
Unit – I	**Organization and Presentation of Data:**	**9+3**
Introduction to Statistics – Collection of data – Classification and tabulation of data – Types of data: primary, secondary, quantitative and qualitative data – Types of Measurements: nominal, ordinal, discrete and continuous data – Presentation of data – Diagrammatic and Graphical Representation: Histogram - Frequency curve - Frequency polygon - Cumulative frequency distributions – Ogive curves – Stem and leaf chart.		
Unit – II	**Descriptive Statistics:**	**9+3**
Measures of location or central tendency: Arithmetic mean – Median – Mode – Geometric mean – Harmonic mean – Partition values: Quartiles – Deciles and percentiles – Measures of dispersion: Mean deviation – Quartile deviation – Standard deviation – Coefficient of variation – Measures of skewness – Kurtosis.		
Unit – III	**Correlation and Regression:**	**9+3**
Correlation and Regression: Scatter Diagram – Karl Pearson's Correlation Coefficient – Rank Correlation - Regression Coefficients – Fitting of Regression Lines. Multiple Correlation and Regression: Multiple and partial correlation – Method of least squares – Plane of regression – Properties of residuals – Coefficient of multiple correlation – Coefficient of partial correlation – Multiple correlation with total and partial correlations – Regression and partial correlations in terms of lower order coefficient..		
Unit – IV	**Non-parametric tests:**	**9+3**
Introduction – Sign test: One sample sign test – Sign test for paired samples – Signed rank test – Rank Sum test: Mann Whitney U test – Kruskal-Wallis test – One sample run test – Tests of randomness.		
Unit – V	**Statistical Quality Control:**	**9+3**
Introduction to Statistical quality control – Control charts – Control chart for variables: $\bar{X}$-chart – R-chart – s-chart – Charts for attributes: np-chart – p-chart – c-chart.		
Lecture:45, Tutorial:15, Total:60		

TEXT BOOK:

1.	S.P.Gupta, "Statistical Methods", 44th Revised Edition, Sultan Chand & Sons, New Delhi, 2011 for Units I,II, V
2.	S.C.Gupta, V.K.Kapoor, "Fundamentals of Mathematical Statistics", 12th Edition, Sultan Chand & Sons, New Delhi, 2022. for Units III, IV.

REFERENCES:

1.	Jay L. Devore., "Probability and Statistics for Engineering and the Sciences", 9th Edition, Cengage Learning, USA, 2016.
2.	G.C.Beri, "Business Statistics", 3rd Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2011.
3.	Johnson. R.A., Miller. I and Freund. J., "Probability and Statistics for Engineers", 9th Edition, Pearson Education, India, 2018.
4.	Anthony Hayter, "Probability and Statistics for Engineers and Scientists", 4th Edition, Cengage Learning, USA, 2012.
5.	J. K. Sharma, "Business Statistics", 5th Edition, Vikas Publishing House Pvt Ltd, Noida, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	demonstrate the classification of data and present the data in various forms.	Understanding (K2)
CO2	compute and interpret descriptive statistical measures using numerical and graphical techniques.	Applying (K3)
CO3	apply statistical methods like correlation, regression analysis in analysing and interpreting experimental data.	Applying (K3)
CO4	use appropriate non-parametric test to analyze experimental data.	Applying (K3)
CO5	identify suitable control charts for monitoring processes..	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	2												
CO3	3	3	2											
CO4	3	3	1											
CO5	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	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)

22PHO01 - THIN FILM TECHNOLOGY							
(Offered by Department of Physics)							
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 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, (Unit I – IV)
2.	Sam Zhang, Lin Li and Ashok Kumar, Materials Characterization Techniques, 1st edition, CRC Press, Boca Raton, 2008 (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	2						2	2		2		
CO2	3	2	2						2	2		2		
CO3	3	2	2						2	2		2		
CO4	3	2	2						2	2		2		
CO5	3	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	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)**

22PHO02 - HIGH ENERGY STORAGE DEVICES							
(Offered by Department of Physics)							
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, Optical and Chemical Storage:**	**9+3**
Magnetic storage: Principle of operation, emerging challenges and a review on devices and technology. Electro-optic and optical storage: Emerging devices and upcoming technologies (qualitative). Chemical storage: Power to gas – Hydrogen and Methane. Power to liquid – Bio fuels – Aluminum-Boron, silicon, and zinc.		
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 I - 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, 2nd edition, Elsevier, 2022
3.	D. Linden and T. S. Reddy, Handbook of Batteries, 4th edition, McGraw Hill, Newyork, 2011

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, optical and chemical storage systems to illustrate the respective process under gone in these 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	2						2	2		2		
CO2	3	2	2						2	2		2		
CO3	3	2	2						2	2		2		
CO4	3	2	2						2	2		2		
CO5	3	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	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)**

22PHO03 - STRUCTURAL AND OPTICAL CHARACTERIZATION OF MATERIALS							
(Offered by Department of Physics)							
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 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+3**
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 (Scherrer equation), strain calculation – Applications.		
Unit – II	**Electron Microscopy:**	**9+3**
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 and working – Different types of filaments – Field emission scanning electron microscope –Wavelength dispersive X-ray analysis – Three parameter equation for quantitative composition analysis.		
Unit – III	**Scanning Tunneling Microscopy:**	**9+3**
Introduction to quantum mechanical tunneling – Basic principles of scanning tunneling microscopy – Two modes of scanning: constant height mode and constant voltage mode – Instrumentation and working – Applications.		
Unit – IV	**Raman Spectroscopy:**	**9+3**
Introduction – Pure rotational Raman spectra – Vibrational Raman spectra – Polarization of light and Raman effect – Structure determination – Instrumentation and working – Near-Infra-Red Raman Spectroscopy – Applications.		
Unit – V	**Ultra Violet &Visible Spectroscopy:**	**9+3**
Regions of UV-Visible radiation – Colour and light absorption – Chromophore concept – Beer's and Lambert's laws – Theory of electronic transition – Frank-Condon principle – Instrumentation and working – Applications.		
Lecture: 45, Tutorial: 15, Total: 60		

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	2						2	2		2		
CO2	3	2	2						2	2		2		
CO3	3	2	2						2	2		2		
CO4	3	2	2						2	2		2		
CO5	3	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	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)**

22CYO01 - INSTRUMENTAL METHODS OF ANALYSIS							
(Offered by Department of Chemistry)							
Programme & Branch	**All BE / BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**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 – Structural elucidation using 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 Electron 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)

22CYO02 - CHEMISTRY CONCEPTS FOR COMPETITIVE EXAMINATIONS

(Offered by Department of Chemistry)

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 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+3**

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+3**

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+3**

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+3**

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+3**

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.

Lecture: 45, Tutorial: 15, Total: 60

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", 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 and 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)

22CYO03 – ORGANIC CHEMISTRY FOR INDUSTRY							
(Offered by Department of Chemistry)							
Programme & Branch	**All BE / BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	Organic Chemistry for Industry aims to equip the students to have wide-range knowledge on organic chemistry in order to meet the industrial needs.	
Unit – I	**Basic aspects of Organic Chemistry**	**9+3**
Organic intermediates: carbocations, carbanions, free radicals, carbenes and nitrenes, their method of formation, stability and synthetic applications- Nucleophilic uni- and bimolecular reactions (SN1 and SN2)- Elimination reactions (E1 & E2; Hoffman & Saytzeff's rule).		
Unit – II	**Molecular Rearrangements**	**9+3**
Reactions involving electron deficient, carbon, nitrogen, oxygen centers, emphasis on synthetic utility of the rearrangements - Migration of carbon: Wagner-Meerwein, Pinacol-pinacolone, benzyl-benzilic acid rearrangement – Migration of nitrogen: Beckmann rearrangement, Hofmann, Curtius, Lossen rearrangements- Migration of oxygen: Bayer-Villiger oxidation.		
Unit – III	**Synthetic Reagents & Applications**	**9+3**
Lithium aluminium hydride- sodium borohydride- selenium-di-oxide- osmium tetroxide- phenyl isothiocyanate- N-bromosuccinamide (NBS)- lead tetraacetate - dicyclohexylcarbodiimide (DCC) – pyridinium chlorochromate (PCC) – Swern oxidation –p-toluenesulphonyl chloride – trifluoroacetic acid- lithium diisopropylamide (LDA) – 1,3- dithiane (reactive umpolung) - crown ethers-Trimethyl silyl iodide - dichlorodicyanobenzoquinone (DDQ) – Gilman reagent– phase transfer catalysts- Wilkinson's catalysts.		
Unit – IV	**Unit Operations**	**9+3**
Extraction: Liquid equilibria-extraction with reflux-extraction with agitation-counter current extraction. **Filtration:** Theory of filtration- pressure and vacuum filtration-centrifugal filtration. **Distillation:** Azeotropic and steam distillation. **Evaporation**: Types of evaporators-factors affecting evaporation. **Crystallization:** Crystallization from aqueous-non- aqueous solutions factors affecting crystallization-nucleation.		
Unit – V	**Unit Processes**	**9+3**
Nitration: Nitrating agents-aromatic nitration-kinetics and mechanism of aromatic nitration- process equipment for technical nitration-mixed acid for nitration. **Halogenation:** Kinetics of halogenations-types of halogenations-catalytic halogenations-Case study on industrial halogenation process. **Fermentation**: Aerobic and anaerobic fermentation. Production of Antibiotics: Penicillin and Streptomycin-Production of Vitamins: B2 and B12.		
Lecture: 45, Tutorial: 15, Total: 60		

TEXT BOOK:

1.	P.S.Kalsi," Organic Reactions and their Mechanisms", 5th Edition, New Age International publishers, 2020, for Unit-I, II, III, V.
2.	Arun Bahl, B.S.Bahl, "Advanced Organic Chemistry", 6th Edition, S Chand, 2022, for Unit-IV, V.

REFERENCES:

1.	V.K.Ahluwalia, Rakesh Parashar, "Organic Reaction Mechanisms" Fourth Edition, 2011
2.	Jonathan Clayden, Nick Greeves, Stuart Warren, "Organic Chemistry", 2nd Edition, Oxford University Press, 2014.
3.	Paula Yurkanis Bruice, "Organic Chemistry",8th Edition, Pearson, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	illustrate the basic concept of organic intermediates to explain the SN1, SN2, E1 and E2 reactions.	Understanding (K2)
CO2	utilize the concepts of molecular rearrangement to explain reactions involving electron deficient, carbon, nitrogen, oxygen centers, emphasis on synthetic utility of the rearrangements.	Applying (K3)
CO3	select the suitable synthetic regents for various functional group conversions in organic synthesis.	Applying (K3)
CO4	make use of the concept of extraction, filtration, distillation, evaporation, crystallization for the purification of organic compounds.	Applying (K3)
CO5	apply the concept of nitration, halogenations and fermentation to explain the industrial unit 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	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	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)

22MAO05 - GRAPH THEORY AND ITS APPLICATIONS							
(Offered by Department of Mathematics)							
Programme & Branch	**All B.E/.BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**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 - Shortest paths – Shortest path algorithms: Dijkstra's algorithm – Warshall's algorithm.		
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 - Minimum Spanning tree – Minimal spanning tree algorithms: Prim's algorithm – Kruskal's algorithm.		
Unit – III	**Graph Coloring:**	**9+3**
Vertex coloring – Chromatic number – Chromatic partitioning – Independent sets – Chromatic polynomial – Matching – Covering – Four color problem (statement only) – Simple applications.		
Unit – IV	**Matrix Representation and Applications:**	**9+3**
Matrix Representation: Incidence matrix – Circuit matrix - Cut-set matrix – Path Matrix – Adjacency matrix – Properties - The Chinese Postman Problem – Fleury's Algorithm – Travelling salesman problem.		
Unit – V	**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.		
Lecture:45, Tutorial:15, Total:60		

TEXT BOOK:

1.	Narsingh Deo, "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	apply basic graph theoretic concepts in finding shortest path.	Applying (K3)
CO2	intrepret 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	apply the concepts of matrix representation of graph structures.	Applying (K3)
CO5	identify the maximal flow in network by means of suitable 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											
CO2	3	1												
CO3	3	1												
CO4	3	2	2											
CO5	3	2	3											

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

ASSESSMENT PATTERN - THEORY

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

22MAX01 - DATA ANALYTICS USING R PROGRAMMING							
(Offered by Department of Mathematics)							
Programme & Branch	**All B.E/.BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**0**	**2**	**4**

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.		

List of Exercises / Experiments:

1.	Implementation of operations of data objects such as vector, list and matrix.
2.	Implementation and use of array, factors and data frames in R.
3.	Programs using decision making statements and looping structures.
4.	Programs to demonstrate programming concepts using functions (Using built-in and user-defined functions)
5.	Performing various basic statistical measures for the given data.
6.	Calculate the regression coefficient and obtain the lines of regression for the given data.
7.	Creating and reading various types of data files.
8.	Create different charts for visualization of given set of data.
9.	Computation of probability using Binomial, Poisson and Normal distributions.
10.	Perform the t-test for testing significance of mean.
11.	Perform various non-parametric tests for the given sample data.
12.	Perform One way and two way ANOVA.

Lecture:45, Practical:30, Total:75

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.
4.	Laboratory Manual

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) Manipulation (S2)
CO2	apply the concepts of decision, looping structures and functions in real time problems.	Applying (K3) Manipulation (S2)
CO3	apply R programming to descriptive statistics.	Applying (K3) Manipulation (S2)
CO4	apply the libraries for data manipulation and data visualization in R.	Applying (K3) Manipulation (S2)
CO5	use R studio to identify the probability and test statistical hypothesis.	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	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	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)

22MAO06 - OPERATIONS RESEARCH							
(Offered by Department of Mathematics)							
Programme & Branch	**All B.E/.BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	To provide the skills for solving the real time engineering problems involving linear objective functions, transportation models and also impart knowledge in finding optimal solutions to problems involving limited resources, project management techniques and game theoretic concepts.	
Unit – I	**Linear Programming:**	**9+3**
Introduction to Operations research – Applications of OR – Linear Programming – Formation of Linear Programming Problem – Solution of LPP: Basic concepts – Graphical Solution – Simplex method – Artificial techniques: Big M method.		
Unit – II	**Transportation and Assignment Problems:**	**9+3**
Transportation Problem: Introduction – Mathematical formulation – Solution of transportation problem: Initial basic feasible solution: North-West Corner Rule – Vogel's Approximation Method – Optimal Solution: MODI method. Assignment Problems: Introduction – Mathematical Formulation – Hungarian Algorithm.		
Unit – III	**Game Theory:**	**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: Algebraic method – Arithmetic method – Graphical method.		
Unit – IV	**Sequencing models:**	**9+3**
Sequencing problems: Introduction – Johnson's algorithm – Processing of n jobs through two machines – Processing of n jobs through three machines – Processing of 'n' jobs through 'm' machines - Processing of two jobs through 'm' machines.		
Unit – V	**Network and Project Management:**	**9+3**
Introduction – Basic terminology **–** Rules of Network construction – Fulkerson's Rule for numbering of events – Construction of network – Critical Path Method (CPM) – Programme Evaluation and Review Technique (PERT).		
Lecture:45, Tutorial:15, Total:60		

TEXT BOOK:

1. Sharma J.K, "Operations Research – Theory and Applications", 6th Edition, Trinity Press, India, New Delhi, 2017.

REFERENCES:

1. Taha, Hamdy A., "Operation Research: An introduction", 9th edition, Pearson Education, 2010.
2. Hiller, Frederick. S. and Lieberman, Gerald. J., "An introduction to Operations research- concepts and cases", Tata McGraw Hill (SIE) 8th edition, 2005.
3. Ravindran, A., Phillips, D.J., and Solberg, J.J., "Operations Research- Principles and Practice", John Wiley & Sons, 2005.
4. Kanti Swarup, P.K. Gupta, Man Mohan, "Operations Research", 15th revised Edition, S. Chand & Sons Education Publications, New Delhi, 2017.
5. Gupta P.K. and Hira D.S., "Operations Research: An Introduction", 7th Revised Edition, S.Chand and Co. Ltd., 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	identify the minimum processing times for sequencing problems	Applying (K3)
CO5	apply the concepts of CPM and PERT in scheduling the project networks.	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN - THEORY

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

22MAO07 - NUMBER THEORY AND CRYPTOGRAPHY							
(Offered by Department of Mathematics)							
Programme & Branch	**All B.E/.BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**1**	**0**	**4**

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:**	**9+3**
Division algorithm – Base-b representations – Number patterns – Prime and composite numbers – GCD – Euclidean Algorithm – Fundamental theorem of Arithmetic – LCM.		
Unit – II	**Theory of Congruences:**	**9+3**
Basic concepts – Properties of congruences – Linear congruences – Solution of linear congruences – Fermat's Little theorem – Chinese remainder theorem.		
Unit – III	**Number Theoretic Functions:**	**9+3**
Introduction – Functions τ and σ – Mobius function – Greatest integer function – Euler's Phi function – Euler's theorem – Properties of Euler's function – Applications to Cryptography.		
Unit – IV	**Primality testing and Factorization:**	**9+3**
Primality testing: Fermat's pseudo primality test – Solvay-Strassen test – Fibonacci test – Lucas test – Integer factorization: Trial division – Pollard's Rho method – Quadratic sieve method.		
Unit – V	**Classical Cryptographic Techniques:**	**9+3**
Introduction – Substitution techniques – Transposition techniques – Encryption and decryption – Symmetric and asymmetric key cryptography – Steganography.		
		Lecture:45, Tutorial:15, Total:60

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)

22PHO04 - SYNTHESIS, CHARACTERIZATION AND BIOLOGICAL APPLICATIONS OF NANOMATERIALS
(Offered by Department of Physics)

Programme & Branch	**All BE/BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course aims to impart the knowledge on the fundamentals of nanomaterials, synthesis of nanomaterials, analysis of nanomaterials, carbon tubes and biological applications of nanomaterials.	
Unit – I	**Introduction to nanomaterials**	**9+3**
Nanoscience and nanotechnology – Scientific revolution – Nanoscale – Nanosized effects – Surface-to-volume ratio – Quantum confinement effect – Classification of nanomaterials based on dimension – Properties of nanomaterials – Metal nanoparticles – Ceramic nanoparticles – Semiconductor nanoparticles – Polymer nanomaterials.		
Unit – II	**Synthesis of nanomaterials**	**9+3**
Physical, chemical and mechanical methods of preparation – Top down approaches and bottom up approaches – Physical Vapor Deposition method – Colloidal precipitation method – Sol-Gel method – Chemical precipitation method – Green synthesis method of nanomaterials.		
Unit – III	**Characterization of nanomaterials**	**9+3**
X-ray diffraction analysis – Grain size calculation – Lattice parameters - Cell volume – Photoluminescence analysis – Emission peak analysis – UV visible spectroscopy analysis – Bandgap estimation – HRTEM & AFM analysis (qualitative) – particle size analysis – BET (qualitative).		
Unit – IV	**Carbon nanotubes**	**9+3**
Allotropes of carbon – Diamond – Graphite – Graphene – Fullerenes – Carbon nanotubes – Properties – SWCNT – MWCNT – Structure of Carbon nanotubes – Preparation: Laser ablation method – CVD – Applications.		
Unit – V	**Biological applications**	**9+3**
Antibacterial activity – Mechanism – Antifungal activity – Microorganism – Gram positive bacteria – Gram negative bacteria – Disc diffusion method – Antioxidant activity – DPPH method – Anticancer activity – Cytotoxity – MTT method –Toxicity of nanoparticles.		
		Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1. Charles P Poole Jr., and Frank J. Ownes ,. “Introduction to Nanotechnology”, John Wiley Sons, Inc., 2003.

REFERENCES:

1. C. Kittel., “Introduction to Solid State Physics”, Wiley Eastern Ltd., (2005).
2. Tamilarasan K. and Prabu K., “Materials Science”, 1st Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	describe the properties of nanomaterials using concepts such as surface to volume ratio and quantum confinement and also able to classify nanomaterials.	Applying (K3)
CO2	explain the synthesis of nanomaterials using select physical and chemical methods.	Applying (K3)
CO3	explain the characterization of nanomaterials using XRD, UV-vis, HRTEM & AFM and BET.	Applying (K3)
CO4	Illustrate the preparation of CNT and their applications.	Applying (K3)
CO5	explore the biological applications of nanomaterials such as antibacterial activity, antifungal activity, antioxidant activity and anticancer activity.	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		
CO2	3	2	2						2	2		2		
CO3	3	2	2						2	2		2		
CO4	3	2	2						2	2		2		
CO5	3	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	20	50	30				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)**

22PHO05 - TECHNIQUES OF CRYSTAL GROWTH
(Offered by Department of Physics)

Programme& Branch	All BE/BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course aims to impart the knowledge on crystals, physics of crystal growth and crystal growth methods.	
Unit – I	**Introduction to Crystals**	**9+3**
Classification of solids – Crystalline and amorphous – Single and polycrystalline materials – Space lattice – Bravais lattice – Lattice planes – Miller indices – Indices of crystal direction – Symmetry – Symmetry elements in cubic crystal – Physical properties.		
Unit – II	**Theories of Crystal Growth**	**9+3**
Phase rule – Phase diagrams – Binary phase diagrams – Alloy and compounds – Binary system with complete solid solution and no solid solution (eutectic) – Invariant reactions – Eutectic, peritectic and peritectoid (qualitative) – Nucleation concept – Homogeneous, heterogeneous nucleation – Classical theory – Energy of formation of nucleus – Kinetic theory of nucleation (qualitative) – Atmospheric nucleation.		
Unit – III	**Melt growth**	**9+3**
Bulk crystal growth methods – Melt growth methods – Bridgman (vertical and horizontal) and Czochralski methods – Liquid encapsulated technique (LEC) for semiconductors – Vermeil growth technique for growing gem crystals – Zone melting.		
Unit – IV	**Solution growth**	**9+3**
Low temperature solution growth – High temperature solution growth – Electro crystallization – Crystal growth in gel – Growth of biological crystals – Hydrothermal technique.		
Unit – V	**Vapour growth**	**9+3**
Physical vapour transport – chemical vapour transport. Epitaxial growth techniques – Liquid phase epitaxy – Vapour phase epitaxy: chloride, hydride, metalorganic – Molecular beam epitaxy – Chemical beam epitaxy.		

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1. Introduction to Crystallography Philips, Read Books (9 June 2011), India.

REFERENCES:

1. B. D. Cullity Addison, Elements of X-ray diffraction, Wesley Publishers, 1977.
2. Santhana Raghavan and Dr. P. Ramasamy, Crystal growth processes and methods, KRU publications, 1999.
3. Leonid V. Azaroff, Introduction to Solids, Tata McGraw Hill Publishing Company.
4. C. Kittel Wiley, Introduction to Solid State Physics, Eastern University Edition.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	describe the physical properties of crystals using the concepts of crystalline materials, amorphous material, space lattice, unit cell, Miller indices and crystal symmetry.	Applying (K3)
CO2	explain nucleation in crystal growth using the concepts of phase diagrams and formation energy.	Applying (K3)
CO3	demonstrate the growth of bulk crystals using melt growth techniques.	Applying (K3)
CO4	demonstrate the growth of crystals using solution growth techniques.	Applying (K3)
CO5	comprehend the growth of epitaxy crystal using vapour growth 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						2	2		2		
CO2	3	2	2						2	2		2		
CO3	3	2	2						2	2		2		
CO4	3	2	2						2	2		2		
CO5	3	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	20	50	30				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)**

22CYO04 - CORROSION SCIENCE AND ENGINEERING

(Offered by Department of Chemistry)

Programme & Branch	All BE / BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	OE	3	1	0	4

Preamble	Corrosion science and engineering aims to equip the students to have a wide-range of knowledge on corrosion and prevention methods in order to meet the industrial needs.	
Unit – I	**Corrosion and its Units**	**9+3**
Introduction- 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 of 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 determining corrosion rates - weight loss method, weight gain method and chemical analysis of solution.		
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 - limitations and applications.		
Unit – III	**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 – IV	**Types of Corrosion**	**9+3**
Introduction - (i) Crevice - differential aeration corrosion (ii) pitting – mechanism and factors (iii) intergranular- chromium depletion theory, weld decay and knife line attack (iv) stress - SCC mechanism, corrosion fatique- Cavitation damage – fretting damage (v) stray current corrosion - causes and its control.		
Unit - V	**Prevention of Corrosion**	**9+3**
Inhibitors – types of inhibitors, chemisorption of inhibitors, effect of concentration, effect of molecular structure, vapour phase 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- painting, vitreous enamels, plastic lining.		

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, Revised 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	utilize the theories of corrosion to interpret with the real time applications.	Applying (K3)
CO4	organize the various types of corrosion to understand the corrosion problems.	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)

22CYO05 - CHEMISTRY OF COSMETICS IN DAILY LIFE

(Offered by Department of Chemistry)

Programme & Branch	All BE / BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course aims to provide knowledge on chemistry of cosmetics for engineering students.	
Unit - I	**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) - basics of dispersions - electrical charges associated with surfaces and barriers – basics of emulsion (stability, Ostwald ripening, prevention of creaming and sedimentation).		
Unit - II	**Structuring Materials and Regulation 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 – cosmetic and personal care product safety – potential contaminants in cosmetics – regulations related to cosmetics – cosmetic regulation in india - future challenges in cosmetics material development.		
Unit - III	**Polymers in Cosmetic Products**	**9+3**
Polymers in Cosmetics - polymer solubility and compatibility, polymer conformation - 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 - IV	**Natural Products and Fragrance in Cosmetics**	**9+3**
Introduction – natural products – extraction methods - encapsulation and controlled release - allergens in cosmetics – testing for allergens - aroma chemicals - fragrance creation and duplication - fragrance applications -– malodor – fragrance allergies and sensitivities.		
Unit - V	**Preparation of Cosmetics**	**9+3**
Cosmetics in day to day life – characteristics, types, formulation, preparation and evaluation methods of lipstick, shampoo, powder, nail lacquer, creams, toothpaste and hair dye.		

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, Jayesh Gadiya, Meenakshi Dhanawat 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 and regulation involved in cosmetics development.	Applying (K3)
CO3	interpret the polymers and its role in cosmetics.	Understanding (K2)
CO4	develop knowledge about natural products and Fragrance in Cosmetics.	Applying (K3)
CO5	apply the knowledge of cosmetics to explain the characteristics, formulation, 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)

(Offered by Department of Chemistry)

Programme& Branch	All BE / BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	**Nil**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course aims to equip the students to have knowledge on processing, characterization, properties, features and applications of nanocomposites.

Unit – I	**Introduction of nanocomposites**	**9+3**

Introduction – nanocomposites – nanocomposites past and present – nomenclature – composite materials: introduction to solids - atomic and molecular solids – role of statistics in materials – primary, secondary and tertiary structure – transitions.

Unit - II	**Properties and features of nanocomposites**	**9+3**

Properties: physics of modulus – continuum measurements – yield – fracture – rubbery elasticity and viscoelasticity – composites and nanocomposites – surface mechanical properties –diffusion and permeability – features of nanocomposites: basics of polymer nanocomposites - nano reinforcements – matrix materials – hazards of particles.

Unit - III	**Processing of nanocomposites**	**9+3**

Viscosity: types of flow, experimental viscosity, non-newtonian flow -low-viscosity processing: solvent processing, particle behavior, in situ polymerization, post-forming, hazards of solvent processing - melt, high shear and direct processing: melting and softening, melt processes with small shears or low-shear rates flow, meltprocesses with large deformations or high-shear rates, thermo-kinetic processes.

Unit - IV	**Characterization of nanocomposites**	**9+3**

Introduction to characterization – experiment design – sample preparation – imaging –structural characterization – scales in nanocomposites – texture – electromagnetic energy –visualization – physicochemical analysis – characterization of physical properties.

Unit - V	**Applications of nanocomposites**	**9+3**

Nanocomposites – optical, structural applications – nanoparticulate systems with organic matrices – applications – biodegradable protein nanocomposites – applications-polypropylene nanocomposites – application as exterior automatic components – hybrid nanocomposite materials – application for corrosion protection.

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Thomas E. Twardowski, “Introduction to Nanocomposite Materials – Properties, Processing, Characterization”, DesTech Publications, April 2007, for Units-I, II, III, IV.
2.	Klaus Friedrich, Stoyko Fakivov, Zhony Shang, “Polymer Composites from Nano – to Macro – scale”, Springer USA, 2005, for Units-I, II, V.

REFERENCES:

1.	Pulickel M. A, Linda S. S, Paul V.B, “Nanocomposite Science and Technology”, Wiley-VCH, 2006.
2.	Vikas Mittal, Characterization techniques for polymer nanocomposites, Wiley-VCH, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify the knowledge of nanocomposites and to explain its structure.	Applying (K3)
CO2	apply the knowledge on various properties and features of nanocomposites.	Applying (K3)
CO3	choose the various concepts involving in the processing of nanocomposites.	Applying (K3)
CO4	apply the acquired knowledge on characterization of nanocomposites.	Applying (K3)
CO5	organize the applications of nanocomposites in various fields.	Applying (K3)

Mapping of COs with POs and PSOs

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

22MAO08 - NON-LINEAR OPTIMIZATION							
(Offered by Department of Mathematics)							
Programme & Branch	**All B.E/.BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**OE**	**3**	**0**	**0**	**3**

Preamble	The course focuses on the basic concepts, various techniques and applications of engineering optimization.	
Unit – I	**Classical Optimization Techniques:**	**9**
Introduction to Optimization – Statement of an Optimization problem – Mathematical formulation – Multi variable optimization with equality constraints – Lagrange multipliers method – Multi variable optimization with inequality constraint – Kuhn Tucker conditions.		
Unit – II	**Non-Linear Programming: One-Dimensional Minimization Method:**	**9**
Introduction – Unimodal function – Elimination Methods: Unrestricted search – Exhaustive search – Dichotomous search – Interval halving method – Fibonacci method – Golden section method – Direct root methods: Newton method – Secant method.		
Unit – III	**Non-Linear Programming: Unconstrained Optimization Techniques:**	**9**
Introduction to Unconstrained optimization – Direct Search Methods: Grid search method – Univariate method – Hookes and Jeeve's method – Powell's method.		
Unit – IV	**Unconstrained Optimization Techniques (Indirect Methods):**	**9**
Gradient of a Function – Indirect Search Methods: Steepest descent method – Fletcher-Reeves method – Newton's method – Marquardt method.		
Unit – V	**Non-Linear Programming: Constrained Optimization Techniques:**	**9**
Introduction – Characteristics of a Constrained Problem – Direct Methods: Random search method – Sequential linear programming – Indirect methods: Transformation techniques – Exterior penalty function method – Interior penalty function method.		
		Total:45

TEXT BOOK:

1. S.S.Rao, Engineering Optimization Theory and Practice, 5th Edition, John Wiley & Sons Ltd, USA, 2020.

REFERENCES:

1. David Luenberger and Yinyu Ye, Linear and Nonlinear Programming, 4th edition, Springer-Verlag, 2015
2. A.Ravindran, K.M.Ragsdell, G.V.Reklaitis, Engineering Optimization: Methods and applications, 2nd Edition, Wiley India Pvt. Ltd., 2006.
3. Yang, Xin-She. Optimization Techniques and Applications with Examples. 1st Edition, John Wiley & Sons, United Kingdom, 2018.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	solve problems with equality and inequality constraints.	Applying (K3)
CO2	solve nonlinear programming problems of functions of single variable.	Applying (K3)
CO3	use methods of unconstrained optimization to solve non linear problems	Applying (K3)
CO4	solve nonlinear optimization problems in the presence of inequality and equality constraints.	Applying (K3)
CO5	apply several modern methods of optimization for solving 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											
CO2	3	2												
CO3	3	3	1											
CO4	3	3	3											
CO5	3	2	3											

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

ASSESSMENT PATTERN - THEORY

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

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

22MAO09 - OPTIMIZATION FOR ENGINEERS							
(Offered by Department of Mathematics)							
Programme & Branch	**All B.E/.BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**OE**	**3**	**0**	**0**	**3**

Preamble	To provide the skills for solving the real time engineering problems involving linear and non-linear objective functions and also impart knowledge in finding optimal solutions to problems involving multi-level decision making and analyzing queuing models.	
Unit – I	**Linear Programming:**	**9**
Introduction to Operations research – Applications of OR – Linear Programming – Formation of Linear Programming Problem – Solution of LPP: Basic concepts – Graphical Solution – Simplex method – Artificial techniques: Big M method.		
Unit – II	**Integer Programming:**	**9**
Introduction – Types of Integer Programming Problems – Solution of Integer programming problems – Gomory's all integer cutting plane method - Gomory's Mixed-Integer Cutting Plane Method – Branch and Bound method.		
Unit – III	**Dynamic programming:**	**9**
Introduction – Characteristics – Formulation of Dynamic programming problems –Dynamic programming Algorithm – Solution of Discrete Dynamic programming problem – Solution of LPP by Dynamic programming.		
Unit – IV	**Queueing Theory:**	**9**
Characteristics of a queueing system – Kendall's notation – Queuing model I (Infinite capacity single server Poisson queue model) (M/M/1) : (∞/FIFO) – Little's formulae – Queuing model II (Infinite capacity multiple server Poisson queue model (M/M/C): (∞/FIFO) – Queuing model III (Finite capacity single server Poisson queue model) (M/M/1): (N/FIFO) – Queueing model IV (Finite capacity multiple server Poisson model) (M/M/C) : (N/ FIFO)..		
Unit – V	**Non-Linear Programming:**	**9**
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

TEXT BOOK:

1.	Sharma J.K, "Operations Research – Theory and Applications", 6th Edition, Trinity Press, India, New Delhi, 2017.

REFERENCES:

1.	Taha, Hamdy A., "Operation Research: An introduction", 9th edition, Pearson Education, 2010.
2.	Hiller, Frederick. S. and Lieberman, Gerald. J., "An introduction to Operations research- concepts and cases", Tata McGraw Hill (SIE) 8th edition, 2005.
3.	Ravindran, A., Phillips, D.J., and Solberg, J.J., "Operations Research- Principles and Practice", John Wiley & Sons, 2005.
4.	Kanti Swarup, P.K. Gupta, Man Mohan, "Operations Research", 15th revised Edition, S. Chand & Sons Education Publications, New Delhi, 2017.
5.	Gupta P.K. and Hira D.S., "Operations Research: An Introduction", 7th Revised Edition, S.Chand and Co. Ltd., 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	solve Integer Programming problems that exist in real time applications.	Applying (K3)
CO3	demonstrate the theoretical workings of dynamic programming method to find shortest path for given network.	Applying (K3)
CO4	use the appropriate queuing model for a given practical application.	Applying (K3)
CO5	apply the concept of non-linear programming for solving the problems involving non-linear constraints and objectives.	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											
CO2	3	2	1											
CO3	3	2	1											
CO4	3	2	1											
CO5	3	2	3											

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

ASSESSMENT PATTERN - THEORY

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

22CYO07 - WASTE AND HAZARDOUS WASTE MANAGEMENT
(Offered by Department of Chemistry)

Programme & Branch	All BE / BTech Branches	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	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, generation, segregation, 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 and dairy industries.

Unit – V	Solid Waste Management and 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 Unit-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	explain the various disposal and treatment methods of hazardous wastes.	Understanding (K2)
CO3	organize the appropriate method for managing e-waste and biomedical waste.	Applying (K3)
CO4	identify the hazards from various industries and apply the waste management techniques for its treatment.	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)

22CYO08 - CHEMISTRY IN EVERY DAY LIFE
(Offered by Department of Chemistry)

Programme& Branch	**All BE / BTech Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**7**	**OE**	**3**	**0**	**0**	**3**

Preamble	This course aims to prepare the students to have the knowledge on oils, fats, sugar, adulterants in food, creams, milk powder, soil, fertilizer, pesticides, insecticides, fungicides and herbicides in order to know its chemistry in our everyday activities.	
Unit – I	**Oils, Fats and Sugar**	**9**
Distinction between oils and fats – properties – classification – edible oils – vegetable oils –animal oils – manufacture of oils by solvent extraction – refining of crude vegetable oils – processing of animal fats – manufacture of cane sugar – manufacture of sucrose from beet root.		
Unit – II	**Adulterants in food**	**9**
Food Adulteration and prevention – common food adulterants – food additives – food colorants– preservatives – flavourants – food poisoning – analysis of adulterants in edible oils, coffee powder, chilli powder, turmeric powder, meat , fish, ghee and milk – harmful effects of food adulterants		
Unit – III	**Creams and Milk powder**	**9**
Creams: Composition-chemistry of creaming process- Factors influencing cream separation (Mention the factors only) - Estimation of fat in cream - Milk powder: Need for making powder-drying process- spraying, drum drying, jet drying and foam drying-principles involved in each.		
Unit – IV	**Soil and Fertilizers**	**9**
Soil analysis: Composition of soil - Organic and Inorganic constituents-Soil acidity - buffering capacity of soils -Liming of soil - Fertilizers: primary nutrients –role of Nitrogen, potassium and phosphorous on plant growth –Complex fertilizers and mixed fertilizers and its composition - Secondary nutrients – micronutrients and their functions in plants -optimal addition of Fertilizers to obtain estimated yield.		
Unit – V	**Pesticides, Insecticides, Fungicides and Herbicides**	**9**
Pesticides – Classification – general methods of application and toxicity, Safety measures when using pesticides-Insecticides: Inorganic pesticides – borates - Organic pesticides – D.D.T. and BHC-Plant derivatives: pyrethrin and Nicotine - Synthetic organic pesticides: Endrin and Aldrin (Chemical name - Structure- functions and uses)-Fungicides: Inorganic (Bordeaux mixture) and organic (dithiocarbamate) fungicides - Industrial fungicides: Creosote fractions - Herbicides: Selective and non-selective - 2, 4-dicholorophenoxyacetic acid and 2,4,5-tricholorophenoxyaceticacid (structure and function).		
		Total: 45

TEXT BOOK:

1.	Sharma B K , Industrial Chemistry, Goel publishing house, New Delhi, 2011, for Units- I, II, IV
2.	Alex V Ramani, Food Chemistry, MJP Publishers, Chennai, 2009, for Units -II, III, V.

REFERENCES:

1.	Dilip Kumar Das, Introductory Soil Science, 1st Edition, Kalyani Publishers, Reprint 2002.
2.	K. Bagavathi Sundari– “Applied Chemistry”, MJP Publishers, Chennai, 2006.
3.	Ashutosh Kar, Medicinal Chemistry, Wiley Eastern limited, New Delhi, 1993.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	outline the importance of oils, fats and sugar.	Understanding (K2)
CO2	identify the harmful effects of adulterants in food.	Applying (K3)
CO3	develop the knowledge on creams and milk powder.	Applying (K3)
CO4	interpret the nature and composition of soil and fertilizers.	Understanding (K2)
CO5	illustrate the difference of pesticides, insecticides, fungicides and herbicides.	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)

22CYO09 - CHEMISTRY OF NUTRITION FOR WOMEN HEALTH
(Offered by Department of Chemistry)

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

Preamble	This course aims to provide knowledge for engineering students on components of health, fitness and also the role of nutrition for women health.	
Unit - I	**Nutrition**	**9**
Energy- functions, sources and concept of energy balance - recommended dietary allowances, dietary sources - effects of deficiency and/ or excess consumption on health of the following nutrients: carbohydrates and dietary fiber – 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	**Women Health**	**9**
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 - III	**Nutrition for Nursing Mother and Infants**	**9**
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 - IV	**Nutrition for Physical Fitness**	**9**
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.		
Unit - V	**Role of Women in National Development**	**9**
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.		
		Total: 45

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	explain the disease pattern and policies towards women health.	Understanding (K2)
CO3	develop knowledge about nutrition during lactation and for infants.	Applying (K3)
CO4	utilize the knowledge of physical fitness and nutrition towards good health.	Applying (K3)
CO5	interpret the various role of women in society.	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											
CO2	3	1												
CO3	3	2	1											
CO4	3	2	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)

22GEO01 - 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	**Nil**	**All**	**OE**	**4**	**0**	**0**	**4**

Preamble	This course serves as an introduction to the German language and awareness towards German lifestyle and cultural aspects of Germany and German speaking countries. One can learn to introduce oneself and able to gain the basic day to day vocabulary. On keen learning one would be able to understand the sentence structure and be able to reciprocate to basic questions	
Unit – I	**Good Day (Guten Tag)**	**12**
Greetings, Self-introduction and introducing others, Numbers, Alphabets, Countries and languages spoken. Grammar – W questions, Simple sentences, Verb conjugation and personal pronoun.		
Unit – II	**Friends & Colleague (Freund und Kollegen):**	**12**
Hobbies, Profession, Week, Months, Season and Generate Profile. Grammar – Articles, Plural, Verbs – have and to be, Yes/No questions.		
Unit – III	**n the City (In der Stadt):**	**12**
Name of places/buildings in the city, asking for directions, Understanding means of transport. Grammar – definite and indefinite articles, Negation articles and Imperative		
Unit – IV	**Food and Appointment (Essen und Termin):**	**12**
Food, Shopping, initiate conversations to understand and do shopping. Grammar – Accusative case, Verbs with Accusative. Understanding time and reciprocating, Appointments, Asking excuse, Family. Grammar – Prepositions: *am, um, von...bis,* Possessive articles- *mein, dein*.., Modal verbs- *müssen, können, wollen*		
Unit – V	**Socializing (Zeit mit Freunden):**	**12**
Planning together, Birthday, Invitation, Restaurant, looking for specific information in texts. Grammar – Separable verbs, Prepositions with Accusative case, Past tense of have and to be, Personal pronoun with Accusative.		
		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 structure of language and introducing each other	Remembering (K1)
CO2	understand vocabulary on seasons and basic verbs	Understanding (K2)
CO3	ask for directions in a new place and avail transport as required	Understanding (K2)
CO4	understand food habits of German and ask for appointments.	Understanding (K2)
CO5	learn to socialize in a German speaking country	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)

22GEO02 - JAPANESE 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	**Nil**	**All**	**OE**	**4**	**0**	**0**	**4**

Preamble	The basic level of Japanese which provides understanding of Hiragana, Katakana and 55 Kanjis also enables one to greet, introduce oneself and other person and also provides the ability to understand basic day to day conversations	
Unit – I	**Introduction to Hiragana and Katakana:**	**12**
Chart 1, Chart 2, Chart 3, Annexures 1 and 2 and basic Japanese rules along with similar sounded vocabularies for each chart.		
Unit – II	**Introduction to Nouns, various particles and usages:**	**12**
Forming simple sentences, asking questions, positioning differentiation and owning fundamentals – new particles and usages		
Unit – III	**Introduction of Verbs, time and place markers:**	**12**
Usage of action words in sentences and framing them – place and time markers usages – giving and receiving – omission of certain particles in a sentence.		
Unit – IV	**Introduction of Adjectives, Adverbs and usages:**	**12**
Describing nouns and verbs and framing them to relate day to day conversations- positive and negative ending of the same – introduction of the likes and dislikes expressions		
Unit – V	**Introduction to Counters and Kanji:**	**12**
How to use numbers-How to use quantifiers-Present form of adjectives and Nouns-Other necessary particles-How to use numbers and quantifiers – 55 kanji characters		
		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	read and understand typical expression in Hiragana and Katakana	Remembering (K1)
CO2	greet and introduce oneself and other	Understanding (K2)
CO3	communicate day to day conversations – basic level	Understanding (K2)
CO4	understand the Kanjis in Japanese Script	Understanding (K2)
CO5	comprehend concept of numbers, days, months, time and counters	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)

22GEO03 - DESIGN THINKING FOR ENGINEERS							
(Offered by Department of Computer Science and Engineering)							
Programme & Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	Design Thinking is human-centered problem solving tool which emphasize on empathy, collaboration, co-creation and stakeholder feedback to unlock creativity and innovation, to devises feasible and viable idea/solutions.	
Unit – I	**Design Thinking and Explore:**	**9+3**
Design Thinking: Key Principles and Mindset – Five Phases, Methods and Tools of Design Thinking – User Guide – Foundation Building for Design Thinking – **Explore**: Methods & Tools – STEEP Analysis – Strategic Priorities – Activity System – Stakeholder Mapping – Opportunity Framing.		
Unit – II	**Empathize**	**9+3**
Empathize: Methods & Tools – Field Observation – Deep User Interview – Empathy Map – User Journey Map - Need Finding – User Insights - User Persona Development.		
Unit – III	**Experiment**	**9+3**
Experiment: Methods & Tools – Ideation – SCAMPER – Analogous Inspiration – Deconstruct & Reconstruct – User Experience Journey – Prototyping– Idea Refinement.		
Unit – IV	**Engage**	**9+3**
Engage: Methods & Tools – Story Telling – Art of Story Telling – Storyboarding – Co-Creation with Users – Collect Feedback from Users.		
Unit – V	**Evolve**	**9+3**
Evolve: Methods & Tools – Concept Synthesis – Strategic Requirements –Evolved Activity Systems – Activity System Integration – Viability Analysis – Innovation Tools using User Needs, CAP, 4S – Change Management - Quick Wins.		
Lecture:45, Tutorial:15, Total:60		

TEXT BOOK:

1.	Lee Chong Hwa, "Design Thinking The Guidebook", Design Thinking Master Trainers of Bhutan, 2017. (E-Book)

REFERENCES:

1.	Jeanne Liedtka and Tim Ogilvie, "Designing for Growth: A Design Thinking Tool Kit for Managers", Columbia University Press, 2011.
2.	Jeanne Liedtka, Tim Ogilvie, and Rachel Brozenske, "The Designing for Growth 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	Construct design challenge and reframe the design challenge into design opportunity.	Applying (K3)
CO2	Interview the user, and know the feelings of users to foster deep user understanding and be able to uncover the deep user insights and needs.	Applying (K3)
CO3	Develop ideas and prototypes by brain storming using the ideation tools.	Applying (K3)
CO4	Organize the user walkthrough experience using ideal user experience journey.	Applying (K3)
CO5	Develop smart strategies & implementation plan that will deliver/achieve the idea/solution deduced from earlier phases.	Applying (K3)

Mapping of COs with POs and PSOs

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

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

ASSESSMENT PATTERN – THEORY

Tests	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT 1	10	20	70				100
CAT 2	10	15	75				100
CAT 3	10	15	75				100
ESE	10	15	75				100

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

22GEO04 - 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**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	This course will inspire the students to think innovation concepts and ideas for business model developments.	
Unit - I	**Innovation and Design Thinking:**	**9+3**
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+3**
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+3**
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+3**
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+3**
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		
Lecture:45, Tutorial:15, Total:60		

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

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

ASSESSMENT PATTERN - THEORY

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

22GEO05 - 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	**All**	**OE**	**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, 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, 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.
2.	

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	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)

22GEO06-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	**All**	**OE**	**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
2.	

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	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)

22GEO07-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**	**All**	**OE**	**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	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)

22GEO08 - 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**	**All**	**OE**	**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)

22GEO09 - 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**	**All**	**OE**	**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)

22GEO10 -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**	**All**	**OE**	**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)

22GEO11 - FRENCH 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	**Fundamentals of French Language**	**All**	**OE**	**4**	**0**	**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, 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)

22GEO12 -FRENCH 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	**Fundamentals of French Language**	**All**	**OE**	**4**	**0**	**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

TEXT BOOK:

1.	A2 – Saison

REFERENCES:

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

22GEO13- FRENCH 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	**Fundamentals of French Language**	**All**	**OE**	**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 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	Knowing about Letter writing, Creating Ads, Expressing Desires, and Instructing Others.	Understanding (K2)
CO4	Understanding rules for travel and Enhancing communications.	Understanding (K2)
CO5	Expressing 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)

22GEO14 - SPANISH 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	**Fundamentals of Spanish Language**	**All**	**OE**	**4**	**0**	**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)

22GEO15 - SPANISH 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	**Fundamentals of Spanish Language**	**All**	**OE**	**4**	**0**	**0**	**4**

Preamble	This course aims to help the Learner to acquire the vocabulary as per theframework of Spanish language A2 level competence. This course will help to assimilate the basicgrammar 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, AgusinGarmendia, 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	prepare for 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)

22GEO16 - SPANISH 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	**Fundamentals of Spanish Language**	**All**	**OE**	**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 (Seamoscreatives)**	**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 International 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	knowing about Letter writing, Creating Ads, Expressing Desires and Instructing Others.	Understanding (K2)
CO4	understanding rules for travel and Enhance communications.	Understanding (K2)
CO5	expressing 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)

22GEO17 - ENTREPRENEURSHIP DEVELOPMENT							
(Offered by Department of Mechatronics Engineering)							
Programme & Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Engineering Economics & Management**	**7**	**OE**	**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- Case Study		
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		
CO2	1	2	2	2		2	2	1	1		3	2		
CO3	2	2	2	2	2	2	2	2	2	2	3	2		
CO4	1	1	2	1		2	1	1	1	2	3	2		
CO5	1	1	2	1		2	1	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	20	40	40				100
CAT2	20	30	30	20			100
CAT3	30	30	40				100
ESE	10	30	40	20			100

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

22GEX01 – 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 & 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 & 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 by 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.						

22GEX02 - 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+3**
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+3**
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+3**
Laws of motion-Forces acting on aircraft – Bernoulli's theorem - Stalling - Primary control surfaces – secondary control surfaces - Aircraft recognition.		
Unit-IV	**Aero Engines**	**9+3**
Introduction of Aero engine -Types of engine - piston engine - jet engines - Turbo prop engines-Basic Flight Instruments - Modern trends.		
Unit–V	**Aero Modeling**	**9+3**
History of aeromodeling - Materials used in Aero-modeling - Types of Aero-models – Static Models - Gliders - Controlline models - Radio Control Models - Building and Flying of Aero-models.		

Lecture:45, Tutorial:30, Total:75

TEXT BOOK:

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

REFERENCES/ MANUAL / SOFTWARE:

1.	"Cadets Handbook – Common Subjects SD/SW", DGNCC, New Delhi.
2.	"Cadets Handbook – Specialised Subjects SD/SW", DGNCC, New Delhi.
3.	"NCCOTA Precise", DGNCC, New Delhi.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	build 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 air planes 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.						

22MBO01 - COST ACCOUNTING FOR ENGINEERS							
(Offered by Department of Management Studies)							
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**NIL**	**5**	**OE**	**3**	**1**	**0**	**4**

Preamble	To provide an In-depth study of the Cost Accounting principles and techniques for identification, analysis and classification of costs components to facilitate decision Making.	
Unit – I	**Introduction to Cost Accounting**	**9 + 3**
Introduction to Cost Accounting: Meaning - Scope, objectives and significance of Cost Accounting its relationship with financial accounting and management accounting– cost centres – cost units – Elements of cost – classification of cost – preparation of cost sheet.		
Unit – II	**Cost Ascertainment – Elements of cost**	**9 + 3**
Material Costs: Procurement of materials – Inventory management and control – scrap, spoilage, defectives and wastage **Labour Costs:** Time Keeping, Time booking and payroll – Labour turnover – principles and methods of remuneration and incentive schemes. **Overheads:** Collection, classification and apportionment and allocation of overheads.		
Unit – III	**Basic Costing Methods**	**9 + 3**
Operating Costing - Meaning - Preparation of Operating Cost Sheet - Transport Costing - Power Supply Costing - Hospital Costing.		
Unit – IV	**Advanced Costing Methods**	**9 + 3**
Features of Job Costing - Batch Costing - Preparation of Cost Sheet Under Job Costing, and Batch Costing - Process Costing - Process Loss - Normal and Abnormal Loss.		
Unit – V	**Cost Accounting Techniques**	**9 + 3**
Budget and Budgetary Control: Budgetary control as a management Tool – Installation of Budgetary control system classification of budgets – Fixed and Flexible Budgeting. **Standard Costing and Variance Analysis:** Budgetary control and standard costing – Suitability of standard costing – Standard costing as a management Tool – Cost variances – Direct material cost variances – Direct labour cost variances – Overhead variances – Sales variance.		
Lecture: 45, Tutorial: 15, Total:60		

TEXT BOOKS

1.	JawaharLal, SeemaSrivastava, Manisha Singh, " Cost Accounting, Text, Problems and Cases", 6th Edition, McGraw Hill Education, New Delhi, 2020.
2.	William Lanen, Shannon Anderson and Michael Maher, "Fundamentals of cost Accounting",7th Edition, McGraw Hill Education, New Delhi, 2020.

REFERENCES

1.	M.N.Arora and PriyankaKatyal, "Cost Accounting", 5th Edition, Vikas publishing House, New Delhi, 2023.
2.	Ravi M.Kishore, " Cost and Management Accounting", 6th Edition, Taxmann, New Delhi, 2021
3.	M.N.Arora, "Cost and Management Accounting",11th Edition, Vikas Publishing, New Delhi, 2021.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand the conceptual frame work of cost accounting	Understanding (K2)
CO2	understand the basic concepts and process in determination of cost of product and services	Understanding (K2)
CO3	use the basic costing methods in different business situation	Applying (K3)
CO4	demonstrate the advanced costing methods in various decision making situation	Applying (K3)
CO5	prepare various types of budgets and determine variance in different situations.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1										2	3	1		
CO2										2	3	1		
CO3										2	3	1		
CO4										2	3	1		
CO5										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	70					100
CAT2	15	35	50				100
CAT 3	15	35	50				100
ESE	25	25	50				100

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

22MBO02 Economic Analysis for Decision Making							
(Offered by Department of Management Studies)							
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Basic understanding of differential calculus**	**6**	**OE**	**3**	**1**	**0**	**4**

Preamble	The course aims at introducing a few vital techniques required for carrying out economic analysis for making informed managerial decisions.	
Unit – I	**Economic Optimization**	**9 + 3**
Economic Optimization: Theory of firm – Business versus Economic profit – Revenue relations – Cost relations – Profit relations – Marginal versus incremental concept.		
Unit – II	**Forecasting**	**9 + 3**
Forecasting: Forecasting applications – Techniques –Naire method – Moving average – Exponential smoothing - Trend analysis – Linear Trend – Growth Trend – Sales, cost and revenue forecasting.		
Unit – III	**Production and Cost Analysis**	**9 + 3**
Production: Production function – Returns to scale and returns to factor – Total, managerial and average product – Law of diminishing returns – Optimal input usage – Production function estimation. **Cost Analysis:** Economic and Accounting costs – Time in cost analysis – Short run cost – Long run cost – cost relations – cost volume – profit analysis.		
Unit – IV	**Competitive Market Analysis**	**9 + 3**
Competitive Market Analysis: Characteristics of competitive markets – Profit maximisation – Marginal analysis in competition – competitive market supply curve – Equilibrium in competitive markets - Monopoly – Monopolistic competition.		
Unit – V	**Game theory and Competitive Strategy**	**9 + 3**
Game Theory Basics - Prisoner's Dilemma - Saddle Point - Two Person Zero Sum Game - Games without Saddle Points - Dominance Rule - Mixed Strategies.		
Lecture: 45, Tutorial: 15, Total:60		

TEXT BOOKS

1.	Mark Hirschey, “Managerial Economics”, 12th Edition, Cengage Learning, New Delhi, 2022.
2.	Geetika, PiyaliGhosh, Purba Roy Choudhury, “Managerial Economics”, 3rd Edition, McGraw Hill Education, New Delhi, 2019.

REFERENCES

1.	Gupta. G, “Managerial Economics”, 2nd Edition, McGraw Hill Education, New Delhi, 2019.
2.	Ahuja. H. L, “Principles of Microeconomics”, 22nd Edition, S. Chand Publishing, New Delhi, 2019.
3.	PanneerSelvam R, P. Sivasankaran, P. Senthilkumar., “Managerial Economics”, 1st Edition, Cengage Learning, New Delhi, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Understand revenue, cost and profit relations and apply techniques to find best course of action.	Applying (K3)
CO2	Apply appropriate forecasting techniques for estimating sales, cost and revenue.	Applying (K3)
CO3	Understand the relation between inputs and output of production system and perform cost – volume – profit analysis	Applying (K3)
CO4	Apply market equilibrium concepts in monopoly and monopolistically competitive markets.	Applying (K3)
CO5	Understand game theory and apply in different strategic decisions	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1					2					1	3			
CO2					2					1	3			
CO3					2					1	3			
CO4					2					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	35	35	30				100
CAT2	15	45	40				100
CAT 3	15	35	50				100
ESE	5	40	55				100

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

22MBO03 Marketing Analytics							
(Offered by Department of Management Studies)							
Programme& Branch	**All BE/BTech Engineering and Technology Branches**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Basic understanding of differential calculus**	**7**	**OE**	**3**	**1**	**0**	**4**
Preamble	Marketing analytics enables marketers to measure, manage and analyze marketing performance to maximize its effectiveness and optimize return on investment (ROI). This course exposes the students with the tools to measure customer value and apply analytic tools to various marketing decisions.						
Unit – I	**Market & Marketing Analytics**						**9 + 3**
Introduction - Introduction to marketing analytics, Models & Metrics **Market Insight** - Market sizing. **Market Segmentation** –Segmentation, Targeting & Positioning							
Unit – II	**Business & Competition**						**9 + 3**
Competitive Analysis - Competitor identification, analysis, and actions **Business Strategy** –Scenarios, Decision Model, Metrics **Business Operations** - Forecasting							
Unit – III	**Product and Price**						**9 + 3**
Product and Service Analytics - Conjoint analysis and product/service metrics **Price Analytics** - Pricing techniques and assessment							
Unit – IV	**Distribution & Promotion**						**9 + 3**
Distribution Analytics –Characteristics, Channel evaluation and selection, Multichannel distribution and metrics. **Promotion Analytics** - Promotion budget estimation and allocation, Metrics							
Unit – V	**Sales**						**9 + 3**
Sales Analytics - Metrics for sales, profitability, and support							
Lecture: 45, Tutorial: 15, Total:60							

TEXT BOOKS

1.	Stephen Sorger, "Marketing Analytics: Strategic Models and Metrics", 1st Edition, Admiral Press, UK, 2016.
2.	Wayne L. Winston, "Marketing Analytics: Data-Driven Techniques with Microsoft Excel", 1st Edition, Wiley, New Delhi, 2018.

REFERENCES

1.	Tommy Blanchard, "Data Science for Marketing Analytics", 1st Edition, Packt Publishing, UK, 2019.
2.	Mike Grigsby, "Marketing Analytics", 2nd Edition, Kogan Page, UK, 2018.
3.	David A. Aaker, V. Kumar, Robert P. Leone, George S. Day., "Marketing Research", 1st Edition, Wiley, New Delhi, 2019.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Understand the importance of Analytics in Marketing, size and segment the market	Understanding (K2)
CO2	Understand the Business, competition and its related decisions.	Understanding (K2)
CO3	Identify important features of a product and suitable pricing methods.	Applying (K3)
CO4	Assess Channel performance and Promotion Metrics.	Applying (K3)
CO5	Assess sales performance.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1										2	3	1		
CO2										2	3	1		
CO3										2	3	1		
CO4										2	3	1		
CO5										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	35	65					100
CAT2	15	35	50				100
CAT 3	15	15	70				100
ESE	25	25	50				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.	22ADH01	Internet of Things and its protocols	3	NIL	5
2.	22ADJ01	Real time analytics and Internet of Things	4	Internet of Things and its protocols	5
3.	22ADH02	Internet of Things and Machine learning	4	Internet of Things and its protocols	6
4.	22ADH03	Intelligent Automation system	4	Internet of Things and its protocols	6
5.	22ADH04	Industrial Internet of Things	3	Internet of Things and its protocols	7
		TOTAL	**18**		

22ADH01 - INTERNET OF THINGS AND ITS PROTOCOLS							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech - Artificial Intelligence and Data Science & B.Tech - Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**5**	**HN**	**3**	**0**	**0**	**3**
Preamble	This course provides a high-level overview of IoT, IoT architecture and IoT applications. Further it discusses about DNA of IoT, Protocols for IoT and IoT communication technologies						
Unit - I	**Introduction:**						**9**
Introduction: Genesis of IoT - IoT and Digitization - IoT Impact - Convergence of IT and OT - IoT Challenges. IoT Network Architecture and Design: Drivers Behind New Network Architectures - Comparing IoT Architectures - A Simplified IoT Architecture - The Core IoT Functional Stack - IoT Data Management and Compute Stack.							
Unit - II	**IoT Applications and Four Pillars:**						**9**
Ubiquitous IoT Applications: A Panoramic View of IoT Applications - Important Vertical IoT Applications. Four Pillars of IoT: The Horizontal, Verticals, and Four Pillars - M2M: The Internet of Devices - RFID: The Internet of Objects - WSN: The Internet of Transducers - SCADA: The Internet of Controllers.							
Unit - III	**DNA and Middleware of IoT:**						**9**
The DNA of IoT: DCM: Device, Connect, and Manage - Device: Things That Talk - Connect: Via Pervasive Networks - Manage: To Create New Business Value. Middleware and IoT: An Overview of Middleware - Communication Middleware for IoT - LBS and Surveillance Middleware							
Unit - IV	**Protocol standards for IoT and WoT:**						**9**
Protocol Standardization for IoT: Web of Things versus Internet of Things - IoT Protocol Standardization Efforts - Unified Data Standards. Architecture Standardization for WoT: Platform Middleware for WoT - Unified Multitier WoT Architecture - WoT Portals and Business Intelligence - Challenges of IoT Information Security							
Unit - V	**IoT Communication Technologies:**						**9**
IoT Communication Technologies: Introduction - Infrastructure Protocols - Discovery Protocols - Data Protocols - Identification Protocols - Device Management - Semantic Protocols. IoT Interoperability: Introduction – Standards – Frameworks.							
							Total: 45

TEXT BOOK:

1. David Hanes, Gonzalo Salgueiro,, Robert Barton, Jerome Henry. “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”. Cisco Press, 1st Edition, USA, 2017, for Unit-1.
2. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 1st edition, New York, 2013, for Unit 2, 3, 4.
3. Sudip Misra, Anandarup Mukherjee, Arijit Roy. “Introduction to IoT”. Cambridge University Press, 1st edition, United Kingdom, 2021, for Unit- 5.

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	explains the IoT Network Architecture and Design	Applying (K3)
CO2	interpret the Pillars of IoT and make use of it in IoT applications	Applying (K3)
CO3	explore the technological aspects of the DCM layers of the IoT value chain and IoT middleware in IoT applications	Applying (K3)
CO4	examine the possibility of creating a unified IoT middleware architecture based on existing protocol standard	Applying (K3)
CO5	determine the requirements associated with IoT communication protocols in real-world solutions	Applying (K3)

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

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

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

22ADJ01 - REAL TIME ANALYTICS AND INTERNET OF THINGS							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech - Artificial Intelligence and Data Science & B.Tech - Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Internet of things and its protocols**	**5**	**HN**	**3**	**0**	**2**	**4**

Preamble	This foundational knowledge of sensors, their types, and how they seamlessly integrate with cutting-edge technologies like Node-RED and Power BI for data visualization is crucial for harnessing the power of data in myriad applications.

Unit – I	**Sensors and Actuators**	**9**
Sensors: Definition of Sensor, Sensor features, Resolution, Classes, Different types of sensors, Calibration methods, classification of errors. Actuators: Different types of Actuators, purpose of Sensors and Actuators in IoT , micro sensors and actuators.		
Unit – II	**LoRa WAN IoT Sensors**	**9**
Lora WAN Protocol: LoRa Vs Lora WAN – Lora WAN Infrastructure - Network Server and Application Server – Gateways – Configuration - Decoding a Lora WAN frame - Lora WAN Server as a MQTT client. Lora WAN Sensors: Photoelectric sensor - Humidity infrared detector (PIR) - Indoor Temperature and Humidity detector - Outdoor Temperature and Humidity detector - Proximity sensor		
Unit – III	**Getting started with Node-RED tool**	**9**
Prerequisite for Node-RED, Installing and upgrading Node-RED, Running Node-RED app locally – network -- auto-start on boot-installation of various libraries for Node-RED - adding node - add debug node - deploy the flow		
Unit – IV	**Visualization using Power BI**	**9**
Introducing Power BI - Importing Data into Power BI Desktop - Data Munging with Power Query-Creating the Data Model - Creating Reports with Power BI Desktop - Publishing Reports and Creating Dashboards in the Power BI Portal		
Unit – V	**Applications and use cases**	**9**
Case studies: IoT Environmental Monitoring with Node-RED and Power BI- Factory I/O to the End user dashboard - Remote Start and Stop from the Dashboard screen to Factory I/O Machine - Emergency Stop Factory I/O Machines with a signal from IoT sensor		

LIST OF EXPERIMENTS / EXERCISES:	
1.	Implement Temperature Monitoring system
2.	Implement IoT system to control and monitor a light remotely
3.	Design and develop Water Level Monitoring Using IoT
4.	Implement automate plant watering based on soil moisture
5.	Implement Energy Consumption and Cost Analysis using IoT
6.	Implement IoT Environmental Monitoring using IoT
7.	Design a dashboard that allows homeowners to control and monitor these devices remotely
8.	Create a real-time dashboard with cloud integration and a web-based interface for monitoring and controlling of real time sensor data

Lecture:45, Practical:30, Total:75

TEXT BOOK:	
1.	Hagino, T, ”Practical Node-RED Programming: Learn powerful visual programming techniques and best practices for the web and IoT” 2021, Packt Publishing Ltd

REFERENCES/ MANUAL / SOFTWARE:	
1.	Dan Clark. “Beginning Microsoft Power BI: A Practical Guide to Self-Service Data Analytics”. 3rd Edition, Apress, 2020.
2.	John G. Webster, HalitEren, “Measurement, Instrumentation, and Sensors Handbook”, 2ndEdition, CRC Press - Taylor & Francis Group, LLC Boca Raton, Florida, 2017
3.	Alai Labs Manual, V-2023

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	make use of sensor to implement IoT applications	Applying (K3) Precision (S3)
CO2	design, deploy, and manage LoRaWAN networks and sensor applications	Applying (K3) Precision (S3)
CO3	install, configure, and utilize Node-RED for creating applications	Applying (K3) Precision (S3)
CO4	design dashboards using Power PI,	Applying (K3) Precision (S3)
CO5	design and implement sensor systems for a wide range of real-world 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	3	2	2								2	3
CO2	3	2	3	2	2								2	3
CO3	3	2	3	2	2								2	3
CO4	3	2	3	2	2								2	3
CO5	3	2	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 %
CAT1	10	55	35				100
CAT2	10	55	35				100
CAT3	10	55	35				100
ESE	10	55	35				100

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

22ADH02 - INTERNET OF THINGS AND MACHINE LEARNING							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech - Artificial Intelligence and Data Science & B.Tech - Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Internet of things and its protocols**	**6**	**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	make use of various tools for storing and accessing IoT data	Applying (K3)
CO2	implement machine learning algorithms for IoT applications	Applying (K3)
CO3	develop various Deep Learning algorithms for IoT	Applying (K3)
CO4	apply Genetic Algorithms for IoT Optimization	Applying (K3)
CO5	implement advanced models for IoT 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	3		2								2	3
CO2	3	2	3		2								2	3
CO3	3	2	3		2								2	3
CO4	3	2	3		2								2	3
CO5	3	2	3		2								2	3

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

ASSESSMENT PATTERN – THEORY

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

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

22ADH03 - INTELLIGENT AUTOMATION SYSTEMS							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech - Artificial Intelligence and Data Science & B.Tech - Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Internet of things and its protocols**	6	HN	**3**	**1**	**0**	**4**

Preamble	This course discusses about the wide variety of techniques available for all building automation areas such as energy, HVAC, information, transportation, safety, security, maintenance, and facility management. This course enables scientists and engineers engaged in research on and the development and application of sensors in the building control area

Unit – I	**Building Automation System**	**9+3**
Introduction–Definitions of intelligent building – Facilities management vs intelligent buildings – Technology systems and evolution of intelligent buildings – Introduction to building automation System (BAS) –The progress of BAS –Programming and monitoring platforms and environment.		
Unit – II	**BAS Communication Standards and Internet Technologies**	**9+3**
BACnet and its features – Lon Works and its features– EIB and its features – Compatibility of different open protocol standards – Integration at management level – Internet protocols – use of Internet technologies at automation level – use of Internet technologies at management level – Convergence networks and total integration.		
Unit – III	**Lighting, Security and Safety Control Systems**	**9+3**
Introduction to lighting control systems – Systems based on common automation protocols–Strategies for energy management and lighting control – Basic CCTV components and analogue CCTV systems – IP surveillance system – Access control systems – Burglar alarm systems.		
Unit – IV	**Control and Optimization of Air- Conditioning Systems**	**9+3**
Typical control loops of the air- conditioning process – Control of CAV systems: Basic control of CAV systems, Sequential split range control of AHU – Control of VAV systems: Control of VAV air handling units, VAV terminal and room temperature control – Outdoor air ventilation control and optimization – Optimal control methods used for HVAC systems – Optimal control of air side systems.		
Unit – V	**Control and Optimization of Central Chilling Systems**	**9+3**
Basic working principles – Basic components and typical types – Chiller capacity control and safety interlocks – Chiller energy performance – Optimal control of central chilling systems – Optimal set point reset of chilled water supply temperature – Sequence control of multiple chiller plants: Temperature based sequence control, Bypass flow based sequence control.		

Lecture : 45, Tutorial : 15, Total:60

TEXT BOOK:

1.	Shengwei Wang, “Intelligent Buildings and Building Automation”, 1st Edition, Spon Press (an imprint of the Taylor & Francis Group), 2010.

REFERENCES:

1.	O. Gassmann, H. Meixner, "Sensors in Intelligent Buildings", 1st Edition, Wiley-VCH Verlag GmbH, Germany, 2001.
2.	NJATC, "Building Automation Control Devices and Applications", 1st Edition, American Technical Publishers, 2008.
3.	Singh S. K., ‘Industrial Instrumentation and Control’, 3rd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2009.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	demonstrate the functions of intelligent building automation system	Applying (K3)
CO2	use BAS Communication Standards and Internet Technologies for automation systems	Applying (K3)
CO3	make use of the different lighting, safety and security systems in building automation	Applying (K3)
CO4	implement the various Control and Optimization techniques for Air- Conditioning Systems	Applying (K3)
CO5	design various Control and Optimization methods for Central Chilling 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	3		2								2	3
CO2	3	2	3		2								2	3
CO3	3	2	3		2								2	3
CO4	3	2	3		2								2	3
CO5	3	2	3		2								2	3

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

ASSESSMENT PATTERN - THEORY

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

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

22ADH04 - INDUSTRIAL INTERNET OF THINGS							
(Common to Artificial Intelligence and Data Science & Artificial Intelligence and Machine Learning branches)							
Programme & Branch	**B.Tech - Artificial Intelligence and Data Science & B.Tech - Artificial Intelligence and Machine Learning**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Internet of things and its protocols**	**7**	**HN**	**3**	**0**	**0**	**3**

Preamble	This course provides the knowledge on Industrial Internet of Things (IIoT) fundamentals to enhance the existing automation system for monitoring the entire planning and product lifecycle.	
Unit – I	**Introduction:**	**9**
Introduction - IoT Background and History, IIoT key technologies, IoT and IIoT similarities and differences – Innovations and the IIoT – Intelligent devices – Key opportunities and benefits: Digital and human workforce – Industrial Internet use-cases - Industry 4.0: Characteristics and design principles.		
Unit – II	**IIoT Architectures:**	**9**
IIoT Reference Architecture – Industrial Internet Architecture Framework – Five Functional domains – Three tier architecture topology – Connectivity: Key system characteristics, Connectivity security and functional characteristics – Functions of communication layer – Overview of Predictive Maintenance Architecture.		
Unit – III	**Sensor and Interfacing:**	**9**
Need of Protocols – Legacy Industrial protocols – Modern Communication protocols: Industrial Ethernet, Encapsulated Field Bus, Standard Ethernet. IIoT device Low-Power WAN optimized technologies for M2M: SigFox, LoRaWAN, nWave, Dash7, Ingenue RPMA, Low Power Wi-Fi, LTE Category-M, Weightless, Millimeter Radio.		
Unit – IV	**Protocols and Cloud:**	**9**
Introduction – Security threats and vulnerabilities of IoT – Industrial challenges – Evolution of Cyber-attacks: cyber attacks and solutions – Strategic principles of cyber security – cyber security measures - Industrial IoT security architecture: IIoT architecture patterns – four Tier IIoT security model- Management risks with IIoT.		
Unit – V	**Industrial IoT- Application Domains:**	**9**
Software Defined Networks: Difference between SDN and NFV – Cloud and Fog - Big Data and Analytics in IIoT. Recent Technological components of Robots: Industrial Robotic applications – Industrial application of AR: Maintenance, assembly, operation and training.		
		Total:45

TEXT BOOK:

1.	Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, 1st Edition, Apress Media, NewYork, 2016.

REFERENCES:

1.	Alp Ustundag and EmreCevikcan, “Industry 4.0: Managing the Digital Transformation”, Springer series in Advanced Manufacturing, Switzerland, 2018.
2.	DimitriosSerpanos and Marilyn Wolf, “Internet-of-Things (IoT) Systems, Architectures, Algorithms, Methodologies”, Springer International Publishing AG, Switzerland, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explore the basics of industrial internet of things and apply it in industrial use cases.	Applying (K3)
CO2	make use of various architectures and components to build IoT systems	Applying (K3)
CO3	design and implement protocols and sensors for IIoT	Applying (K3)
CO4	elucidate the various security layers and implement solutions for various security attacks	Applying (K3)
CO5	apply IIoT in real time Industrial 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	3		2								2	3
CO2	3	2	3		2								2	3
CO3	3	2	3		2								2	3
CO4	3	2	3		2								2	3
CO5	3	2	3		2								2	3

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

ASSESSMENT PATTERN - THEORY

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

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