# KONGU ENGINEERING COLLEGE

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

**PERUNDURAI ERODE – 638 060**

**TAMILNADU INDIA**

Estd : 1984

## REGULATIONS, CURRICULUM & SYLLABI - 2020

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

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

## BACHELOR OF TECHNOLOGY DEGREE
## IN
## ARTIFICAL INTELLIGENCE AND DATA SCIENCE

KONGU
Assuring the Best

# INDEX

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

## INSTITUTE VISION

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

## INSTITUTE MISSION

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

## QUALITY POLICY

We are committed to

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

## DEPARTMENT OF COMPUTER SCIENCE ENGINEERING

## VISION

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

## MISSION

Department of Computer Science Engineering is committed to:

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

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

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

## PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduate of Computer Science Engineering programme will:

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

PEO2: Analyze, design, develop and verify computer-based solutions to real world problems.

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

## MAPPING OF MISSION STATEMENTS (MS) WITH PEOs

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

1 – Slight, 2 – Moderate, 3 – Substantial

## PROGRAM OUTCOMES (POs)

Graduates of Computer Science Engineering will**:**

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

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

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

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

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

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

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

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

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

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

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

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

## PROGRAM SPECIFIC OUTCOMES (PSOs)

Graduates of Computer Science Engineering will**:**

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

**PSO2** **Software design and Development:** Ability to develop computer based systems using engineering skills, knowledge of software design process, programming languages and tools.

## MAPPING OF PEOs WITH POs AND PSOs

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

1 – Slight, 2 – Moderate, 3 – Substantial

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

**(Autonomous)**

**REGULATIONS 2020**

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

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

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

## 1. DEFINITIONS AND NOMENCLATURE

In these Regulations, unless otherwise specified:

i. "University" means ANNA UNIVERSITY, Chennai.

ii. "College" means KONGU ENGINEERING COLLEGE.

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

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

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

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

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

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

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

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

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

## 2. PROGRAMMES AND BRANCHES OF STUDY

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

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

## 3. ADMISSION REQUIREMENTS

### 3.1 First Semester Admission

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

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

(OR)

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

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

### 3.2 Lateral Entry Admission

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

study.

(OR)

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

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

## 4. STRUCTURE OF PROGRAMMES

### 4.1 Categorisation of Courses

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

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

ii. Basic Science (BS) Courses

iii. Engineering Science (ES) Courses

iv. Professional Core (PC) Courses

v. Professional Elective (PE) Courses

vi. Open Elective (OE) Courses

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

viii. Audit Courses (AC)

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

x. Honours Degree Courses (HC)

### 4.2 Credit Assignment and Honours Degree

#### 4.2.1. Credit Assignment

Each course is assigned certain number of credits as follows:

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

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

### 4.2.2. Honours Degree

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

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

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

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

## 4.3 Employability Enhancement Courses

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

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

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

(or)

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

(or)

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

### 4.3.2 Comprehensive Test & Viva

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

### 4.3.3 Internships

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

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

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

clause 4.4 and clause 4.5 respectively.

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

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

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

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

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

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

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

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

**4.5 Flexibility to Add or Drop Courses**

**4.5.1** A candidate has to earn the total number of credits specified in the curriculum of the respective programme of study in order to be eligible to obtain the degree. However, if the candidate wishes, then the candidate is permitted to earn more than the total number of credits prescribed in the curriculum of the candidate's programme.

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

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

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

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

## 5. DURATION OF THE PROGRAMME

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

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

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

## 6. COURSE REGISTRATION FOR THE EXAMINATION

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

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

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

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

## 7. ASSESSMENT AND EXAMINATION PROCEDURE FOR AWARDING MARKS

**7.1** The BE/BTech programmes consist of Theory Courses, Theory cum Practical courses, Practical courses, Project Work, Professional Skills Training / Industrial Training, Internship and Entrepreneurships/ Start ups. Performance in each course of study shall be evaluated based on (i) Continuous Assessments (CA) throughout the semester and (ii)

End Semester Examination (ESE) at the end of the semester except for the courses which are evaluated based on continuous assessment only. Each course shall be evaluated for a maximum of 100 marks as shown below:

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

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

### 7.3 Theory Courses

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

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

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

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

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

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

## 7.4 Theory cum Practical Courses

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

## 7.5 Practical Courses

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

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

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

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

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

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

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

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

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

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

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

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

## 7.7 Project Work I Phase I / Industrial Training

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

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

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

## 7.8 Professional Skills Training

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

## 7.9 Comprehensive Test/Viva

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

## 7.10 Entrepreneurships/ Start ups

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

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

### 7.11 Projects through Internships

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

### 7.12 Value Added Course

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

### 7.13 Online Course

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

### 7.14 Self Study Course

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

### 7.15 Audit Course

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

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

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

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

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

### 7.16 Mandatory Course

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

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

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

## 8. REQUIREMENTS FOR COMPLETION OF A SEMESTER

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

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

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

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

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

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

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

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

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

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

## 9. REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION

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

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

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

## 10. PROVISION FOR WITHDRAWAL FROM EXAMINATIONS

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

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

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

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

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

## 11. PROVISION FOR BREAK OF STUDY

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

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

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

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

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

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

## 12. PASSING REQUIREMENTS

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

**12.2** A candidate who secures not less than 50 % in continuous assessment marks prescribed for the courses which are evaluated based on continuous assessment only shall be declared to have successfully passed the course. If a candidate secures less than 50% in the continuous assessment marks, he / she shall have to re-enroll for the same in the subsequent semester and satisfy the attendance requirements.

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

## 13. REVALUATION OF ANSWER SCRIPTS

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

## 14. SUPPLEMENTARY EXAMINATION

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

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

## 15. AWARD OF LETTER GRADES

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

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

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

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

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

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

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

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

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

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

## 16. ELIGIBILITY FOR THE AWARD OF DEGREE

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

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

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

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

iv. No disciplinary action pending against him / her.

## 17. CLASSIFICATION OF THE DEGREE AWARDED

**17.1 First Class with Distinction:**

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

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

(OR)

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

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

**17.2 First Class:**

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

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

**17.3 Second Class:**

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

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

**17.5 Honours Degree:**

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

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

## 18. MALPRACTICES IN TESTS AND EXAMINATIONS

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

## 19. AMENDMENTS

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

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| CURRICULUM BREAKDOWN STRUCTURE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Summary of Credit Distribution** | | | | | | | | | | |
| **Category** | **Semester** | | | | | | | | **Total number of credits** | **Curriculum Content (% of total number of credits of the program)** |
| | **I** | **II** | **III** | **IV** | **V** | **VI** | **VII** | **VIII** | | |
| **HS** | **3** | **4** | **3** | | | | **3** | | **13** | **7.69** |
| **BS** | **11** | **5** | **3** | | | | | | **19** | **11.24** |
| **ES** | **4** | **9** | **4** | **4** | | | | | **21** | **12.43** |
| **PC** | **4** | **4** | **14** | **14** | **15** | **11** | **4** | | **66** | **39.05** |
| **PE** | | | | | **3** | | **12** | **3** | **18** | **10.65** |
| **OE** | | | | **4** | **4** | **3** | | **3** | **11** | **8.28** |
| **EC** | | | | | **2** | **6** | **3** | **7** | **18** | **10.65** |
| **Semesterwise Total** | **22** | **22** | **24** | **22** | **24** | **20** | **22** | **13** | **169** | **100.00** |

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

| CATEGORISATION OF COURSES | | | | | | | |
|---|---|---|---|---|---|---|---|
| **HUMANITIES AND SOCIAL SCIENCE INCLUDING MANAGEMENT (HS)** | | | | | | | |
| **S. No.** | **Course Code** | **Course Name** | **L** | **T** | **P** | **C** | **Sem** |
| 1. | 20EGT11 | English Language Skills 1 | 3 | 0 | 0 | 3 | I |
| 2. | | Advanced Communication Skills | 3 | 0 | 0 | 3 | II |
| 3. | | Yoga and Values for Holistic Development | 1 | 0 | 1 | 1 | II |
| 4. | | English for Workplace Communication Laboratory | 0 | 0 | 2 | 1 | III |
| 5 | | Universal Human Values | 2 | 0 | 0 | 2 | III |
| 6 | | Engineering Economics and Management | 3 | 0 | 0 | 3 | VII |
| **Total Credits to be earned** | | | | | | **13** | |

| BASIC SCIENCE (BS) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **L** | **T** | **P** | **C** | **Sem** |
| 1. | 20MAC11 | Matrices and Differential Equation | 3 | 1* | 2* | 4 | I |
| 2. | 20PHT11 | Applied Physics | 3 | 0 | 0 | 3 | I |
| 3. | 20CYT11 | Applied Chemistry | 3 | 0 | 0 | 3 | I |
| 4. | 20PHL11 | Physical Sciences Laboratory | 0 | 0 | 2 | 1 | I |
| 5. | | Discrete Mathematics and Linear Algebra | 3 | 1 | 0 | 4 | II |
| 6. | | Open Source Laboratory | 0 | 0 | 2 | 1 | II |
| 7. | | Probability Theory and Inferential Statistics | 3 | 0 | 0 | 3 | III |
| **Total Credits to be earned** | | | | | | **19** | |

| ENGINEERING SCIENCE (ES) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **L** | **T** | **P** | **C** | **Sem** |
| 1. | 20ADC11 | Basic of Electrical and Electronic Engineering | 3 | 0 | 2 | 4 | I |
| 2. | | Digital Principles and Design | 3 | 0 | 2 | 4 | II |
| 3. | | Engineering Practices Laboratory | 0 | 0 | 2 | 1 | II |
| 4. | | Python Programming | 3 | 0 | 2 | 4 | II |
| 5 | | Foundation of Artificial Intelligence and Data Science | 3 | 0 | 2 | 4 | III |
| 6 | | Web Technology | 3 | 0 | 0 | 3 | IV |
| 7 | | Web Technology Laboratory | 0 | 0 | 2 | 1 | IV |
| **Total Credits to be earned** | | | | | | **21** | |

| PROFESSIONAL CORE (PC) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **L** | **T** | **P** | **C** | **Sem** | **Domain/ Stream** |
| 1. | 20ADT11 | Problem Solving and Programming | 3 | 0 | 0 | 3 | I | SD |
| 2. | 20ADL11 | Problem Solving and Programming Laboratory | 0 | 0 | 2 | 1 | I | SD |
| 3. | | Data Structures | 3 | 0 | 0 | 3 | II | SD |
| 4. | | Data Structures Laboratory | 0 | 0 | 2 | 1 | II | SD |
| 5. | | Design and Analysis of Algorithms | 3 | 0 | 2 | 4 | III | SD |
| 6. | | Computer Organization | 3 | 0 | 0 | 3 | III | AP |
| 7. | | Database Management System | 3 | 0 | 0 | 3 | III | AP |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 8. | | Data Analysis | 2 | 0 | 2 | 3 | III | AI |
| 9. | | Database Management System Laboratory | 0 | 0 | 2 | 1 | III | SD |
| 10. | | Optimization Techniques | 3 | 1 | 0 | 4 | IV | AI |
| 11. | | Object Oriented Programming | 2 | 0 | 2 | 3 | IV | SD |
| 12. | | Operating Systems | 3 | 0 | 0 | 3 | IV | AP |
| 13. | | Applied Machine Learning | 3 | 0 | 0 | 3 | IV | AI |
| 14. | | Applied Machine Learning Laboratory | 0 | 0 | 2 | 1 | IV | AI |
| 15. | | Artificial Intelligence | 3 | 0 | 0 | 3 | V | AI |
| 16. | | Deep Learning | 3 | 0 | 0 | 3 | V | AI |
| 17. | | Data Modeling and Business Intelligence | 3 | 0 | 2 | 4 | V | AI |
| 18. | | Big Data Analytics | 3 | 0 | 2 | 4 | V | AI |
| 19. | | Deep Learning Laboratory | 0 | 0 | 2 | 1 | V | AI |
| 20. | | Artificial Intelligence and Robotics | 3 | 0 | 0 | 3 | VI | AI |
| 21. | | Text and Speech Analytics | 2 | 0 | 2 | 3 | VI | AI |
| 22. | | Regression Analysis | 3 | 1 | 0 | 4 | VI | AI |
| 23. | | Artificial Intelligence and Robotics Laboratory | 0 | 0 | 2 | 1 | VI | AI |
| 24. | | Image and Video Analytics | 3 | 0 | 2 | 4 | VII | AI |
| **Total Credits to be earned** | | | | | | **66** | | |

| **PROFESSIONAL ELECTIVE (PE)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **L** | **T** | **P** | **C** | **Sem** | **Domain/ Stream** |
| | | Elective 1 | | | | | | |
| 1. | | Theory of Computation | 3 | 0 | 0 | 3 | V | SD |
| 2. | | Multi-core Architecture | 3 | 0 | 0 | 3 | V | AI |
| 3. | | Design Patterns and Principles | 2 | 0 | 2 | 3 | V | SD |
| 4. | | Computer Networks | 3 | 0 | 0 | 3 | V | NS |
| | | Elective 2 | | | | | | |
| 5 | | Wireless and Sensor Networks | 3 | 0 | 0 | 3 | VII | NS |
| 6. | | Cloud Computing | 2 | 0 | 2 | 3 | VII | NS |
| 7. | | Nature Inspired Optimization Techniques | 3 | 0 | 0 | 3 | VII | AI |
| 8. | | Modeling and Simulation | 3 | 0 | 0 | 3 | VII | AI |
| | | Elective 3 | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 9. | | Information Security | 3 | 0 | 0 | 3 | VII | NS |
| 10. | | Information Retrieval Techniques | 3 | 0 | 0 | 3 | VII | AI |
| 11. | | Reinforcement Learning | 3 | 0 | 0 | 3 | VII | AI |
| 12. | | Healthcare Analytics | 3 | 0 | 0 | 3 | VII | AI |
| | | Elective 4 | | | | | | |
| 13. | | Time Series Analysis and Forecasting | 3 | 0 | 0 | 3 | VII | AI |
| 14. | | Social Media Analytics | 3 | 0 | 0 | 3 | VII | AI |
| 15. | | Real Time Analytics | 3 | 0 | 0 | 3 | VII | AI |
| 16. | | Ethics of Artificial Intelligence | 3 | 0 | 0 | 3 | VII | AI |
| | | Elective 5 | | | | | | |
| 17. | | Neural Machine Translation | 3 | 0 | 0 | 3 | VII | AI |
| 18. | | Multivariate Data Analysis | 3 | 0 | 0 | 3 | VII | AI |
| 19. | | Cognitive Science and Analytics | 3 | 0 | 0 | 3 | VII | AI |
| 20. | | Graph Theory and its Applications | 3 | 0 | 0 | 3 | VII | AI |
| | | Elective 6 | | | | | | |
| 21. | | Software Defined Networks | 3 | 0 | 0 | 3 | VIII | NS |
| 22. | | Software Quality and Testing | 3 | 0 | 0 | 3 | VIII | SDE |
| 23. | | Software Project Management | 3 | 0 | 0 | 3 | VIII | SDE |
| 24. | | Cyber Forensics | 3 | 0 | 0 | 3 | VIII | NS |
| | | Agile Methodologies for Software Development | 3 | 0 | 0 | 3 | VIII | SDE |
| **Total Credits to be earned** | | | | | | **18** | | |

**EMPLOYABILITY ENHANCEMENT COURSES (EC)**

| S. No. | Course Code | Course Name | L | T | P | C | Sem | Domain/ Stream |
|---|---|---|---|---|---|---|---|---|
| 1. | | Professional Skills Training 1 / Industrial Training 1 | - | - | - | 2 | V | -- |
| 2. | | Comprehensive Test and Viva | - | - | - | 2 | VI | -- |
| 3. | | Professional Skills Training 2 / Industrial Training 2 | - | - | - | 2 | VI | -- |
| 4. | | Project Work 1 | - | - | 4 | 2 | VI | -- |
| 5. | | Project Work 2 Phase 1 | - | - | 6 | 3 | VII | -- |
| 6. | | Internship / Project Work 2 Phase 2 | - | - | 14 | 7 | VIII | -- |
| **Total Credits to be earned** | | | | | | **18** | | |

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

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

**MANDATORY COURSES**

| **S. No.** | **Course Code** | **Course Name** | **L** | **T** | **P** | **C** | **Sem** |
|---|---|---|---|---|---|---|---|
| 1 | 20MNT11 | Induction Training Program | - | - | - | 0 | I |
| 2. | | Environmental Science | 2 | 0 | 0 | 0 | IV |

| OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENTS (OE) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **L** | **T** | **P** | **C** | **Sem** |
| 1. | | Deep Learning for Engineering Applications | 3 | 0 | 2 | 4 | IV |
| 2. | | Computer Vision | 3 | 0 | 2 | 4 | V |
| 3. | | Artificial Intelligence for Data Science | 3 | 0 | 0 | 3 | VI |
| 4. | | Business Analytics | 3 | 0 | 0 | 3 | VIII |
| **Total Credits to be earned** | | | | | | **14** | |

## ADDITIONAL COURSES FOR B.Tech HONORS:

**Eligibility norms for registering Honors degree:**

- A candidate shall have not less than 8.0 CGPA and no history of arrears till third semester to opt for the honors degree.

List of Additional Courses to be registered for BTech Honors:

**Specialization: Internet of Things**

| S. No. | Course Name | Hours / Week | | | Credit |
|---|---|---|---|---|---|
| | | L | T | P | |
| 1 | Introduction to IOT | 3 | 0 | 0 | 3 |
| 2 | IOT Architecture and its Protocols | 3 | 0 | 0 | 3 |
| 3 | Cognitive IoT | 3 | 0 | 0 | 3 |
| 4 | Industrial and Medical IOT | 3 | 0 | 0 | 3 |
| 5 | IOT and Machine learning | 3 | 0 | 0 | 3 |
| 6 | Privacy and security in IOT | 3 | 0 | 0 | 3 |
| **Total Credits** | | | | | **18** |

**Specialization: Blockchain Technology**

| S. No. | Course Name | Hours / Week | | | Credit |
|---|---|---|---|---|---|
| | | L | T | P | |
| 1 | Introduction to Blockchain | 3 | 0 | 0 | 3 |
| 2 | Cryptography | 3 | 0 | 0 | 3 |
| 3 | Bitcoin Technology | 3 | 0 | 0 | 3 |
| 4 | Blockchain and Cryptocurrency Technologies | 3 | 0 | 0 | 3 |
| 5 | Blockchain application development through smart contracts | 3 | 0 | 0 | 3 |
| 6 | Practical Aspects of Blockchain | 3 | 0 | 0 | 3 |
| **Total Credits** | | | | | **18** |

# KEC R2020: SCHEDULING OF COURSES – B.Tech(ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)

**Total Credits: 169**

| Sem. | Course1 | Course2 | Course3 | Course4 | Course5 | Course6 | Course7 | Course8 | Course9 | Course10 | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| I | English Language Skills(3-0-0-3) | Matrices and Differential Equations (3-1*-2*-4) | Applied Physics(3-0-0-3) | Applied Chemistry(3-0-0-3) | Problem Solving and Programming( 3-0-0-3) | Basics of Electrical and Electronics Engineering (3-0-2-4) | Problem Solving and Programming Laboratory(0-0-2-1) | Physical Sciences Laboratory I(0-0-2-1) | Induction Training Program (0-0-0-0) | | **22** |
| II | Advance Communication Skills(3-0-0-3) | Discrete Mathematics and Linear Algebra(3-1-0-4) | Digital Principles and Design (3-0-2-4) | Data Structures(3-0-0-3) | Python Programming (3-0-2-4) | Data Structures Laboratory(0-0-2-1) | Open Source Laboratory(0-0-2-1) | Engineering Practices Laboratory(0-0-2-1) | Yoga Values for Holistic Development(1-0-1-1) | | **22** |
| III | Probability Theory And Inferential Statistics (3-0-0-3) | Foundations of Artificial Intelligence and Data Science(3-0-2-4) | Design and Analysis of Algorithms(3-0-2-4) | Computer Organization (3-0-0-3) | Database Management System(3-0-0-3) | Data Analysis (2-0-2-3) | Database Management System Laboratory(0-0-2-1) | English for Workplace Communication Laboratory(0-0-2-1) | Universal Human Values(2-0-0-2) | | **24** |
| IV | Optimization Techniques(3-1-0-4) | Web Technology(3-0-0-3) | Object Oriented Programming( 2-0-2-3) | Operating Systems(3-0-0-3) | Applied Machine Learning(3-0-0-3) | Open Elective - I(3-1/0-0/2-4) | Web Technology Laboratory(0-0-2-1) | Applied Machine Learning Laboratory(0-0-2-1) | Environmental Science(2-0-0-0) | | **22** |
| V | Artificial Intelligence(3-0-0-3) | Deep Learning(3-0-0-3) | Data Modeling and Business intelligence (3-0-2-4) | Big Data Analytics (3-0-2-4) | Professional Elective -1(3-0-0-3) | Open Elective – 2(3-1/0-0/2-4) | Deep Learning Laboratory(0-0-2-1) | Professional Skills Training 1 (0-0-0-2) | | | **24** |
| VI | Artificial Intelligence and Robotics (3-0-0-3) | Text and Speech Analytics(2-0-2-3) | Regression Analysis (3-1-0-4) | Open Elective - 3(2/3-0-0/2-3) | Artificial Intelligence and Robotics Laboratory(0-0-2-1) | Comprehensive Test / Viva(0-0-0-2) | Professional Skills Training 2/ Industrial Training 2 /(0-0-0-2) | Project Work 1 (0-0-4-2) | | | **20** |
| VII | Engineering Economics & Management(3-0-0-3) | Image and Video Analytics(3-0-2-4) | Professional Elective – 2(3-0-0-3) | Professional Elective – 3(3-0-0-3) | Professional Elective – 4(3-0-0-3) | Professional Elective – 5(3-0-0-3) | Project Work 2 Phase I(0-0-6-3) | | | | **22** |
| VIII | Professional Elective -6(3-0-0-3) | Open Elective – 4(2/3-0-0/2-3) | Internship / Project work 2 Phase 2(0-0-14-7) | | | | | | | | **13** |

# MAPPING OF COURSES WITH PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

| Sem. | Course Code | Course Title | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | English Language Skills | | | | | | ✓ | | | ✓ | ✓ | ✓ | ✓ | | |
| 1 | | Matrices and Differential Equations | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 1 | | Applied Physics | ✓ | ✓ | ✓ | | | | | | | | | | | |
| 1 | | Applied Chemistry | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | |
| 1 | | Problem Solving and Programming | ✓ | ✓ | ✓ | | ✓ | | | | | | | | ✓ | ✓ |
| 1 | | Basics of Electrical and Electronics Engineering | ✓ | ✓ | ✓ | | ✓ | | | | | | | | ✓ | ✓ |
| 1 | | Problem Solving and Programming Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | ✓ | | | ✓ | ✓ |
| 1 | | Physical Sciences Laboratory I | | | | ✓ | | | | | | | | | | |
| 1 | | Induction Training Program # | | | | | | | | | | | | | | |
| 2 | | Advance Communication Skills | | | | | | ✓ | | | ✓ | ✓ | ✓ | ✓ | | |
| 2 | | Discrete Mathematics and Linear Algebra | ✓ | ✓ | ✓ | ✓ | | | | | | | | | ✓ | |
| 2 | | Digital Principles and Design | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 2 | | Data Structures | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 2 | | Python Programming | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 2 | | Data Structures Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | ✓ | ✓ | ✓ |
| 2 | | Open Source Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 2 | | Engineering Practices Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | ✓ | ✓ | ✓ | | |
| 2 | | Yoga Values for Holistic Development | | | | | | ✓ | | ✓ | ✓ | | | ✓ | | |
| 3 | | Probability Theory And Inferential Statistics | ✓ | ✓ | ✓ | ✓ | | | | | | | | | ✓ | |
| 3 | | Foundations of Artificial Intelligence and Data Science | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 3 | | Design and Analysis of Algorithms | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 3 | | Computer Organization | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 3 | | Database Management System | ✓ | ✓ | ✓ | | | | | | ✓ | | | | ✓ | ✓ |
| 3 | | Data Analysis | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 3 | | Database Management System Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | ✓ | ✓ | | ✓ | ✓ |

| Sem. | Course Code | Course Title | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | | English for Workplace Communication Laboratory | | | | | | | | | ✓ | ✓ | | | ✓ | |
| 3 | | Universal Human Values | | | | | | ✓ | | ✓ | | | | | | |
| 4 | | Optimization Techniques | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 4 | | Web Technology | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 4 | | Object Oriented Programming | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 4 | | Operating Systems | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 4 | | Applied Machine Learning | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 4 | | Web Technology Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 4 | | Applied Machine Learning Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 4 | | Environmental Science | ✓ | ✓ | ✓ | | | | ✓ | | | | | | | |
| 5 | | Artificial Intelligence | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 5 | | Deep Learning | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 5 | | Data Modeling and Business intelligence | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 5 | | Big Data Analytics | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 5 | | Deep Learning Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 5 | | Professional Skills Training 1 / Industrial Training 1 *$ | | | | | | | | | | | | | | |
| 6 | | Artificial Intelligence and Robotics | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 6 | | Text and Speech Analytics | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 6 | | Regression Analysis | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 6 | | Artificial Intelligence and Robotics Laboratory | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 6 | | Comprehensive Test / Viva | | | | | | | | | | | | | | |
| 6 | | Professional Skills Training 2 / Industrial Training 2 @ | | | | | | | | | | | | | | |
| 6 | | Project Work 1 | | | | | | | | | | | | | | |
| 7 | | Engineering Economics & Management | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 7 | | Image and Video Analytics | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 7 | | Project Work 2 Phase I | | | | | | | | | | | | | | |
| 8 | | Internship / Project work 2 Phase 2 | | | | | | | | | | | | | | |

| Sem. | Course Code | Course Title | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Professional Elective Courses | | | | | | | | | | | | | | |
| 5 | | Theory of Computation | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 5 | | Multi-core Architecture | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 5 | | Design Patterns and Principles | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 5 | | Computer Networks | ✓ | ✓ | ✓ | ✓ | | | | | | | | | ✓ | ✓ |
| 7 | | Wireless and Sensor Networks | ✓ | ✓ | ✓ | ✓ | | | | | | | | | ✓ | ✓ |
| 7 | | Cloud Computing | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 7 | | Nature Inspired Optimization Techniques | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | | Modeling and Simulation | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | | Information Security | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | | Information Retrieval Techniques | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | | Reinforcement Learning | ✓ | ✓ | ✓ | ✓ | | | | | | | | | ✓ | ✓ |
| 7 | | Healthcare Analytics | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | | Time Series Analysis and Forecasting | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |
| 7 | | Social Media Analytics | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | | Real Time Analytics | ✓ | ✓ | ✓ | | ✓ | | | | | | | | ✓ | ✓ |
| 7 | | Ethics of Artificial Intelligence | ✓ | ✓ | ✓ | | | ✓ | | ✓ | | | | | ✓ | ✓ |
| 7 | | Neural Machine Translation | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | | Multivariate Data Analysis | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | | Cognitive Science and Analytics | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 7 | | Graph Theory and its Applications | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 8 | | Software Defined Networks | ✓ | ✓ | ✓ | | ✓ | | | | | | | | ✓ | ✓ |
| 8 | | Software Quality and Testing | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 8 | | Software Project Management | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 8 | | Cyber Forensics | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| 8 | | Agile Methodologies for Software Development | ✓ | ✓ | ✓ | | | | | | ✓ | ✓ | ✓ | | ✓ | ✓ |

| Sem. | Course Code | Course Title | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Open Elective Courses | | | | | | | | | | | | | | |
| 4 | | Deep Learning for Engineering Applications | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 5 | | Computer Vision | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | | |
| 6 | | Artificial Intelligence for Data Science | ✓ | ✓ | ✓ | | | | | | | | | | | |
| 8 | | Business Analytics | ✓ | ✓ | ✓ | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Honours Degree | | | | | | | | | | | | | | |
| | | **IOT** | | | | | | | | | | | | | | |
| | | Introduction to IOT | ✓ | ✓ | ✓ | ✓ | | | | | | | | | ✓ | ✓ |
| | | IOT Architecture and its Protocols | ✓ | ✓ | ✓ | ✓ | | | | | | | | | ✓ | ✓ |
| | | Cognitive IoT | ✓ | ✓ | ✓ | | ✓ | | | | | | | | ✓ | ✓ |
| | | Industrial and Medical IOT | ✓ | ✓ | ✓ | | ✓ | | | | | | | | ✓ | ✓ |
| | | IOT and Machine learning | ✓ | ✓ | ✓ | | ✓ | | | | | | | | ✓ | ✓ |
| | | Privacy and Security in IOT | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| | | **BLOCK CHAIN** | | | | | | | | | | | | | | |
| | | Introduction to Blockchain | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| | | Cryptography | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| | | Bitcoin Technology | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| | | Blockchain and Cryptocurrency Technologies | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| | | Blockchain application development through smart contracts | ✓ | ✓ | ✓ | | | | | | | | | | ✓ | ✓ |
| | | Practical Aspects of Blockchain | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | ✓ | ✓ |

## B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE CURRICULUM – R2020

| SEMESTER – I | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Title | Hours / Week | | | Credit | Maximum Marks | | | Category |
| | | L | T | P | | CA | ESE | Total | |
| **Theory/Theory with Practical** | | | | | | | | | |
| 20EGT11 | English Language Skills | 3 | 0 | 0 | 3 | 50 | 50 | 100 | HS |
| 20MAC11 | Matrices and Differential Equations | 3 | 1* | 2* | 4 | 50 | 50 | 100 | BS |
| 20PHT11 | Applied Physics | 3 | 0 | 0 | 3 | 50 | 50 | 100 | BS |
| 20CYT11 | Applied Chemistry | 3 | 0 | 0 | 3 | 50 | 50 | 100 | BS |
| 20ADT11 | Problem Solving and Programming | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 20ADC11 | Basics of Electrical and Electronics Engineering | 3 | 0 | 2 | 4 | 50 | 50 | 100 | ES |
| **Practical / Employability Enhancement** | | | | | | | | | |
| 20ADL11 | Problem Solving and Programming Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | PC |
| 20PHL11 | Physical Sciences Laboratory I | 0 | 0 | 2 | 1 | 50 | 50 | 100 | BS |
| 20MNT11 | Student Induction Program # | --- | --- | --- | 0 | 100 | 0 | 100 | MC |
| **Total Credits to be earned** | | | | | **22** | | | | |

*# Induction Training Program (including, Indian Constitution and Essence of Indian Knowledge Tradition, etc.) to 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** | | | | | | | | | |
| 20EGT21 | Advanced Communication Skills | 3 | 0 | 0 | 3 | 50 | 50 | 100 | HS |
| 20MAT21 | Discrete Mathematics and Linear Algebra | 3 | 1 | 0 | 4 | 50 | 50 | 100 | BS |
| 20ADC21 | Digital Principles and Design | 3 | 0 | 2 | 4 | 50 | 50 | 100 | ES |
| 20ADT21 | Data Structures | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 20ADC22 | Python Programming | 3 | 0 | 2 | 4 | 50 | 50 | 100 | ES |
| **Practical / Employability Enhancement** | | | | | | | | | |
| 20ADL21 | Data Structures Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | PC |
| 20ADL22 | Open Source Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | BS |
| 20MEL11 | Engineering Practices Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | ES |
| 20VEC11 | Yoga and Values for Holistic Development | 1 | 0 | 1 | 1 | 100 | 0 | 100 | HS |
| **Total Credits to be earned** | | | | | **22** | | | | |

## B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE CURRICULUM – R2020

| SEMESTER – III | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Title | Hours / Week | | | Credit | Maximum Marks | | | Category |
| | | L | T | P | | CA | ESE | Total | |
| **Theory/Theory with Practical** | | | | | | | | | |
| 20MAT35 | Probability Theory And Inferential Statistics | 3 | 0 | 0 | 3 | 50 | 50 | 100 | BS |
| 20ADC31 | Foundations of Artificial Intelligence and Data Science | 3 | 0 | 2 | 4 | 50 | 50 | 100 | ES |
| 20ADC32 | Design and Analysis of Algorithms | 3 | 0 | 2 | 4 | 50 | 50 | 100 | PC |
| 20ADT31 | Computer Organization | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 20ADT32 | Database Management Systems | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 20ADC33 | Data Analysis | 2 | 0 | 2 | 3 | 50 | 50 | 100 | PC |
| **Practical / Employability Enhancement** | | | | | | | | | |
| 20ADL31 | Database Management Systems Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | PC |
| 20EGL31 | English for Workplace Communication Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | HS |
| 20GET31 | Universal Human Values | 2 | 0 | 0 | 2 | 100 | 0 | 100 | HS |
| **Total Credits to be earned** | | | | | **24** | | | | |

| SEMESTER – IV | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Title | Hours / Week | | | Credit | Maximum Marks | | | Category |
| | | L | T | P | | CA | ESE | Total | |
| **Theory/Theory with Practical** | | | | | | | | | |
| 20ADT41 | Optimization Techniques | 3 | 1 | 0 | 4 | 50 | 50 | 100 | PC |
| 20ADT42 | Web Technology | 3 | 0 | 0 | 3 | 50 | 50 | 100 | ES |
| 20ADC41 | Object Oriented Programming | 2 | 0 | 2 | 3 | 50 | 50 | 100 | PC |
| 20ADT43 | Operating Systems | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 20ADT44 | Applied Machine Learning | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| | Open Elective - I | 3 | 1/0 | 0/2 | 4 | 50 | 50 | 100 | OE |
| **Practical / Employability Enhancement** | | | | | | | | | |
| 20ADL41 | Web Technology Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | ES |
| 20ADL42 | Applied Machine Learning Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | PC |
| 20MNT31 | Environmental Science | 2 | 0 | 0 | 0 | 100 | 0 | 100 | MC |
| **Total Credits to be earned** | | | | | **22** | | | | |

## B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE CURRICULUM – R2020

| SEMESTER – V | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Title | Hours / Week | | | Credit | Maximum Marks | | | Category |
| | | L | T | P | | CA | ESE | Total | |
| **Theory/Theory with Practical** | | | | | | | | | |
| 20ADT51 | Artificial Intelligence | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 20ADT52 | Deep Learning | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 20ADC51 | Data Modeling and Business intelligence | 3 | 0 | 2 | 4 | 50 | 50 | 100 | PC |
| 20ADC52 | Big Data Analytics | 3 | 0 | 2 | 4 | 50 | 50 | 100 | PC |
| | Professional Elective -1 | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PE |
| | Open Elective – 2 | 3 | 1/0 | 0/2 | 4 | 50 | 50 | 100 | OE |
| **Practical / Employability Enhancement** | | | | | | | | | |
| 20ADL51 | Deep Learning Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | PC |
| 20GEL51 | Professional Skills Training 1 / Industrial Training 1 *$ | -- | -- | -- | 2 | 100 | 0 | 100 | EC |
| **Total Credits to be earned** | | | | | **24** | | | | |

**$ Professional Skills Training / Industrial Training for a total period of about 80 hr during the period of 4th sem end summer holidays and 5th sem.**

| SEMESTER – VI | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Title | Hours / Week | | | Credit | Maximum Marks | | | Category |
| | | L | T | P | | CA | ESE | Total | |
| **Theory/Theory with Practical** | | | | | | | | | |
| 20ADT61 | Artificial Intelligence and Robotics | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PC |
| 20ADC61 | Text and Speech Analytics | 2 | 0 | 2 | 3 | 50 | 50 | 100 | PC |
| 20ADT62 | Regression Analysis | 3 | 1 | 0 | 4 | 50 | 50 | 100 | PC |
| | Open Elective - 3 | 2/3 | 0 | 0/2 | 3 | 50 | 50 | 100 | OE |
| **Practical / Employability Enhancement** | | | | | | | | | |
| 20ADL61 | Artificial Intelligence and Robotics Laboratory | 0 | 0 | 2 | 1 | 50 | 50 | 100 | PC |
| 20GEP61 | Comprehensive Test / Viva | --- | --- | --- | 2 | 100 | 0 | 100 | EC |
| 20GEL61 | Professional Skills Training 2 / Industrial Training 2 @ | --- | --- | --- | 2 | 100 | 0 | 100 | EC |
| 20ADP61 | Project Work 1 | 0 | 0 | 4 | 2 | 100 | 0 | 100 | EC |
| **Total Credits to be earned** | | | | | **20** | | | | |

@ Professional Skills Training / Industrial Training for a total period of about 80 hr during 5th sem end summer holidays and 6th sem.

## B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE CURRICULUM – R2020

| SEMESTER – VII | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Title | Hours / Week | | | Credit | Maximum Marks | | | Category |
| | | L | T | P | | CA | ESE | Total | |
| **Theory/Theory with Practical** | | | | | | | | | |
| 20MBT71 | Engineering Economics and Management | 3 | 0 | 0 | 3 | 50 | 50 | 100 | HS |
| 20ADC71 | Image and Video Analytics | 3 | 0 | 2 | 4 | 50 | 50 | 100 | PC |
| | Professional Elective – 2 | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PE |
| | Professional Elective – 3 | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PE |
| | Professional Elective – 4 | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PE |
| | Professional Elective – 5 | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PE |
| **Practical / Employability Enhancement** | | | | | | | | | |
| 20ADP71 | Project Work 2 Phase I | 0 | 0 | 6 | 3 | 50 | 50 | 100 | EC |
| **Total Credits to be earned** | | | | | **22** | | | | |

| SEMESTER – VIII | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Title | Hours / Week | | | Credit | Maximum Marks | | | Category |
| | | L | T | P | | CA | ESE | Total | |
| **Theory/Theory with Practical** | | | | | | | | | |
| | Professional Elective -6 | 3 | 0 | 0 | 3 | 50 | 50 | 100 | PE |
| | Open Elective – 4 | 2/3 | 0 | 0/2 | 3 | 50 | 50 | 100 | OE |
| **Practical / Employability Enhancement** | | | | | | | | | |
| 20ADP81 | Internship / Project work 2 Phase 2 $ | --- | --- | 14 | 7 | 50 | 50 | 100 | EC |
| **Total Credits to be earned** | | | | | **13** | | | | |

**$ Mandatory for all students**

| PROFESSIONAL ELECTIVE (PE) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **S. No.** | **Course Code** | **Course Name** | **L** | **T** | **P** | **C** | **Sem** | **Domain/ Stream** |
| | | Elective 1 | | | | | | |
| 1. | 20ADE01 | Theory of Computation | 3 | 0 | 0 | 3 | V | SD |
| 2. | 20ADE02 | Multi-core Architecture | 3 | 0 | 0 | 3 | V | AI |
| 3. | 20ADE03 | Design Patterns and Principles | 2 | 0 | 2 | 3 | V | SD |
| 4. | 20ADE04 | Computer Networks | 3 | 0 | 0 | 3 | V | NS |
| | | Elective 2 | | | | | | |
| 5. | 20ADE05 | Wireless and Sensor Networks | 3 | 0 | 0 | 3 | VII | NS |
| 6. | 20ADE06 | Cloud Computing | 2 | 0 | 2 | 3 | VII | NS |
| 7. | 20ADE07 | Nature Inspired Optimization Techniques | 3 | 0 | 0 | 3 | VII | AI |
| 8. | 20ADE08 | Modeling and Simulation | 3 | 0 | 0 | 3 | VII | AI |
| | | Elective 3 | | | | | | |
| 9. | 20ADE09 | Information Security | 3 | 0 | 0 | 3 | VII | NS |
| 10. | 20ADE10 | Information Retrieval Techniques | 3 | 0 | 0 | 3 | VII | AI |
| 11. | 20ADE11 | Reinforcement Learning | 3 | 0 | 0 | 3 | VII | AI |
| 12. | 20ADE12 | Healthcare Analytics | 3 | 0 | 0 | 3 | VII | AI |
| | | Elective 4 | | | | | | |
| 13. | 20ADE13 | Time Series Analysis and Forecasting | 3 | 0 | 0 | 3 | VII | AI |
| 14. | 20ADE14 | Social Media Analytics | 3 | 0 | 0 | 3 | VII | AI |
| 15. | 20ADE15 | Real Time Analytics | 3 | 0 | 0 | 3 | VII | AI |
| 16. | 20ADE16 | Ethics of Artificial Intelligence | 3 | 0 | 0 | 3 | VII | AI |
| | | Elective 5 | | | | | | |
| 17. | 20ADE17 | Neural Machine Translation | 3 | 0 | 0 | 3 | VII | AI |
| 18. | 20ADE18 | Multivariate Data Analysis | 3 | 0 | 0 | 3 | VII | AI |
| 19. | 20ADE19 | Cognitive Science and Analytics | 3 | 0 | 0 | 3 | VII | AI |
| 20. | 20ADE20 | Graph Theory and its Applications | 3 | 0 | 0 | 3 | VII | AI |
| | | Elective 6 | | | | | | |
| 21. | 20ADE21 | Software Defined Networks | 3 | 0 | 0 | 3 | VIII | NS |
| 22. | 20ADE22 | Software Quality and Testing | 3 | 0 | 0 | 3 | VIII | SDE |
| 23. | 20ADE23 | Software Project Management | 3 | 0 | 0 | 3 | VIII | SDE |
| 24. | 20ADE24 | Cyber Forensics | 3 | 0 | 0 | 3 | VIII | NS |
| 25. | 20ADE25 | Agile Methodologies for Software Development | 3 | 0 | 0 | 3 | VIII | SDE |
| **Total Credits to be earned** | | | | | | **18** | | |

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

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

| S. No. | Course Code | Course Name | L | T | P | C | Sem |
|---|---|---|---|---|---|---|---|
| 1 | 20ADO01 | Deep Learning for Engineering Applications | 3 | 0 | 2 | 4 | IV |
| 2 | 20ADO02 | Computer Vision | 3 | 0 | 2 | 4 | V |
| 3 | 20ADO03 | Artificial Intelligence for Data Science | 3 | 0 | 0 | 3 | VI |
| 4 | 20ADO04 | Business Analytics | 3 | 0 | 0 | 3 | VIII |

**SEMESTER I**

**20EGT11 ENGLISH LANGUAGE SKILLS**

(Common to all Engineering and Technology Branches)

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

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

**Lecture: 45, Total: 45**

**TEXT BOOK:**


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


**REFERENCES:**


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

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**20MAC11 - MATRICES AND DIFFERENTIAL EQUATIONS**

(Common to All Engineering and Technology Branches)

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

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

**List of Exercises / Experiments:**

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

***Alternate week**

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

**TEXT BOOK:**


1. Ravish R. Singh, Mukul Bhatt "Engineering Mathematics", 1st Edition, McGraw Hill Education, New Delhi, 2016. for Unit I, II, III, IV and V.


**REFERENCES:**


1. Kreyszig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley Sons, 2011.
2. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics For First Year B.E/B.Tech", Reprint Edition 2014, S.Chand and Co., New Delhi.
3. Duraisamy C., Vengataasalam S., Arun Prakash K. and Suresh M., "Engineering Mathematics – I", 2nd Edition, Pearson India Education, New Delhi, 2020.
4. MATLAB Manual.

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**20PHT11 - APPLIED PHYSICS**

(Common to All Engineering and Technology Branches)

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

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

**Total: 45**

**TEXT BOOK:**


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


**REFERENCES:**


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

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**20CYT11 - APPLIED CHEMISTRY**

(Common to All Engineering and Technology Branches)

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

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

**Lecture: 45, 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 and 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, 2017.

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

## 20ADT11 - PROBLEM SOLVING AND PROGRAMMING

| Programme & Branch | BTech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 1 | PC | 3 | 0 | 0 | 3 |

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

**Lecture: 45, Total:45**

**TEXT BOOK:**


1. Sumitabha Das, “Computer Fundamentals and C Programming”, 1st Edition, McGraw Hill, 2020. for Unit I, II, III, IV and V.


**REFERENCES:**


1. Yashavant Kanetkar, "Let us C", 16th Edition, BPB Publications, 2020.
2. Reema Thareja., “Programming in C ”, 2nd Edition, Oxford University Press, New Delhi, 2020.
3. Balagurusamy E., "Programming in ANSI C", 7th Edition, Mc Graw Hill Education, 2017.

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

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

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

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

## 20ADC11 - BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

| Programme & Branch | BTech- Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 1 | ES | 3 | 0 | 2 | 4 |

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

**List of Experiments / Exercises:**

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

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

**TEXT BOOK:**

| | |
|---|---|
| 1. | Muthusubramanian R. and Salivahanan S., "Basics of Electrical and Electronics Engineering", 18th Reprint, Tata McGraw Hill, 2014. for Unit I, II, III, IV and V. |

**REFERENCES:**

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

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

## 20ADL11 - PROBLEM SOLVING AND PROGRAMMING LABORATORY

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

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

**List of Exercises / Experiments:**

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

**Total: 30**

**REFERENCES /MANUALS/SOFTWARES:**

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

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

**Mapping of COs with POs and PSOs**

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

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

**20PHL11 – PHYSICAL SCIENCES LABORATORY I**

(Common to All Engineering and Technology Branches)

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

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

**List of Exercises / Experiments:**

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

**Total: 30**

**REFERENCES:**


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


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

**Mapping of COs with POs and PSOs**

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

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

**SEMESTER-II**

**20EGT21 ADVANCED COMMUNICATION SKILLS**

(Common to all Engineering and Technology Branches)

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

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

**Lecture: 45, Total: 45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Jack C. Richards, Jonathan Hull, and Susan Proctor, "Interchange - Student's Book 3", 4th Edition, Cambridge University Press, New York, 2017. for Unit I, II, III, IV and V. |

**REFERENCES:**

| | |
|---|---|
| 1. | Sanjay Kumar and Pushp Lata, "Communication Skills: A Workbook based on AICTE Syllabus", Oxford University Press, 2020. |
| 2. | Board of Editors, "Skills Annexe: Functional English for Success", Orient BlackSwan, Hyderabad, 2013. |

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**20MAT21 – DISCRETE MATHEMATICS AND LINEAR ALGEBRA**
**(Common to AI & DS and AI & ML branches)**

| Programme & Branch | B.TECH. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 2 | BS | 3 | 1 | 0 | 4 |

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

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

**TEXT BOOK:**


1. Veerarajan T., "Discrete Mathematics with Graph Theory and Combinatorics", Reprint Edition, Tata McGraw Hill Publishing Company, New Delhi, 2013. for Unit I, II, III, IV and V.
2. Howard Anton, Chris Rorres, "Elementary Linear Algebra", 11th Edition, John Wiley & Sons, 2014. for Unit IV and V.


**REFERENCES:**


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

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**DIGITAL PRINCIPLES AND DESIGN**
**(Common to AI & DS and AI & ML branches)**

| Programme& Branch | 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. | | |

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

**List of Exercises / Experiments:**

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

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

**TEXT BOOK:**


| | |
|---|---|
| 1. | Morris Mano M, "Digital Design", 6th Edition, Pearson Education Pvt. Ltd, New Delhi, 2020. for Unit I, II, III, IV and V. |


**REFERENCES:**


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

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**DATA STRUCTURES**
**(Common to AI & DS and AI & ML branches)**

| Programme & Branch | B.Tech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 2 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | The course focuses on the basic concepts and applications of linear data structures and non linear data structures. | |
| **Unit - I** | **List:** | **9** |
| Data Structures – Abstract Data Types (ADT)–List ADT and Array Implementation – Linked List – Doubly Linked List – Circular Linked List – Applications of Linked Lists. | | |
| **Unit - II** | **Stack and Queue:** | **9** |
| Stack ADT – Array and Linked List implementation of Stacks – Applications of Stacks – Queue ADT – Array and Linked List implementation of Queue – Circular Queue – Applications of Queue. | | |
| **Unit - III** | **Trees:** | **9** |
| Preliminaries: Implementation of trees –Tree Traversals – Binary trees: Implementation– Expression trees – The Search Tree ADT – Binary Search Trees: Construction – Searching – Insertion – Deletion – Find Min – Find Max – AVL trees: Rotation – Insertion – Deletion. | | |
| **Unit - IV** | **Graphs:** | **9** |
| Definitions – Representation of Graphs – Types of Graph – Depth-first traversal – Breadth-first traversal – Topological Sort – Applications of DFS: Bi-connectivity – Euler circuits – Finding Strongly Connected Components – Applications of BFS: Bipartite graph – Graph Coloring. | | |
| **Unit - V** | **Searching, Sorting and Hashing:** | **9** |
| Searching: Linear search – Binary Search – Sorting: Internal sorting: Bubble sort – Shell sort – Bucket sort – External sorting: Multiway Merge – Polyphase Merge - Hashing: Hash Functions – Separate Chaining – Open Addressing: Linear Probing – Quadratic Probing – Double Hashing – Rehashing – Extendible Hashing. | | |

**Lecture: 45, Total: 45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Weiss M. A., "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2016. for Unit I, II, III, IV and V. |

**REFERENCE:**

| | |
|---|---|
| 1. | Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, Mcgraw Hill, 2009 for Unit IV. |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | solve problems using various implementations of linked list. | Applying (K3) |
| CO2 | make use of ADTs like stack and queue for solving real world problems. | Applying (K3) |
| CO3 | implement the tree structure and its operations. | Applying (K3) |
| CO4 | apply appropriate graph algorithms for computing problems. | Applying (K3) |
| CO5 | demonstrate the concept of sorting, searching and hashing techniques. | Applying (K3) |

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**PYTHON PROGRAMMING**
**(Common to AI & DS and AI & ML branches)**

| Programme & Branch | BTech.& Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | C Programming | 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 – modules – operators – Flow control statements- Strings – Calendars and clocks. | | |
| **Unit - II** | **Functions and Data types** | **9** |
| **Functions**: Basics –function arguments – modules – Recursion – Special functions. **Lists**: Creating, traversing and slicing - functions – nested lists. **Tuples:** Creating, initializing and accessing – tuple functions – swapping tuples, unpacking tuples – **Dictionaries:** Basics of Creating, initializing and accessing – dictionary functions and methods-view objects. | | |
| **Unit - III** | **Object Oriented Programming** | **9** |
| Concepts of OOP- OOP concepts for Python – Built in Attributes and methods –polymorphism- operator overloading - Inheritance and Namespace – Method types - Exceptions: Built-in and User defined exceptions. | | |
| **Unit - IV** | **Strings, Files and Regular Expressions** | **9** |
| **Strings:** Built-in methods for string manipulation – Case studies. Modules and Packages : import statement – creating user defined modules and packages. **Files:** File operations –Reading and Writing a file. **Regular Expressions**: match, search, sub, find all and finite functions - Case studies. | | |
| **Unit - V** | **User Interface and GUI Programming** | **9** |
| **User Interface design:** Tkinter - Events – Connecting with databases. **Web Frameworks:** - Web servers - Introduction to web server frameworks (Bottle, Django and Flask) | | |

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

**List of Exercises / Experiments :**

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

**TEXT BOOK:**


| | |
|---|---|
| 1. | Anurag Gupta, G P Biswas. Python Programming, McGraw Hill Education,1st edition, 2020. for Unit I, II, III, IV and V. |


**REFERENCES:**


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

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT 1 | 15 | 30 | 55 | | | | 100 |
| CAT 2 | 15 | 30 | 55 | | | | 100 |
| CAT 3 | 15 | 30 | 55 | | | | 100 |
| ESE | 15 | 30 | 55 | | | | 100 |

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

**DATA STRUCTURES LABORATORY**
**(Common to AI & DS and AI & ML branches)**

| Programme & Branch | B.Tech. &Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 2 | PC | 0 | 0 | 2 | 1 |

| | |
|---|---|
| **Preamble** | The course provides knowledge to develop applications using the concepts of Linear and Non-linear Data Structures. |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Implementation of singly linked list and its operations |
| 2. | Implementation of doubly linked list and its operations |
| 3. | Implementation of stack and its operations |
| 4. | Infix to postfix conversion using stack ADT |
| 5. | Evaluating postfix expression using stack ADT |
| 6. | Implementation of queue and its operations |
| 7. | Implementation of circular queue and its operations |
| 8. | Reverse a queue using stack |
| 9. | Implementation of binary search tree traversals |
| 10. | Implementation of graph traversal techniques |
| 11. | Implementation of linear and binary search algorithms |
| 12. | Implementation of sorting algorithms |

**Total: 30**

**REFERENCES/MANUAL/SOFTWARE:**

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

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | implement linear and non linear data structures to solve the given problem | Applying (K3), Precision (S3) |
| CO2 | use a data structure to implement another data structure | Applying (K3), Precision (S3) |
| CO3 | implement searching and sorting operations for a given problem | Applying (K3), Precision (S3) |

**Mapping of COs with POs and PSOs**

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

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

**OPEN SOURCE LABORATORY**
**(Common to AI & DS and AI & ML branches)**

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

**List of Exercises / Experiments:**

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

**Total: 30**

**REFERENCES/MANUAL/SOFTWARE:**

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

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

**Mapping of COs with POs and PSOs**

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

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

**ENGINEERING PRACTICES LABORATORY**
**(Common to all Engineering and Technology Branches)**

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

**List of Exercises / Experiments:**

| | |
|---|---|
| | **PART A – MECHANICAL ENGINEERING** |
| 1. | To prepare square or rectangular shaped MS plates using power tools for cutting, polishing and shaping to the required dimensions. |
| 2. | To carryout drilling, tapping and assembly on the given MS plates. |
| 3. | To carryout thread forming on a GI/PVC pipes and prepare water leak proof water line from overhead tank. |
| 4. | To prepare a wood or plywood box/tray/any innovative models using modern power tools like cutting machine, router, jigsaw, power screw driver etc. |
| 5. | To prepare a leak proof sheet metal tray/box/funnel using modern power tools. |
| 6. | Welding practice using welding simulator. |
| 7. | Project: Preparing innovative articles using wood/sheet metal. |
| | **PART B – ELECTRICAL AND ELECTRONICS ENGINEERING** |
| 8. | Safety Aspects of Electrical Engineering, Electrical Symbols, Components Identification, Fuse selection and installation, Circuit Breakers selection |
| 9. | Wiring circuit for fluorescent lamp and stair case wiring |
| 10. | Measurement of earth resistance |
| 11. | Soldering of simple circuits and trouble shooting |
| 12. | Implementation of half wave and full wave rectifier using diodes |

**Total:30**

**REFERENCES/MANUAL/SOFTWARE:**

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

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

**Mapping of COs with POs and PSOs**

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

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

**YOGA AND VALUES FOR HOLISTIC DEVELOPMENT**
**(Common to all Engineering and Technology Branches)**

| Programme& Branch | B.Tech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 2 | HS | 1 | 0 | 1 | 1 |

| | | |
|---|---|---|
| Preamble | ProvidingValueEducationtoimprovetheStudents"character-understanding yogic life and physical health-maintaining youthfulness- Measure and method in five aspects of life | |
| **Unit- I** | **Physical Health:** | **2** |
| **Manavalakalai (SKY) Yoga:** Introduction - Education as a means for youth empowerment - Greatness of Education - Yoga for youthEmpowerment. **Simplified Physical Exercises:** Need and Objectives of Simplified Physical Exercise - Hand, Leg, Breathing, Eyeexercises - Kapalabathi, Makarasana Part I, Makarasana Part II, Body Massage, Acu pressure, Relaxation exercises - Benefits.**Yogasanas:** Pranamasana - HasthaUttanasana - Pada Hasthasana - AswaSanjalana Asana - ThuvipathaasvaSanjalana asana -AstangaNamaskara - Bhujangasana - Atha Muktha Savasana - AswaSanjalana Asana - Pada Hasthasana - HasthaUttanasana -Pranamasana.**Pranayama:**Naddisuddi-Clearance Practice- Benefits. | | |
| **Unit- II** | **LifeForce:** | **2** |
| **Reasons for Diseases:** Body Function - Reason for Diseases and Prevention - Natural reasons (Genetic / imprints, Planetary Position,Natural calamities and climatic changes) - Unnatural reasons (Food habits, Thoughts, Deeds). **Philosophy of Kaya kalpa:** EnrichingBio-Magnetism-Physicalbody-Sexualvitalfluid-Lifeforce-Bio-Magnetism-Mind.**Maintainingyouthfulness:**Postponingold age<br>- Transformation of food into seven components - Importance of sexual vital fluid - Measure and method in five aspects of life -ControllingunduePassion.**Kayakalpapractice:** AswiniMudra- Ojasbreath-BenefitsofKayaKalpa. | | |
| **Unit- III** | **MentalHealth:** | **2** |
| **Mental Frequencies:** Beta, Apha, Theta and Delta wave- Agna Meditation explanation - benefits. Shanti meditation: ShanthiMeditation explanation – benefits. **Thuriya Meditation:** Thuriya Meditation explanation – benefits. **Benefits of Blessing**: Self blessing(Autosuggestion)-Familyblessing-Blessing theothers-Worldblessing-Divine protection. | | |
| **Unit- IV** | **Values:** | **2** |
| **Human Values:** Self control - Self confidence - Honesty Contentment - Humility – Modesty - Tolerance - Adjustment - Sacrifice –Forgiveness - Purity (Body, Dress, Environment) - Physical purity - Mental purity - Spiritual purity. **Social Values:** Non violence –Service. Patriotism –Equality. Respect for parents and elders- care and protection - Respect for teacher. Punctuality- TimeManagement. | | |
| **Unit- V** | **Morality(Virtues):** | **2** |
| ImportanceofIntrospection:I-Mine(Ego,Possessiveness).SixEvilTemperaments-Greed-Anger-Miserliness-Immoralsexualpassion-InferiorityandsuperiorityComplex–Vengeance.ManeuveringofSixTemperaments:Contentment-Tolerance-Charity-<br>Chastity-Equality-Pardon(Forgiveness).FiveessentialQualitiesacquiredthroughMeditation:Perspicacity-Magnanimity-Receptivity- Adaptability - Creativity(Improved MemoryPower). | | |

**Lecture:10,Practical:10,Total:20**

**TEXT BOOK:**


1. ThathuvagnaniVethathiriMaharishi,"YogaforYouthEmpowerment",VethathiriPublications,2019. for Unit I, II, III, IV and V.


**REFERENCES:**


1. ThathuvagnaniVethathiriMaharishi,"YogaforModernAge",VethathiriPublications,2019.
2. ThathuvagnaniVethathiriMaharishi,"SimplifiedPhysicalExercises",VethathiriPublications,2019.
3. NeelamSharma,"HolisticEducationandYoga",ShipraPublications,2017.
4. Dr.JosephMurphy,"ThePowerofYourSubconsciousMind",PushpakPublication,2019.

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

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

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

**SEMESTER –III**

**20MAT35 PROBABILITY THORY AND INFERENTIAL STATISTICS**
**(Common to AI & DS and AI & ML branches)**

| Programme & Branch | B.TECH. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 3 | BS | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| 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.<br>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. | | |

**Lecture: 45, Total: 45**

**TEXT BOOK:**


1. Jay L. Devore, "Probability and Statistics for Engineering and Sciences", 9th Edition, Cengage Learning USA, 2016. for Unit I, II, III, IV and V.


**REFERENCES:**


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

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | interpret the concept of random variables. | Applying (K3) |
| CO2 | apply different types of distributions in engineering problems. | Applying (K3) |
| CO3 | utilize the concepts of correlation and point estimation in intelligent systems | Applying (K3) |
| CO4 | apply statistical tests for solving engineering problems involving small and large samples. | Applying (K3) |
| CO5 | apply the concepts of analysis of variance to experimental data. | Applying (K3) |

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

## FOUNDATIONS OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

| Programme& Branch | BTech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 3 | PC | 3 | 0 | 2 | 4 |

| | | |
|---|---|---|
| Preamble | The course focuses on the methodology of how to translate a data driven business problem into an effective solution by using the powerful AI technologies according to the Data Science paradigm. | |
| **Unit - I** | **The AI-Based Data Science Workflow and Data Preparation** | **9** |
| The AI-Based Data Science Workflow: Overview of Workflow - Key Steps of AI-Based Data Science Workflow - Project Organization. Data Preparation: Data Collection - Visual Data Exploration - Data Preprocessing. | | |
| **Unit - II** | **Data Analysis and Model Development** | **9** |
| Data Analysis: Translation of Data into Insight - Multivariate Data Analysis - Variable Selection - Feature Extraction - Data Visualization. Model Development: Advantages of mathematical models - Key features of a good model - Fighting Overfitting the Data - Model Generation - Model Ensembles. | | |
| **Unit - III** | **Revolution of AI and ML, Prediction using Regression** | **9** |
| Introduction to Machine Learning – Machine Learning vs Classical Programming – The ability to predict – Introduction to Regression – Regression Models – Linear Regression Model and Machine Learning – Evaluating Model Quality using different metrics – Insurance cost prediction problem | | |
| **Unit - IV** | **Non-Linear Models and Feature Engineering** | **9** |
| Non-Linear Models – Feature Engineering - Insurance cost modeling problem – Reasons for Model Errors – Rectification of Model Errors – Overfitting and Underfitting – Deriving Data to Train the Model – Train/Test Split on the Insurance Problem | | |
| **Unit - V** | **Classification Problems and Confusion Matrix** | **9** |
| Introduction to Classification – Approach followed by Classification Algorithms – A Visual Representation of Logistic Regression – Evaluating Classification Model Accuracy – Classification with Logistic Regression – Introduction to Confusion Matrix – Hands-on with Confusion Matrix- Importance of Class wise Accuracy. | | |

**List of Exercises / Experiments:**

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

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

**TEXT BOOK:**


| | |
|---|---|
| 1. | Arthur K. Kordon “Applying Data Science: How to Create Value with Artificial Intelligence”. Springer Nature, Switzerland, 1st edition, 2020. for Unit I, II. |
| 2. | Sujit Bhattacharyya, Subhrajit Bhattacharyya, “Practical Handbook of Machine Learning”, Career Launcher Infrastructure Pvt Ltd and G.K. PublicationsPvt Ltd, 1st edition, 2021. for Unit III, IV and V. |


**REFERENCES:**


| | |
|---|---|
| 1. | Avrim Blum, John Hopcroft and Ravindran Kannan. “Foundations of Data Science”. Cambridge University Press, 1st edition, England, 2020. |
| 2. | Dr. LavikaGoel, “Artificial Intelligence: Concepts and Applications ”. Wiley India PvtLtd., 1st edition, India, 2021. |
| 3. | Stuart Russell, Peter Norvig. “Artificial Intelligence: A Modern Approach”. Pearson, 4th edition, India, 2020 |

**REFERENCES/MANUAL/SOFTWARE:**

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

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | adapt the data science workflow for finding solution to a given problem | Applying (K3) |
| CO2 | examine data analysis sequence and various modeling methods | Applying (K3) |
| CO3 | use regression models to solve problems | Applying (K3) |
| CO4 | apply feature engineering techniques and estimate model errors | Applying (K3) |
| CO5 | use the metrics and evaluate the performance of machine learning algorithms | Applying (K3) |
| CO6 | exhibit proficiency to build and evaluate models using weka / Rapid Miner tools | Applying (K3), Precision (S3) |
| CO7 | demonstrate various classification model | Applying (K3), Precision (S3) |
| CO8 | demonstrate various clustering and regression model | Applying (K3), Precision (S3) |

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 45 | 55 | | | | | 100 |
| CAT2 | 35 | 65 | | | | | 100 |
| CAT3 | 20 | 55 | 25 | | | | 100 |
| ESE | 20 | 55 | 25 | | | | 100 |

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

**DESIGN AND ANALYSIS OF ALGORITHMS**
**(Common to AI & DS and AI & ML branches)**

| Programme & Branch | B.Tech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Data Structures | 3 | PC | 3 | 0 | 2 | 4 |

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

**List of Exercises:**

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

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

**TEXT BOOK:**

| | |
|---|---|
| 1. | Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson Education, 2012. for Unit I, II, III, IV and V. |

**REFERENCES:**

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

**REFERENCES/MANUAL/SOFTWARE:**

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

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | analyze the efficiency of algorithms using various frameworks | Analyzing (K4) |
| CO2 | apply brute force and divide-and-conquer techniques to solve various problems and analyze their efficiency. | Analyzing (K4) |
| CO3 | utilize decrease-and-conquer and transform-and-conquer strategies for solving problems | Applying (K3) |
| CO4 | make use of dynamic programming and greedy techniques to solve problems | Applying (K3) |
| CO5 | solve difficult combinatorial problems with backtracking and branch & bound techniques | Applying (K3) |
| CO6 | evaluate the Space and Time efficiency of various algorithms | Analyzing (K4) Precision (S3) |
| CO7 | estimate the performance of various algorithm design techniques | Analyzing (K4) Precision (S3) |
| CO8 | use appropriate design strategies for solving a given problem | Applying (K3) Precision (S3) |

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| **Mapping of COs with POs and PSOs** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| CO1 | 3 | 3 | 2 | | | | | | | | | | 3 | 2 |
| CO2 | 3 | 3 | 2 | | | | | | | | | | 3 | 2 |
| CO3 | 3 | 2 | 2 | | | | | | | | | | 3 | 2 |
| CO4 | 3 | 2 | 2 | | | | | | | | | | 3 | 2 |
| CO5 | 3 | 2 | 2 | | | | | | | | | | 3 | 2 |
| CO6 | 3 | 2 | 2 | 2 | 2 | | | | | | | | 3 | 2 |
| CO7 | 3 | 2 | 2 | 2 | 2 | | | | | | | | 3 | 2 |
| CO8 | 3 | 2 | 2 | 2 | 2 | | | | | | | | 3 | 2 |
| 1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy | | | | | | | | | | | | | | |

| **7ASSESSMENT PATTERN - THEORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | 10 | 30 | 40 | 20 | | | 100 |
| CAT2 | 10 | 30 | 50 | 10 | | | 100 |
| CAT3 | 10 | 30 | 60 | | | | 100 |
| ESE | 10 | 20 | 50 | 20 | | | 100 |

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

**COMPUTER ORGANIZATION**
**(Common to CSE, IT, AI & DS and AI & ML branches)**

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

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

**Total: 45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Carl Hamacher, ZvonkoVranesic, SafwatZaky and NaraigManjikian, “Computer Organization and Embedded Systems”, 6th Edition, McGraw Hill International Edition, 2012. for Unit I, II, III, IV and V. |

**REFERENCES:**

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

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

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

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

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 20 | 60 | 20 | | | | 100 |
| CAT2 | 20 | 50 | 30 | | | | 100 |
| CAT3 | 20 | 55 | 25 | | | | 100 |
| ESE | 20 | 40 | 40 | | | | 100 |

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

**DATABASE MANAGEMENT SYSTEMS**
**(Common to AI & DS and AI & ML branches)**

| Programme & Branch | B.Tech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 3 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | The course provides an emphasis on how to organize, maintain and retrieve information from a database management systemmore efficiently and effectively. | |
| **Unit - I** | **Data Models** | **9** |
| Introduction – Database System Applications – Purpose of database systems – View of data – Database Languages – Relational Databases – Database Architecture – Database Users and administrators – Relational Model – Structure of Relational Databases – Database Schema – Keys – Schema Diagrams – Relational Query Languages – Relational Algebra – Fundamental Relational Operations – Additional Relational Operations. | | |
| **Unit - II** | **SQL and Database Design** | **9** |
| Database Design – ER model – Constraints – ER diagrams – Reduction to Relational Schema – ER design issues – SQL: Basic structure – Operations – Aggregate Functions –Sub queries – Nested Sub queries – modification of the database – Intermediate SQL: Joins – views– Index – Integrity Constraints – SQL data types and schemas – Authorization. | | |
| **Unit - III** | **Relational Database Design** | **9** |
| Features of good relational designs – Functional dependency – Decomposition using functional dependencies – Normal Forms: 1NF, 2NF, 3NF, BCNF, 4NF, 5NF. | | |
| **Unit - IV** | **Indexing and Hashing** | **9** |
| Ordered indices – B tree index files – B+ Tree index files – Multiple key access – Static and Dynamic Hashing – Bitmap indices – Overview of Query Processing. | | |
| **Unit - V** | **Transactions** | **9** |
| Transaction concept – Transaction model –Storage structure – Transaction atomicity and durability – Isolation – Serializability– Concurrency control: Lock-based Protocols – Deadlock Handling. | | |

**Total: 45**

**TEXT BOOK**

| | |
|---|---|
| 1. | Silberschatz Abraham, Korth Henry F. and Sudarshan S., "Database System Concepts", 7th Edition , McGraw Hill, New York, 2019. for Unit I, II, III, IV and V. |

**REFERENCES**

| | |
|---|---|
| 1. | ElmasriRamez and NavatheShamkant 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:**<br>On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | determine various keys and sketch a suitable schema for a given application. | Applying (K3) |
| CO2 | design an ER model and write SQL queries for a queries for a given scenario. | Applying (K3) |
| CO3 | design relational database using normalization methods for a given application. | Applying (K3) |
| CO4 | apply indexing and hashing techniques in the design of relational database. | Applying (K3) |
| CO5 | apply the concept of concurrency control in transaction processing. | Applying (K3) |

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**DATA ANALYSIS**
**(Common to AI & DS and AI & ML branches)**

| Programme & Branch | B.Tech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 3 | PC | 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 Exercises / Experiments:**

| | |
|---|---|
| 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. for Unit I, II, III, IV and V. |

**REFERENCE BOOK:**

| | |
|---|---|
| 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) |
| CO2 | understand and design data model and DAX applications | Applying (K3) |
| CO3 | interpret the concepts in developing Power BI reports and dashboards | Applying (K3) |
| CO4 | develop applications using Power Pivot, Pivot Tables and Charts | Applying (K3) |
| CO5 | implement advanced operations in Power BI | Applying (K3) |
| CO6 | create data model and implement DAX operations for various applications | Applying (K3) Precision (S3) |
| CO7 | create customized reports and dashboards using Power BI | Applying (K3) Precision (S3) |
| CO8 | integrate Power BI with other 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 | 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 |
| CO6 | 3 | 2 | 2 | 2 | 3 | | | | | | | | 3 | 3 |
| CO7 | 3 | 2 | 2 | 2 | 3 | | | | | | | | 3 | 3 |
| CO8 | 3 | 2 | 2 | 2 | 3 | | | | | | | | 3 | 3 |

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

**ASSESSMENT PATTERN - THEORY**

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

**DATABASE MANAGEMENT SYSTEMS LABORATORY**
**(Common to AI & DS and AI & ML branches)**

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

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Demonstrate Data Definition Language and integrity constraints. |
| 2. | Demonstrate Data Manipulation Language, Data Control Language commands and TCL commands. |
| 3. | Execute nested and sub queries in SQL. |
| 4. | Demonstrate Join operations in SQL. |
| 5. | Create Views and index and perform SQL operations in it. |
| 6. | Demonstrate the concept of looping using PL/SQL statements. |
| 7. | Implement Cursors and its operations. |
| 8. | Implement Triggers and its operations. |
| 9. | Develop Procedures and Functions to perform operations in SQL. |
| 10. | Embed SQL queries in high level languages. |
| 11. | Mini project on Application Development using Oracle/ SQL SERVER / MYSQL. |

**Total: 30**

**REFERENCES/MANUAL/SOFTWARE:**

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

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

**Mapping of COs with POs and PSOs**

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

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

**20EGL31 - ENGLISH FOR WORKPLACE COMMUNICATION LABORATORY**
**(Common to all Engineering and Technology Branches)**

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

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

**List of Exercises / Experiments:**

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

**Total:30**

**TEXT BOOK**


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

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**UNIVERSAL HUMAN VALUES**
**(Common to all Engineering and Technology Branches)**

| Programme & Branch | BTech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 3 | HS | 2 | 0 | 0 | 2 |

| | | |
|---|---|---|
| Preamble | To make the student to know what they 'really want to be' in their life and profession, understand the meaning of happiness and prosperity for a human being. Also to facilitate the students to understanding of harmony at all the levels of human living, and live accordingly | |
| **Unit - I** | **Introduction** | **6** |
| Need and Basic Guidelines of Value Education – Content and Process of Value Education – Self Exploration – purpose of self-Exploration – Content and Process of Self exploration – Natural Acceptance – Realization and Understanding – Basic Human Aspirations – Continuous Happiness and Prosperity – Exploring Happiness and Prosperity – Basic Requirement for Fulfillment of Human Aspirations – Relationships – Physical Facilities – Right Understanding. | | |
| **Unit - II** | **Harmony in the Self and Body** | **6** |
| Human Begin and Body – Understanding Myself as Co–existence of Self ('I') and Body, Needs of the Self and Body, Activities in the Self and Body, Self ('I') as the Conscious Entity, the Body as the Material Entity – Exercise – Body as an Instrument– Harmony in the Self ('I) – Understanding Myself – Harmony with Body. | | |
| **Unit - III** | **Harmony in the Family and Society** | **6** |
| Harmony in the Family – Justice – Feelings (Values) in Human Relationships – Relationship from Family to Society – Identification of Human Goal – Five dimensions of Human Endeavour. | | |
| **Unit - IV** | **Harmony in Nature and Existence** | **6** |
| Order of Nature – Interconnectedness – Understanding the Four order – Innateness – Natural Characteristic – Basic Activity – Conformance – Introduction to Space – Co–existence of units of Space – Limited and unlimited – Active and No–activity – Existence is Co–existence. | | |
| **Unit - V** | **Implications of the above Holistic Understanding of Harmony on Professional Ethics** | **6** |
| Values in different dimensions of Human Living – Definitiveness of Ethical Human Conduct –Implications of Value based Living – Identification of Comprehensive Human Goal – Humanistic Education – Universal Human Order – Competence and Issues in Professional Ethics. | | |

**Lecture: 45; Total: 45**

**TEXT BOOK:**


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


**REFERENCES:**


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

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**SEMESTER IV**

**OPTIMIZATION TECHNIQUES**

**(Common to AI & DS and AI & ML branches)**

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

| | | |
|---|---|---|
| Preamble | The course focuses on the basic concepts, various techniques and applications of engineering optimization. | |
| **Unit - I** | **Classical Optimization Techniques** | **9 + 3** |
| 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 – KuhnTucker conditions. | | |
| **Unit - II** | **Non-Linear Programming: One-Dimensional Minimization Method** | **9 + 3** |
| 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 + 3** |
| Introduction to Unconstrained optimization – Direct Search Methods: Random search methods – Grid search method – Univariate method –Hookes and Jeeve's method – Powell's method – Indirect Search Methods: Steepest descent method – Fletcher-Reeves method – Newton's method. | | |
| **Unit - IV** | **Non-Linear Programming: Constrained Optimization Techniques** | **9 + 3** |
| 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. | | |
| **Unit - V** | **Advanced Non-Linear Optimization** | **9 + 3** |
| Genetic Algorithms – Introduction – Working Principle –Genetic operators –Particle swarm optimization – Computational Implementation – Ant colony optimization – Working principle – Neural network based optimization. | | |

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

**TEXT BOOK:**


1. S.S.Rao, Engineering Optimization Theory and Practice,5th Edition, New Age International, 2019. for Unit I, II, III, IV and V.


**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 andapplications, 2ndEdition, Wiley India Pvt. Ltd., 2006.
3. Yang, Xin-She. Optimization Techniques and Applications with Examples. 1st Edition, John Wiley & Sons, United Kingdom: Wiley, 2020.

| | **COURSE OUTCOMES:**<br>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 | 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 | 2 | | | | | | | | | | 3 | 2 |

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

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 5 | 10 | 85 | | | | 100 |
| CAT2 | 5 | 10 | 85 | | | | 100 |
| CAT3 | 5 | 10 | 85 | | | | 100 |
| ESE | 5 | 20 | 75 | | | | 100 |

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

**WEB TECHNOLOGY**
**(Common to CSE, AI & DS and AI & ML branches)**

| Programme& Branch | B.Tech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Object Oriented Programming | 4 | ES | 3 | 0 | 0 | 3 |

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

**Lecture:45, Total:45**

**TEXT BOOKS:**

| | |
|---|---|
| 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(first half), II. |
| 2. | Infosys campus connect material shared by infy. for Unit I (Second Half), III. |
| 3. | https://www.javatpoint.com for Unit IV and V. |

| | COURSE OUTCOMES:<br>On completion of the course, the students will be able to | BT Mapped (Highest Level) |
|---|---|---|
| CO1 | design static web pages using HTML, CSS and Bootstrap. | Applying (K3) |
| CO2 | develop interactive and dynamic web pages using javascript | Applying (K3) |
| CO3 | develop a web application using node JS with database connectivity | Applying (K3) |
| CO4 | apply the features of ReactJS to develop web applications. | Applying (K3) |
| CO5 | demonstrate client-side JS framework to develop web applications | Applying (K3) |

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**OBJECT ORIENTED PROGRAMMING**
**(Common to CSE, AI & DS and AI & ML branches)**

| Programme & Branch | B.Tech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 4 | PC | 2 | 0 | 2 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides a concise introduction to the fundamental concepts of Java programming including inheritance, interfaces, exception handling and threads. | |
| **Unit - I** | **Introduction to OOP and Java** | **6** |
| Overview of OOP – Object oriented programming paradigms – Features of Object Oriented Programming – Java Buzz words – Evolution of Java – Overview of Java–Data Types, Variables and Arrays – Operators – Control Statements. | | |
| **Unit - II** | **Classes, objects and Methods** | **6** |
| Classes: Class Fundamentals-objects–Assigning Object Reference Variables – Introducing Methods – Constructors – this keyword – Garbage Collection – Stack Class. Overloading Methods – Objects as Parameters – Argument Passing – Returning Objects – Recursion – Access Control–Static – Nested and Inner Classes – Command–Line Arguments – Variable Length Arguments. | | |
| **Unit - III** | **Inheritance, Packages and Interfaces** | **6** |
| Inheritance: Basics – Super keyword -Multilevel Hierarchy–Method Overriding – Dynamic Method Dispatch –Abstract Classes – final with Inheritance - Packages and Interfaces: Packages – Packages and Member Access –Importing Packages – Interfaces. | | |
| **Unit - IV** | **Exception handling, Multithreading and I/O** | **6** |
| Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in Exceptions – User defined Exception. Multithreaded Programming: Java Thread Model–Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread Communication- Suspending –Resuming, and Stopping Threads –Multithreading- I/O Basics – Reading and Writing Console I/O – Reading and Writing Files. | | |
| **Unit - V** | **String handling, Generics and Collections** | **6** |
| Generics: Introduction – Example –Parameters – General Form – Generic Methods, Constructors and Interfaces. Strings: Basic String class, methods and String Buffer Class. Collection frameworks: Overview – Collection Classes – Collection Interfaces. | | |

**List of Exercises / Experiments:**

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

**Lecture: 30; Practical: 30; Total: 60**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Herbert Schildt, "Java: The Complete Reference", 11th Edition, McGraw Hill Education, New Delhi, 2019 for Unit I, II, III, IV and V. |

**REFERENCES/MANUAL/SOFTWARE:**

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

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | interpret the role of object oriented programming, java and its variations | Applying (K3) |
| CO2 | apply the concepts of classes, objects and methods to solve simple problems | Applying (K3) |
| CO3 | develop programs using inheritance, packages and interfaces | Applying (K3) |
| CO4 | make use of exception handling mechanisms and multithreaded model along with i/o packages to solve real world problems | Applying (K3) |
| CO5 | build java applications with string classes, collections and generics concepts | Applying (K3) |
| CO6 | design and develop java programs using object oriented programming concepts | Applying (K3) Precision (S3) |
| CO7 | develop simple applications using package, exceptions and multithreading. | Applying (K3) Precision (S3) |
| CO8 | develop a solution for real world problems using i/o, generics and collections. | Applying (K3) Precision (S3) |

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**OPERATING SYSTEMS**
**(Common to CSE, AI & DS and AI & ML branches)**

| Programme & Branch | B.Tech. & Artificial Intelligence and Data Science. | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 4 | PC | 3 | 0 | 0 | 3 |

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

**Lecture: 45; Total: 45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 10th Edition, John Wiley & Sons Inc., 2020. for Unit I, II, III, IV and V. |

**REFERENCES:**

| | |
|---|---|
| 1. | William Stallings, "Operating Systems Internals and Design Principles", 9th Edition, Prentice Hall, 2020. |
| 2. | Andrew S. Tanenbaum, "Modern Operating Systems", 4th Edition, Pearson Education, 2016. |

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**APPLIED MACHINE LEARNING**

**(Common to AI & DS and AI & ML branches)**

| Programme& Branch | B.Tech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| **Prerequisites** | **Nil** | **4** | **PC** | **3** | **0** | **0** | **3** |

| | | |
|---|---|---|
| Preamble | The course provides the concepts and algorithms in machine learning and the methods to apply them in real time problems | |
| **Unit - I** | **Introduction to Machine Learning and Learning Theory** | **9** |
| Need for Machine Learning –Machine Learning in relation to other fields – Types of Machine Learning – Challenges of Machine Learning – Machine Learning Process and Applications – Data – Data Analytics –Descriptive Statistics– Univariate, Bivariate and Multivariate Data – Feature Engineering – Dimensionality Reduction techniques– Learning and its Types – Computation Learning Theory – Concept Learning – Induction Biases – Modeling – Learning Frameworks | | |
| **Unit - II** | **Similarity based Learning and Regression Analysis** | **9** |
| Introduction to Similarity based Learning – Nearest Neighbor Learning – Weighted K-Nearest Neighbor Algorithm – Nearest Centroid Classifier – Locally weighted Regression – Introduction to Regression – Linearity, Correlation and Causation – Linear Regression – Multiple Linear Regression – Polynomial Regression – Logistic Regression – Ridge, Lasso and Elastic net Regression | | |
| **Unit - III** | **Decision Tree and Rule-based Learning** | **9** |
| Decision Tree learning Model – Decision Tree Induction Algorithms – Validating and Pruning of Decision Trees– Sequential Covering Algorithm – First Order Rule Learning – Induction as Inverted Deduction – Inverting Resolution – Analytical Learning – Active Learning | | |
| **Unit - IV** | **Bayesian Learning, Probabilistic Graphical Models and Support Vector Machines** | **9** |
| Probability based Learning – Bayes Theorem – Classification using Bayes Model – Naïve Bayes Algorithm for Continuous Attributes – Other Naïve Bayes Classifiers – Bayesian Belief Network – Markov Chain – Problems Solved with HMM– Introduction to Support Vector Machine – Optimal Hyperplane – Functional and Geometric Margin – Hard Margin – Soft Margin – Kernels and Non-Linear Regression | | |
| **Unit - V** | **Ensemble Learning, Clustering Algorithms and Reinforcement Learning** | **9** |
| Introduction – Parallel Ensemble Models – Incremental Ensemble Models – Sequential Ensemble Models –Introduction to Clustering Approaches – Proximity Measures – Hierarchical Clustering Algorithms –Partitional Clustering Algorithm – Density Based Methods – Grid Based Approach – Probability Model-based Methods – Cluster Evaluation Methods – Overview of Reinforcement Learning – Reinforcement Learning as Machine Learning – Components – Markov Decision Process | | |

**Lecture:45, Total: 45**

**TEXT BOOK:**


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

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | adapt to basic concepts of machine learning, to understand data and concept learning | Applying (K3) |
| CO2 | demonstrate similarity based learning and various regression techniques | Applying (K3) |
| CO3 | carry out decision tree learning and rule-based learning | Applying (K3) |
| CO4 | develop Bayesian , probabilistic and support vector machine models | Applying (K3) |
| CO5 | apply learned models to create ensemble models and to work with clustering algorithms, reinforcement learning | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 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 | 15 | 35 | 50 | | | | 100 |
| CAT2 | 15 | 35 | 50 | | | | 100 |
| CAT3 | 15 | 35 | 50 | | | | 100 |
| ESE | 10 | 40 | 50 | | | | 100 |

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

**WEB TECHNOLOGY LABORATORY**
**(Common to CSE, AI & DS and AI & ML branches)**

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

**List of Exercises / Experiments:**

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

**Practical:30, Total:30**

**REFERENCES / MANUAL /SOFTWARE**

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

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

**Mapping of COs with POs and PSOs**

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

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

**APPLIED MACHINE LEARNING LABORATORY**
**(Common to AI & DS and AI & ML branches)**

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

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Create a sample dataset and explore statistical operations using Pandas and visualize the results through plots |
| 2. | Create a sample dataset and apply preprocessing techniques |
| 3. | Perform dimensionality reduction using Principal Component Analysis |
| 4. | Apply Find-S algorithm on sample dataset and find maximally specific hypothesis |
| 5. | Implement K-Nearest Neighbor Algorithm |
| 6. | Implement linear regression and multiple linear regression algorithms |
| 7. | Implement and demonstrate decision tree based ID3 algorithm |
| 8. | Implement and demonstrate the working of Naive Bayesian classifier |
| 9. | Implement and demonstrate Hidden Markov Model |
| 10. | Implement Support Vector Machine |
| 11. | Implement and compare the working of Random Forest classifier with Adaboost model |
| 12. | Implement K-Means clustering algorithm |

**Practical: 30; Total: 30**

**REFERENCES/MANUAL/SOFTWARE:**

| | |
|---|---|
| 1. | Laboratory Manual |
| 2. | Python / MATLAB |

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

**Mapping of COs with POs and PSOs**

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

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

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

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

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

**Total: 25**

**TEXT BOOK:**


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


**REFERENCES:**


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

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**SEMESTER V**
**ARTIFICIAL INTELLIGENCE**
**(Common to AI & DS and AI & ML branches)**

| Programme & Branch | B.Tech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 5 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | The course focuses on search methods, game playing, constraint satisfaction,planning and knowledge representation in artificial intelligence. | |
| **Unit - I** | **Intelligent Agents** | **9** |
| Introduction to AI – Agents and Environments – Concept of rationality – Nature of environments – Structure of agents– Problem Solving agents – search algorithms – uninformed search strategies. | | |
| **Unit - II** | **Problem Solving** | **9** |
| Heuristic search strategies – heuristic functions–Local search and optimization problems – local search in continuous space – search with non- deterministic actions – search in partially observable environments – online search agents and unknown environments. | | |
| **Unit - III** | **Game Playing and CSP** | **9** |
| Game theory – optimal decisions in games – alpha-beta search – monte-carlo tree search – stochastic games – partially observable games–Constraint satisfaction problems – constraint propagation – backtracking search for CSP – local search for CSP – structure of CS. | | |
| **Unit - IV** | **Logical Agents** | **9** |
| Knowledge-based agents – propositional logic – propositional theorem proving – propositional model checking – agents based on propositional logic–First-order logic – syntax and semantics – knowledge representation and engineering – inferences in first-order logic – forward chaining – backward chaining – resolution. | | |
| **Unit - V** | **Knowledge Representation and Planning** | **9** |
| Ontological engineering – categories and objects – events – mental objects and modal logic – reasoning systems for categories – reasoning with default information–Classical planning – algorithms for classical planning – heuristics for planning – hierarchical planning – non-deterministic domains – time, schedule, and resources – analysis. | | |

**Theory:45; Total:45**

**TEXTBOOK:**

| | |
|---|---|
| 1. | Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition, Pearson Education, 2013. for Unit I, II, III, IV and V. |

**REFERENCE:**

| | |
|---|---|
| 1. | Khemani D., “A First Course in Artificial Intelligence”, 1st Edition, 9th reprint, McGraw Hill Education (India) Private Limited, 2019. |

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

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | | | | | | | | | | 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 | 20 | 40 | 40 | | | | 100 |
| CAT2 | 20 | 30 | 50 | | | | 100 |
| CAT3 | 20 | 30 | 50 | | | | 100 |
| ESE | 20 | 30 | 50 | | | | 100 |

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

**DEEP LEARNING**
**(Common to AI & DS and AI & ML branches)**

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

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

**Theory:45; Total: 45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Aggarwal, Charu C, Neural networks and deep learning, Springe,r 2018. for Unit I, II, III, IV and V. |

**REFERENCES:**

| | |
|---|---|
| 1. | Ian Goodfellow, YoshuaBengio, and Aaron Courvill, “Deep Learning”, MIT Press, USA, 2016 |
| 2. | Josh Patterson and Adam Gibson, “Deep Learning – A Practitioner’s Approach”, First Edition, O’Reilly Series, August 2017. |
| 3. | Indra den Bakker, “Python Deep Learning Cookbook”, First Edition, Packt Publishing, October 2017. |

| **COURSE OUTCOMES:**<br>On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | use Artificial Neural Network .concepts to solve real world problems | Applying (K3) |
| CO2 | solve simple real world problems using deep neural networks. | Applying (K3) |
| CO3 | use the concepts of RBF and Boltzman machines to solve real world problems | Applying (K3) |
| CO4 | exemplify the concepts of CNN models and apply it for solving computer vision related problems. | Applying (K3) |
| CO5 | explicate the concepts of RNN models and apply it for solving Natural Language 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 | 3 | | | | | | | | | | 2 | 3 |
| CO2 | 3 | 2 | 3 | | | | | | | | | | 2 | 3 |
| CO3 | 3 | 2 | 3 | | | | | | | | | | 2 | 3 |
| CO4 | 3 | 2 | 3 | | | | | | | | | | 2 | 3 |
| CO5 | 3 | 2 | 3 | | | | | | | | | | 2 | 3 |

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

**ASSESSMENT PATTERN - THEORY**

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

## DATA MODELING AND BUSINESS INTELLIGENCE

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

| | | |
|---|---|---|
| **Preamble** | This course provides an exposure on loading, transforming and handling of data. Also it provides Knowledge about analyzing, reporting results for better decision making. | |
| **Unit - I** | **Data preprocessing** | **9** |
| Data objects and attribute types – Statistical descriptions of data – Measuring data similarity and dissimilarity - Major tasks in data preprocessing - Data Cleaning – Data Integration – Data Reduction. | | |
| **Unit - II** | **Data Models** | **9** |
| OLTP, OLAP and Multidimensional Data Modeling: OLTP – OLAP – OLAP Architectures – Data Model – Role of OLAP Tools in BI – OLAP Operations. Multidimensional Data Modeling: Basics of Data Modeling – Types of Data Model – Data Modeling Techniques – Fact Table – Dimension Table – Dimensional Models – Dimensional Modeling Life Cycle | | |
| **Unit - III** | **ETL Process** | **9** |
| ETL data structures- Extraction process – cleaning and confirming – delivering dimension tables – delivering fact tables. | | |
| **Unit - IV** | **ETL and Reporting Tools** | **9** |
| ETL tools:: Airflow – Basic operations on Airflow. Click view – Azure Data factory – Stitch – Case studies and real time applications. | | |
| **Unit - V** | **Performance Management and Enterprise Reporting** | **9** |
| Performance Management and Enterprise Reporting: Measures, Metrics, KPIs and Performance Management: 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. | | |

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

**TEXT BOOKS:**

| | |
|---|---|
| 1. | Han Jiawei, and Kamber Micheline, "Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kaufmann Publishers, 2012. (Units I) |
| 2. | Prasad R.N. and Seema Acharya, "Fundamentals of Business Analytics", 2ndEdition, Wiley, 2016. (Units II, IV, V) |
| 3. | Ralph Kimball, Joe Caserta."The Data Warehouse ETL Toolkit". 2ndedition, Wiley, 2008. (Unit III) |

**REFERENCES:**

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

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Evaluate and display statistical descriptions of data |
| 2. | Perform data cleaning operations on the given dataset |
| 3. | Implement data reduction operations |
| 4. | Demonstrate data integration methods |
| 5. | Create different types of schema |
| 6. | Experiment ETL process in the chosen dataset using Airflow |
| 7. | Create reports for real life problems |
| 8. | Develop dashboards and score cards for the given problem |

**REFERENCES/MANUAL/SOFTWARE:**

| | |
|---|---|
| 1. | Python |
| 2. | Any ETL tool like Airflow, clickview, Azure |
| 3. | Lab manual |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1: | interpret basic data preprocessing operations | Applying (K3) |
| CO2: | build various data models and perform OLAP operations | Applying (K3) |
| CO3: | apply ETL operations on the dataset | Applying (K3) |
| CO4: | demonstrate various ETL tools | Applying (K3) |
| CO5: | implement Performance Management and Enterprise Reporting | Applying (K3) |
| CO6: | experiment various data preprocessing operations | Applying (K3) Precision (S3) |
| CO7: | use ETL tools for processing the data | Applying (K3) Precision (S3) |
| CO8: | create reports for various real life BI applications | Applying (K3) Precision (S3) |

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT 1 | 15 | 30 | 55 | | | | 100 |
| CAT 2 | 15 | 30 | 55 | | | | 100 |
| CAT 3 | 15 | 30 | 55 | | | | 100 |
| ESE | 15 | 30 | 55 | | | | 100 |

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

**BIG DATA ANALYTICS**
**(Common to AI & DS and AI & ML branches)**

| Programme& Branch | B.TECH. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 5 | PC | 3 | 0 | 2 | 4 |

| | | |
|---|---|---|
| Preamble | This course focuses on the fundamentals of big data models , processing Frameworks , machine learning models and stream processing using Spark | |
| **Unit - I** | **Bigdata and Ingestion** | **9** |
| Introduction to Bigdata and Analytics - Four vs of Big Data - Challenges of Traditional System Data Ingestion into Big Data Systems: Introduction to data Ingestion -Tools for data Ingestion- **Apache Sqoop** -Sqoop Processing- Sqoop Import Process - Sqoop Connectors -Importing and Exporting Data from MySQL to HDFS - **Apache Flume** - Components in Flume's Architecture -Configuring Flume Components - Ingest Twitter Data | | |
| **Unit - II** | **Distributed Processing Framework** | **9** |
| Distributed Processing in Map reduce –-Distributed Systems - Word Count Example - Map Execution Phases -Map reduce Jobs - Mapreduce Job Work Interaction – Data Types in Hadoop -Output formats in Map Reduce -A**pache Hive** -Hive Architecture - Hive Queries- Hive Metastore -Hive DDL and DML - Table Data Types -Validation of Data -File Format Types -Data Serialization -Hive Table and Avro Schema- Hive Optimization - Dynamic Partitioning in Hive Bucketing -Hive Analytics UDF and UDAF. | | |
| **Unit - III** | **SPARK RDD** | **9** |
| **Apache Spark** – Introduction - Components of Spark -In-memory Processing - Spark Architecture -Spark Cluster - Spark RDD Introduction -Creating Spark RDD - RDD Operations - transformation- Actions –Caching and Persistence -Storage Levels - Lineage and DAG -Need for DAG -Debugging in Spark -Partitioning in Spark -Scheduling in Spark -Shuffling in Spark -Sort Shuffle -Aggregating Data. | | |
| **Unit - IV** | **Machine Learning with MLib** | **9** |
| Data Analytics using Spark - Spark SQL- Data Analysis Operations- Dataset ETL Process-Machine Learning Supervised Learning -Classification of Linear SVM Linear Regression with Real World Case Studies - Unsupervised Learning K-means clustering -Reinforcement Learning -Semi-supervised - Mlib Pipelines | | |
| **Unit - V** | **Spark Stream Processing** | **9** |
| Apache Kafka – Introduction to Publish subscribe systems-Requirements of Kafka - Kafka architecture-Kafka Internals- Kafka Development- Java/Scala Coding - Kafka Cluster -Kafka Streams - Kafka Connect -Encryption and Authentication using SSL -- Kafka – HDFS- Stream queries- stream processing- stream computing-Frequent item sets-Real Time Analytics platform -Graph analytics with graphx platform | | |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Installing and Configuring Hadoop for single node and Multinode architecture |
| 2. | Implement Word count/frequency program using Map reduce |
| 3. | Perform ingestion of data from relational database to HDFS using Apache Sqoop/Flume |
| 4. | Installation of HIVE and apply Hive to create, alter, and drop databases, tables, views, functions and indexes |
| 5. | Implementation of supervised learning application using Spark Mlib |
| 6. | Implementation of unsupervised learning application using Spark Mlib |
| 7. | Implement producer consumer application using Kafka |
| 8. | Apply stream processing using Kafka in spark Environment |

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

**TEXT BOOK:**


| | |
|---|---|
| 1. | Raj Kamal, PreetiSaxena, "Big Data Analytics, Introduction to Hadoop, Spark, and Machine-Learning", 1st Edition, McGraw Hill Education,2019. for Unit I, II, III, IV. |
| 2. | Neha Narkhede,Gwen shaper and Todd Palino, "Kafka The Definitive Guide-Real-Time Data and stream processing at scale", 1st Edition, Oreilly, 2019. for Unit V. |

**REFERENCES:**


| | |
|---|---|
| 1. | Seema Acharya, SubhashiniChellappan, “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. |


| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | apply various tools to extract value from data sources | Applying (K3) |
| CO2 | apply map reduce programming andHive queries to perform data analysis on real world datasets | Applying (K3) |
| CO3 | use Spark and Spark SQL environment for developing applications | Applying (K3) |
| CO4 | apply machine learning modelling on big data in spark | Applying(K3) |
| CO5 | apply stream processing on big data in spark | Applying (K3) |
| CO6 | apply map reduce programming for big data | Applying (K3), Precision (S3) |
| CO7 | apply Hive queries to perform data analysis on real world datasets | Applying (K3), Precision (S3) |
| CO8 | apply Machine Learning and stream processing using Kafka and Spark | 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 |
| CO6 | 3 | 2 | 2 | 1 | 2 | | | | | | | | 3 | 2 |
| CO7 | 3 | 2 | 2 | 1 | 2 | | | | | | | | 3 | 2 |
| CO8 | 3 | 2 | 2 | 1 | 2 | | | | | | | | 3 | 2 |

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

**ASSESSMENT PATTERN - THEORY**

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

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

## DEEP LEARNING LABORATORY

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

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Create a multi-layer neural network and apply it to MNIST dataset. |
| 2. | Test the performance of multi-layer neural network with various activation and loss functions and tune the performance with hyper parameters |
| 3. | Implement Logistic Regression. |
| 4. | Develop an application for outlier detection using autoencoder |
| 5. | Implement Convolutional neural networks and use them to classify images |
| 6. | Implement a movie recommender system using RBM |
| 7. | Implement Recurrent neural networks to generate new text. |
| 8. | Implement Stock Price prediction application using LSTM |
| 9. | Develop a image captioning application using RNN |
| 10. | Develop a image recognition application using CNN |
| 11. | Develop a hand written character recognition application using CNN |
| 12. | Implement GAN model to simulate realistic images |

**Total : 30**

**REFERENCES / MANUAS / SOFTWARE:**

| | |
|---|---|
| 1. | Operating System : Windows / Linux |
| 2. | Software : Python |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1: | apply deep neural network for simple problems. | Applying (K3), Precision (S3) |
| CO2: | apply CNN for image processing and RNN for text analysis. | Applying (K3), Precision (S3) |
| CO3 | develop a real world application using suitable deep neural networks. | Applying (K3), Precision (S3) |

**Mapping of COs with POs and PSOs**

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

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

**THEORY OF COMPUTATION**

**(Common to CSE, AI & DS and AI & ML branches)**

| Programme & Branch | B.Tech. & Artificial Intelligence and Data Science | 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. | | |

**Lecture:45, Total:45**

**TEXT BOOK:**


| | |
|---|---|
| 1. | Hopcroft J.E., Motwani R. and Ullman J.D., "Introduction to Automata Theory, Languages and Computations", 3rd Edition, Pearson Education, New Delhi, 2008. for Unit I, II, III, IV and V. |
| 2. | Martin J., "Introduction to Languages and the Theory of Computation", 4th Edition, Tata McGraw-Hill, New Delhi, 2010. |
| 3. | Linz P., "Introduction to Formal Language and Computation", 4th Edition, Narosa Publishing, 2007. |

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**MULTICORE ARCHITECTURE**
**(Common to CSE, AI & DS and AI & ML branches)**

| Programme& Branch | B.TECH. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Computer Organization | 5 | PE | 3 | 0 | 0 | 3 |

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

**Lecture: 45, Total:45**

**TEXT BOOK:**


1. John L. Hennessey and David A. Patterson, "Computer Architecture – A Quantitative Approach", 6th Edition, Morgan Kaufmann, Elsevier, 2019. for Unit I, II, III, IV and V.


**REFERENCE**


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

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | interpret the limitations of ILP and the need for multicore architectures | Applying (K3) |
| CO2 | know the importance of memory hierarchy and benefits of cache memory | Applying (K3) |
| CO3 | achieve data level parallelism by applying loop level parallelism and understand the architecture of Vector/GPU processor | Applying (K3) |
| CO4 | explore the cache coherence issues using different memory architectures and different types of inter connection networks | 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 | | | | | | | | | | 3 | 2 |
| CO2 | 3 | 3 | 2 | | | | | | | | | | 3 | 2 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 3 | 2 |
| CO4 | 3 | 3 | 2 | | | | | | | | | | 3 | 2 |
| CO5 | 3 | 3 | 2 | | | | | | | | | | 3 | 2 |

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

**ASSESSMENT PATTERN - THEORY**

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

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

**DESIGN PATTERNS AND PRINCIPLES**
**(Common to AI & DS and AI & ML branches)**

| Programme& Branch | BTech. & Artificial Intelligence and Machine Learning | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 5 | PC | 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** | **9** |
| Overview of UML : Basics and Details : Diagram Types – Class Diagrams – Sequence Diagram – Use Cases – Object Diagrams – State Diagrams - Examples | | |
| **Unit - II** | **Design Principles** | **9** |
| 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** : | **9** |
| Design Pattern – Introduction - Classification of Design Patterns ; Creational Design Patterns – Factory Method – Abstract Factory – Builder – Prototype - Singleton | | |
| **Unit - IV** | **Structural Design Pattern** | **9** |
| Use and Solution of Structural Design Pattern : Adapter – Bridge – Composite – Decorator – Façade – Flyweight – Proxy – Examples - Implementations | | |
| **Unit - V** | **Behavioral Design Patterns** | **9** |
| Use and Solutions of Behavioral Patterns: Chain of Responsibility – Command – Iterator – Mediator – Memento – Observer – State – Strategy – Template Method – Visitor – Examples – Implementations | | |

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

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Write a program to implement the following concepts in java.<br>a. Method overriding. b. Interface. c. Abstract class. |
| 2. | Write programs to implement SOLID principles |
| 3. | a. Write a Program to implement Factory pattern.<br>b. Write a program to implement abstract factory. |
| 4. | a. Write a Program to implement Singleton pattern.<br>b. Write a Program to implement Composite design pattern. |
| 5. | a. Write a program to implement decorator pattern.<br>b. Write a Program to implement proxy design pattern. |
| 6. | a. Write a Program to design chain of responsibility pattern.<br>b. Write a Program to design mediator pattern |
| 7. | Write a program to implement iterator pattern. |
| 8. | Write a program to implement visitor pattern. |
| 9. | Case Study Draw UML diagrams and implement Railway Reservation System |
| 10 | Case Study : Draw UML diagrams and implement Inventory Management System |

**TEXT BOOK:**


| | |
|---|---|
| 1. | Martin, Robert C. UML for Java programmers. Prentice Hall PTR, 2003.( Units I and II) |
| 2. | Vaskaran Sarkar, Java Design Patterns, Apress, 2016 (Units III, IV and V) |

**REFERENCES:**

| | |
|---|---|
| 1. | Rohit Joshi, Java Design Patterns: Reusable Solutions to Common Problems, Java Code Geeks, 2021 |
| 2. | https://refactoring.guru/design-patterns/ |

**REFERENCES / MANUAS / SOFTWARE:**

| | |
|---|---|
| 1. | Operating System : Windows |
| 2. | Software : IBM Rational Suite, Java SDK |

**Rational R**

| **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) |
| CO2 | apply design principles for designing the code for a problem | Applying (K3) |
| CO3 | use creational pattern to design the instantiation process | Applying (K3) |
| CO4 | use structural pattern to compose interfaces | Applying (K3) |
| CO5 | apply behavioral patterns to show communication between classes | Applying (K3) |
| CO6: | select and Implement appropriate SOLID principles for a given problem | Applying (K3) Precision(S3) |
| CO7: | implement Creational, Structural and Behavioral design patterns for real world problems | Applying (K3) Precision(S3) |
| CO8 | design and implement solutions for real world problems using UML and design patterns | Applying (K3) Precision(S3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO 7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 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 |
| CO6 | 3 | 2 | 3 | 2 | 3 | | | | | | | | 2 | 3 |
| CO7 | 3 | 2 | 3 | 3 | 3 | | | | | | | | 2 | 3 |
| CO8 | 3 | 2 | 3 | 3 | 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 | 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)**

**COMPUTER NETWORKS**
**(Common to CSE, IT, AI & DS and AI & ML branches)**

| Programme& Branch | B. Tech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| **Prerequisites** | **Nil** | **5** | **PE** | **3** | **0** | **0** | **3** |

| | | |
|---|---|---|
| Preamble | This course deals with the fundamental concepts of computer networks. It presents bottomup approach of different layers along with their concepts and protocols. | |
| **Unit - I** | **Network Models and Physical Layer** | **9** |
| Data Communications – Networks – Networks Types. Network Models: TCP/IP Protocol model - The OSI Model. 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– Framing – HDLC - Point-to-point protocol. Media Access Control Protocols: Random Access Protocols – Channelization - Wired LAN: Standard Ethernet – Connecting Devices – Virtual LANs. | | |
| **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 – UDP – TCP. Quality of Service: Data Flow Characteristics -Techniques to improve QoS. | | |
| **Unit - V** | **Application Layer** | **9** |
| WWW - HTTP- FTP - Electronic mail –Telnet - SSH, DNS. Network Management: Introduction - SNMP. | | |

**Lecture: 45, Total: 45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Behrouz A. Forouzan, “Data Communications and Networking”, McGraw-Hill, 5th Edition, 2013. for Unit I, II, III, IV and V. |

**REFERENCES:**

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

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

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

**SEMESTER VI**

**ARTIFICIAL INTELLIGENCE AND ROBOTICS**
**(Common to AI & DS and AI & ML branches)**

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

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

**Theory:45,Total: 45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Ronald C. Arkin, Robin R. Murphy, “An Introduction to AI Robotics”, 1st edition, MIT Press, USA, 2001 for Unit I, II. |
| 2 | Saha S.K., "Introduction to Robotics", 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014. for Unit III, IV and V. |

**REFERENCES:**

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

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

## TEXT AND SPEECH ANALYTICS

| Programme & Branch | B.Tech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 6 | PC | 2 | 0 | 2 | 3 |

| | | |
|---|---|---|
| Preamble | This course explores text extraction, text data analysis and speech processing and modeling | |
| **Unit - I** | **Text Extraction** | **6** |
| Introduction- Rapid automatic keyword extraction: candidate keywords - keyword scores - adjoining keywords - extracted keywords - Benchmark evaluation: precision and recall – efficiency - stoplist generation - Evaluation on new articles | | |
| **Unit - II** | **Anomaly and Trend Detection** | **6** |
| Text visualization techniques: Visualization in text analysis - Tag clouds - authorship and change tracking - Data Exploration and the search for noval patterns - sentiment tracking, visual analytics and FutureLen - scenario discovery - adaptive threshold setting for novelty mining: Introduction - adaptive threshold for anomaly - Experimental study. | | |
| **Unit - III** | **Text Streams** | **6** |
| Events and trends in text streams: Introduction - Text streams - Feature extraction and data reduction - Event detection - Trend detection - Event and trend descriptions - Embedding semantics in LDA topic models: Introduction - vector space modeling - latent semantic analysis - probabilistic latent semantic analysis - Latent Dirichlet allocation - embedding external semantics from Wikipedia - data-driven semantic embedding | | |
| **Unit - IV** | **Speech processing** | **6** |
| Phonetics - Articulatory Phonetics - Phonological Categories - Acoustic Phonetics and Signals - Speech Synthesis - Text Normalization - Phonetic and Acoustic Analysis - Diphone Waveform synthesis – Evaluation - Automatic Speech Recognition - Architecture - Hidden Markov Model to Speech - MFCC vectors - Acoustic Likelihood Computation - Evaluation. | | |
| **Unit - V** | **Speech modeling** | **6** |
| Hidden Markov Models: Markov Processes - HMMs - Evaluation, Optimal State Sequence - Viterbi Search, Baum-Welch Parameter Re-estimation - Implementation issues | | |

**Lecture: 30;Practical: 30 Total: 60**

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Perform stop word removal process from technical abstract dataset. |
| 2. | Apply rapid automatic keyword extraction for news articles and evaluate the performance. |
| 3. | Implement various text visualization techniques. |
| 4. | Perform sentiment analysis on movie review dataset and track the sentiment. |
| 5. | Implement event detection process for short text message. |
| 6. | Apply word embedding into sample text dataset and represent it using vector space model. |
| 7. | Apply word embedding into sample text dataset and represent it using latent semantic analysis. |
| 8. | Apply word embedding into sample text dataset and represent it using latent dirichlet allocation. |
| 9. | Develop HMM based speech recognition system. |
| 10. | Apply Viterbi approach to develop enhanced speech recognition system. |

**TEXT BOOK:**

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

**REFERENCES:**


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


**Total: 30**

**REFERENCES/MANUAL/SOFTWARE:**

| | |
|---|---|
| 1. | ABB Robot Studio Manual |
| 2. | Fire Bird – V Software and Hardware manual |
| 3. | 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) |
| CO2 | apply visualization techniques and perform anomaly & trend detection | Applying (K3) |
| CO3 | perform event operations in Text streams | Applying (K3) |
| CO4 | identify the different linguistic components of natural language | Applying (K3) |
| CO5 | decide on the appropriate modeling technique necessary for a given language and application | Applying (K3) |
| CO6 | work with text extraction process. | Applying (K3), Precision (S3) |
| CO7 | detect anomaly, trend and perform sentiment analysis. | Applying (K3), Precision (S3) |
| CO8 | work with speech data analysis. | Applying (K3), Precision (S3) |

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

## REGRESSION ANALYSIS

| Programme & Branch | BTech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 6 | PC | 3 | 1 | 0 | 4 |

| | | |
|---|---|---|
| Preamble | This course bring together many of the important new ideas in regression analysis and explain them in a statistical framework. Also, emphasize the mathematical methods and their conceptual under pinnings. | |
| **Unit - I** | **Fitting a straight by least square** | **9+3** |
| Distributions – Confidence Intervals and t-Test – Elements of matrix algebra. Straight Line: Introduction – Relationship between two variables – linear regression – Analysis of variance – confidence intervals – F-Test - Correlation. Checking the straight line fit: Lack of fit and pure error – Testing homogeneity of pure error – examining residuals – non-normality checks – checks for time effects, Non-sconstant variance. | | |
| **Unit - II** | **Regression in Matrix Term** | **9+3** |
| Fitting a straight line in matrix term – Singularity – Analysis of variance in matrix – variance of Y using matrix development - non-singular case. General linear regressing - least square properties – confidence intervals verses regions. | | |
| **Unit - III** | **Sum of Squares** | **9+3** |
| Polynomial Models – Two alternative forms of extra SS -Sequential sum of squares – problem with polynomial models – partial sum of squares - Two predictor variable example – sum of squares of set of linear functions. | | |
| **Unit - IV** | **Serial Correlations in residuals and Durbin-Watson test** | **9+3** |
| Serial Correlation in residuals –Durbin-Watson test for serial correlation – Primary test -simplified test – Width of the primary test – mean square successive difference – Examining the runs in the time sequence plot of residuals. | | |
| **Unit - V** | **Checking fitted models** | **9+3** |
| Hat matrix and various types of residuals – Added variable plot and partial residuals – detection of influential observation – statistical measuring influence. Multiple Regression – Testing general linear hypothesis – Generalize and weighted least square – example of weighted least square – restricted least square – inverse regression – planar regression. | | |

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

**TEXT BOOK:**


| | |
|---|---|
| 1. | Norman R. Draper, Harry Smith,"Applied Regression Analysis", 3rdedition, John Wiley & Sons,USA, 2014. for Unit I, II, III, IV and V. |


**REFERENCES:**


| | |
|---|---|
| 1. | Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani,"An Introduction to Statistical Learning: with Applications in R", 2ndedition, Springe, Germany,2021. |
| 2. | Shai Shalev-Shwartz, Shai Ben-David,"Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press , United Kingdom, 2014. |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | illustrate the fitting of straight line by least square | Applying (K3) |
| CO2 | make use of matrix for fitting as straight line | Applying (K3) |
| CO3 | apply sum of square and tests for parameters being zero | Applying (K3) |
| CO4 | illustrate Serial Correlations in residuals and Durbin-Watson test | Applying (K3) |
| CO5 | analysis the model for checking fitness. | Applying (K3) |

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

| **ASSESSMENT PATTERN - THEORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | 20 | 60 | 20 | | | | 100 |
| CAT2 | 20 | 50 | 30 | | | | 100 |
| CAT3 | 20 | 55 | 25 | | | | 100 |
| ESE | 20 | 50 | 30 | | | | 100 |

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

## ARTIFICIAL INTELLIGENCE AND ROBOTICS LABORATORY

| Programme& Branch | BTech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 6 | PC | 0 | 0 | 2 | 1 |
| Preamble | The laboratory course on AI and Robotics is intended to provide a practical realization of industrial robotand mobile robot for real time applications. | | | | | | |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Study the functions of ABB IRB 1410 industrial robot- components, drive system and end effectors. |
| 2. | Virtual reality robot programming for different tasks. |
| 3. | Creation of Tool Centre Point (TCP) and Work Object using ABB IRB 1410 industrial robot. |
| 4. | Robot programming exercises: Point-to-point and Continuous path programming. |
| 5. | Pick and place operation in teach mode using ABB IRB 1410 industrial robot. |
| 6. | Vision based on line Inspection and sorting of components using ABB IRB 1410 industrial robot. |
| 7. | Development of embedded programming for motion control using Fire Bird – V robot. |
| 8. | Development of embedded programming for velocity control using Fire Bird – V robot. |
| 9. | Development of embedded programming for path planning using Fire Bird – V robot. |
| 10. | Development of embedded programming for obstacle avoidance using Fire Bird – V robot. |

**Total: 30**

**REFERENCES/MANUAL/SOFTWARE:**

| | |
|---|---|
| 1. | ABB Robot Studio Manual |
| 2. | Fire Bird – V Software and Hardware manual |
| 3. | Laboratory Manual |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | analyze the industrial robot work cell problems and develop robot programming through ON/OFF line mode | Applying (K3), Precision (S3) |
| CO2 | develop an embedded programming for autonomous mobile robot | Applying (K3), Precision (S3) |
| CO3 | develop an on line inspection system using machine vision techniques | Applying (K3), Precision (S3) |

**Mapping of COs with POs and PSOs**

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

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

**SEMESTER VII**

**ENGINEERING ECONOMICS AND MANAGEMENT**

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

| Programme& Branch | BTech. & Artificial Intelligence and Data Science | 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. for Unit I, II, III, IV and V. |

**REFERENCES:**


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

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

## IMAGE AND VIDEO ANALYTICS

| Programme& Branch | B.Tech. & Artificial Intelligence and Machine Learning | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 7 | 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 Libratry - Hand Written Number Recognition with Keras and OpenCV | | |
| **Unit - II** | **Convolutional Neural Network for Computer Vision** | **9** |
| Convolution Neural Network – CNN architectures and drawbacks of DNN- convolution and pooling operations in tensor flow – training and evaluating CNN – model performance optimization – ImageNet – LeNet – AlexNet – VGGNet – GoogleLENet - TesNet. | | |
| **Unit - III** | **Feature extraction, object detection and segmentation** | **9** |
| Feature extraction approach – transfer learning example – multi-task learning – Auto encoders of CNN – difference between object detection and image classification - Traditional, nonCNN approaches to object detection - R-CNN – Regions with CNN features - Fast R-CNN – fast region-based CNN - Faster R-CNN – faster region proposal network-based CNN -Mask R-CNN – Instance segmentation with CNN | | |
| **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 in to 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 Handwritten Number Recognition using Tesnsorflow |
| 2. | Build a CNN model to perform Handwritten Number Recognition using Keras |
| 3 | Experiment the model performance using the available CNN models. |
| 4 | Develop a CNN model to perform object detection |
| 5 | Apply and segmentation procedures and design a model for image classification |
| 6 | Experiment image to image translation using GAN |
| 7 | Explore generative adversarial networks and its features on simple data set |
| 8 | Perform video classification using deep learning techniques. |

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

**TEXT BOOK:**

| | |
|---|---|
| 1. | Mohit Sewak, Md. Rezaul Karim and Pradeep Pujari, “Practical Convolutional Neural Networks, Packt Publishing, 2018. for Unit I, II, III. |
| 2. | Rajalingappaa Shanmugamani, “Deep Learning for Computer Vision”, Packt Publishing, 2018, for Unit IV and V. |

**REFERENCES/MANUAL/SOFTWARE:**

| | |
|---|---|
| 1. | D. L. Baggio et al., “Mastering OpenCV with Practical Computer Vision Projects”, Packt Publishing, 2012. |

| | |
|---|---|
| 2. | Jan Erik Solem, “Programming Computer Vision with Python: Tools and algorithms for analyzing images”, O'Reilly Media, 2012. |
| 3. | Windows/Linux |
| 4 | Tensorflow/OpenCV |
| 5. | Matlab/Python |
| 6. | Lab Manual |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | make use of the basic concepts of image processing and its libraries | Applying (K3) |
| CO2 | interpret the various CNN models used for image analytics | Applying (K3) |
| CO3 | apply the various levels of segmentation and interpret the results for object detection and feature extraction. | Applying (K3) |
| CO4 | make use of the GAN model to solve the real world problems. | Applying (K3) |
| CO5 | predict the more reliable video analytic solutions for real time problems. | Applying (K3) |
| CO6 | experiment the basic features of Keras and Tensorflow to implement CNN model. | Applying (K3) Precision (S3) |
| CO7 | implement image segmentation and GAN to provide more effective solutions. | Applying (K3) Precision (S3) |
| CO8 | develop a real time model for video analytics using deep learning techniques | Applying (K3) Precision (S3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | 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 |
| CO6 | 3 | 2 | 2 | 1 | 1 | | | | | | | | 3 | 2 |
| CO7 | 3 | 2 | 2 | 1 | 1 | | | | | | | | 3 | 2 |
| CO8 | 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 | 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)**

**WIRELESS SENSOR NETWORKS**
**(Common to AI & DS and AI & ML branches)**

| Programme& Branch | B.Tech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Computer Networks | 7 | PE | 3 | 0 | 0 | 3 |

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

**Total: 45**

**TEXT BOOK:**


1. WaltenegusDargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", 1st Edition, John Wiley & Sons, 2011. for Unit I, II, III, IV and V.


**REFERENCES:**


1. Mohammad S. Obaidat, SudipMisra, "Principles of Wireless Sensor Networks", 1st Edition, Cambridge University Press, London, 2014.
2. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks", 1st Edition, Elsevier, 2004.

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

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

| **ASSESSMENT PATTERN - THEORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | 30 | 50 | 20 | | | | 100 |
| CAT2 | 30 | 50 | 20 | | | | 100 |
| CAT3 | 30 | 30 | 40 | | | | 100 |
| ESE | 25 | 35 | 40 | | | | 100 |

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

**CLOUD COMPUTING**
**(Common to AI & DS and AI & ML branches)**

| Programme & Branch | B.TECH. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| **Prerequisites** | **Operating Systems** | **7** | **PE** | **2** | **0** | **2** | **3** |

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

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Find procedure to run the virtual machine of different configuration. Check how many virtual machines can be utilized at particular time in host machine. (Virtual Box or VM Ware or Hyper-V) |
| 2. | Install a C compiler in the virtual machine and execute a sample program. |
| 3. | Show the virtual machine migration from one node to another. |
| 4. | Develop a web application to provide Storage as a Service that offers a simple interface which allows users to manage file systems quickly and easily. |
| 5. | Explore public cloud services like Amazon, Google and Azure. |
| 6. | Configure IaaS architecture for installing guest operating system using OpenNebula. |
| 7. | Configure IaaS architecture in Nimbus for installing multiple operating systems in same host machine by sharing different core in the same processor. |
| 8. | Implement PaaS-Mobile sensor based IoT application hosted via PaaS environment |

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

**TEXT BOOK:**

| | |
|---|---|
| 1. | Kai Hwang, Geoffrey C Fox & Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", 1st Edition, (Reprint) Morgan Kauffmann, 2017. for Unit I, II, III, IV and V. |

**REFERENCES/MANUAL/SOFTWARE:**

| | |
|---|---|
| 1. | VMware, Google App Engine |
| 2. | C/Python/Java |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | explain the concepts, characteristics and benefits of Distributed System Models and apply the same for internet computing | Applying (K3) |
| CO2 | describe the importance of virtualization along with their technologies and apply in virtual resource management | Applying (K3) |
| CO3 | use and examine different cloud computing services | Applying (K3) |
| CO4 | analyze the components of Cloud Programming and Software Environments | Applying (K3) |
| CO5 | develop strategies for Ubiquitous Clouds and the Internet of Things | Applying (K3) |
| CO6 | demonstrate the use of cloud computing in various applications | Applying (K3), Precision (S3) |
| CO7 | apply different cloud programming model for the real world problems | Applying (K3), Precision (S3) |
| CO8 | develop and deploy cloud architecture and model | Applying (K3), Precision (S3) |

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**NATURE INSPIRED OPTIMIZATION TECHNIQUES**
**(Common to AI & DS and AI & ML branches)**

| Programme& Branch | B.Tech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 7 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides an introduction to nature inspired techniques and applications. | |
| **Unit - I** | **Introduction** | **9** |
| Philosophy of Natural Computing - Three Branches: A Brief Overview - Conceptualization -Individuals- Entities and agents - Parallelism and Distributivity - Interactivity – Adaptation - Feedback-Self-Organization-Complexity- Emergence and Reductionism- Bottom-up Vs Top-Down - Determination- Chaos and Fractals. | | |
| **Unit - II** | **Computing Inspired By Nature** | **9** |
| Evolutionary Computing- Hill Climbing and Simulated Annealing- Evolutionary biology - Darwin's Dangerous Idea- Genetics Principles- Standard Evolutionary Algorithm - Genetic Algorithms - Selection-Crossover- Mutation- Neurocomputing- Artificial neurons - network architectures- learning approaches - Hebbian learning- Single layer perceptron- Multi-layer perceptron - Self organization maps- discrete Hopfield network. | | |
| **Unit - III** | **Swarm Intelligence** | **9** |
| Introduction - Ant Colonies- Ant Foraging Behavior- Ant Colony Optimization- Simple ACO and scope of ACO algorithms- Ant Clustering Algorithm (ACA)- Swarm Robotics- Foraging for food- Social Adaptation of Knowledge - Particle Swarm Optimization (PSO) - Scope of PSO- social systems to particle swarm. | | |
| **Unit - IV** | **Immuno Computing** | **9** |
| Introduction- Immune System - Physiology and main components- Pattern Recognition and Binding -adaptive immune response- Self/Non-self discrimination- Immune Network Theory- Danger Theory- artificial immune systems- Evaluating Interaction - Immune Algorithms- Bone Marrow Models - Negative selection algorithms- Clonal selection and affinity maturation- Artificial Immune Networks. | | |
| **Unit - V** | **Computing With New Natural Materials** | **9** |
| DNA Computing - Basic concepts - DNA Molecule - Filtering models- Adleman's experiment - Test tube programming language- Formal models - Universal DNA Computers - Scope of DNA Computing - From Classical to DNA Computing - Quantum computing- Introduction- basic concepts from quantum theory- principles from quantum mechanics. | | |

**Lecture:45, Total: 45**

**TEXT BOOK:**


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

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**MODELING AND SIMULATION**
**(Common to AI & DS and AI & ML branches)**

| Programme& Branch | B.Tech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 7 | PE | 3 | 0 | 0 | 3 |

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

**Lecture:45, 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. for Unit I, II, III, IV and V.

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 30 | 45 | 25 | | | | 100 |
| CAT2 | 10 | 45 | 45 | | | | 100 |
| CAT3 | 25 | 45 | 30 | | | | 100 |
| ESE | 20 | 40 | 40 | | | | 100 |

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

## INFORMATION SECURITY

| Programme& Branch | BTech – Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Computer Networks | 7 | PE | 3 | 0 | 0 | 3 |

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

**Lecture:45, Total:45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Michael E. Whitman and Herbert J. Mattord, “Principles of Information Security”, 6th Edition, Cengage Learning, India, 2018. for Unit I, II, III, IV and V. |

**REFERENCES:**

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

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

## INFORMATION RETRIEVAL TECHNIQUES

| Programme& Branch | B.Tech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Applied Machine Learning | 7 | PC | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course discusses the basics of information retrieval, search engine operations and multimedia 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 - How people search - Search interfaces today - Visualization in Search Interfaces | | |
| **Unit - II** | **Modeling and Retrieval Evaluation** | **9** |
| Basic IR Models – Boolean Model – TF-IDF (Term Frequency/Inverse Document Frequency) Weighting – Vector Model – Probabilistic Model – Latent Semantic Indexing Model – Neural Network Model – Retrieval Evaluation – Retrieval Metrics – Precision and Recall – Reference Collection – User-based Evaluation | | |
| **Unit - III** | **Text Operations, Indexing and Searching** | **9** |
| Text Properties - Document Preprocessing - Text Compression – Text Classification – Characterization of Text Classification – Unsupervised Algorithms – Supervised Algorithms – Decision Tree – K-NN Classifier – SVM Classifier – Feature Selection or Dimensionality Reduction – Evaluation Metrics – Accuracy and Error – Indexing and Searching – Inverted Indexes – Sequential Searching – Multidimensional Indexing. | | |
| **Unit - IV** | **Web Retrieval and Web Crawling** | **9** |
| The Web – Search Engine Architectures – Cluster Based Architecture – Distributed Architectures – Search Engine Ranking – User Interaction –Browsing – Web Crawling – Applications of a Web Crawler – Taxonomy – Architecture and Implementation – Scheduling Algorithms – Evaluation. | | |
| **Unit - V** | **Multimedia Information Retrieval** | **9** |
| Content-based image retrieval – Audio and music retrieval – Retrieving and browsing video – Fusion models – Segmentation – Compression and MPEG standards –Case study: Digital Library | | |

**Lecture:45;Total: 45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Ricardo Baeza-Yate, Berthier Ribeiro-Neto, “Modern Information Retrieval”, 2nd Edition, Pearson Education Asia, 2011 for Unit I, II, III, IV and V. |

**REFERENCE:**

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

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | describe the basic concepts of information retrieval | Applying (K3) |
| CO2 | apply the various modeling techniques | Applying (K3) |
| CO3 | discuss the concepts of text operations, indexing and searching | Applying (K3) |
| CO4 | learn about web information retrieval and web crawling | Applying (K3) |
| CO5 | explore audio, music and video information retrieval techniques | Applying (K3) |

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**REINFORCEMENT LEARNING**
**(Common to AI & DS and AI & ML branches)**

| Programme& Branch | B.Tech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 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- The Markov Property- Markov Decision Processes- Value Functions- 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 | | |

**Lecture: 45, Total: 45**

**TEXT BOOK:**

| | |
|---|---|
| 1 | Richard S. Sutton and Andrew G. Barto, “Reinforcement Learning: An Introduction", 2nd Edition, MIT Press, London, 2018. for Unit I, II, III, IV and V. |

**REFERENCES:**

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

| | **COURSE OUTCOMES:**<br>On completion of the course, the students will be able to | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | illustrate RL tasks and the core principles behind the RL | Applying (K3) |
| 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 | outline temporal-difference learning and Q-learning | Applying (K3) |

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

## HEALTH CARE ANALYTICS

| Programme & Branch | B.Tech. & Artificial Intelligence & Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Deep learning | 7 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course enables the students to learn and understand health data formats, frameworks and apply health care analytics through machine learning and deep learning algorithms | |
| **Unit - I** | **Introduction to healthcare analysis** | **9** |
| Overview - History of Healthcare Analysis Parameters on medical care systems- Health care policy- Standardized code sets – Data Formats – Machine Learning Foundations: Tree Like reasoning , Probabilistic reasoning and Bayes Theorem, Weighted sum approach. | | |
| **Unit - II** | **Analytics on machine learnin** | **9** |
| Machine Learning Pipeline – Pre-processing –Visualization – Feature Selection – Training model parameter – Evaluation model : Sensitivity , Specificity , PPV ,NPV, FPR ,Accuracy , ROC , Precision Recall Curves , Valued target variables –Python: Variables and types, Data Structures and containers , Pandas Data Frame :Operations – Scikit –Learn : Pre-processing , Feature Selection. | | |
| **Unit – III** | **Health care management** | **9** |
| IOT- Smart Sensors – Migration of Healthcare Relational database to NoSQL Cloud Database – Decision Support System – Matrix block Cipher System – Semantic Framework Analysis – Histogram bin Shifting and Rc6 Encryption – Clinical Prediction Models – Visual Analytics for Healthcare. | | |
| **Unit – IV** | **Healthcare and deep learning** | **9** |
| Introduction on Deep Learning – DFF network CNN- RNN for Sequences – Biomedical Image and Signal Analysis – Natural Language Processing and Data Mining for Clinical Data – Mobile Imaging and Analytics – Clinical Decision Support System. | | |
| **Unit – V** | **Case studies** | **9** |
| Predicting Mortality for cardiology Practice –Smart Ambulance System using IOT –Hospital Acquired Conditions (HAC) program-Healthcare and Emerging Technologies – ECG Data Analysis. | | |

**Lecture:45;Total:45**

**TEXT BOOK**


| | |
|---|---|
| 1. | Chandan K.Reddy, Charu C. Aggarwal, “Health Care data Analysis”, First edition, CRC, 2015. for Unit I, II, III, IV and V. |


**REFERENCE BOOKS**


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

| **COURSE OUTCOMES:**<br>On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | use machine learning and deep learning algorithms for health data analysis | Applying (K3) |
| CO2 | apply the data management techniques for healthcare data | Applying (K3) |
| CO3 | evaluate the need of healthcare data analysis in e-healthcare, telemedicine and other critical care applications | Applying (K3) |
| CO4 | apply health data analytics for real time applications | Applying (K3) |
| CO5 | discuss about case studies in health data analysis | Applying (K3) |

| **Mapping of COs with POs and PSOs** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| CO1 | 3 | 2 | 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 | 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)**

**TIME SERIES ANALYSIS AND FORECASTING**
**(Common to AI & DS and AI & ML branches)**

| Programme & Branch | BTech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 7 | PE | 2 | 0 | 2 | 3 |

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

**List of Exercises / Experiments:**

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

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

**TEXT BOOK:**

| | |
|---|---|
| 1. | Douglas C. Montgomery, Cheryl L. Jennings, Murat Kulahci, "Introduction to Time Series Analysis and Forecasting", 2nd Edition, Wiley, 2016. for Unit I, II, III, IV and V. |

**REFERENCE:**

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

**REFERENCES/MANUAL/SOFTWARE:**

| | |
|---|---|
| 1. | Python |
| 2. | Laboratory Manual |

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**SOCIAL MEDIA ANALYTICS**
**(Common to AI & DS and AI & ML branches)**

| Programme & Branch | B.TECH. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| **Prerequisites** | **Nil** | **7** | **PE** | **3** | **0** | **0** | **3** |

| | | |
|---|---|---|
| Preamble | The course gives exposure to perform analytical operations on different types of data in social media | |
| **Unit - I** | **Foundations of social media analytics** | **9** |
| Creating value with Social media analytics – Understanding social media: Core characteristics – Understanding Social media analytics: Emergence – layers – types – social media analytics value creation cycle – challenges – social media analytics industry. | | |
| **Unit - II** | **Analytics Business Alignment and social media network analytics** | **9** |
| **Analytics Business Alignment** : Digital analytics maturity model – Role of CIO and its management – Formulation of strategy. **Social media network analytics:** Social network terms – network structures – network topologies – types of networks – network strategies - Network analysis tools. | | |
| **Unit - III** | **Text and Social media actions analytics** | **9** |
| **Text Analytics :** Types of social media text – deployment models – purpose – social media text analytics for Business Intelligence – text analytics value creation cycle – common terms – issues – Case studies. **Social media actions analytics**: Common social media actions - actions analytics tools - | | |
| **Unit - IV** | **Search Engine, location and hyperlink analytics** | **9** |
| **Search Engine analytics:** types of search engines - working - analytics – developing search engine optimization strategy and implementing – search engine data analytics - **Location analytics:** Sources of location data – data collection – location metrics – tools**. Social media hyperlink analytics:** types – hyperlink analytics – tools**.** | | |
| **Unit - V** | **Mobile and multimedia analytics** | **9** |
| **Mobile analytics:** types of apps- development perspective – classifying apps by their purpose – characteristics of mobile apps – tools**. Multimedia analytics:** Types – image analytics tools - video analytics. Social media legal, privacy and security issues. | | |

**Lecture:45;Total:45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Gohar F. Khan. Creating Value With Social Media Analytics. 1st edition, Create space, 2018. for Unit I, II, III, IV and V. |

**REFERENCES:**

| | |
|---|---|
| 1 | Marshall Sponder. Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics. 1st edition, McGrawHill, 2011. |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1: | get familiar with basic foundations of social media analytics | Understanding (K2) |
| CO2: | recall concepts Analytics Business Alignment and social media network analytics | Understanding (K2) |
| CO3: | implement techniques for Text and Social media actions analytics | Applying (K3) |
| CO4: | demonstrate different methods for Search Engine, location and hyperlink analytics | Applying (K3) |
| CO5: | use Mobile and multimedia analytics for various real life social media 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 | 3 | 3 | | | | | | | | | | 3 | 2 |
| CO2 | 3 | 3 | 2 | | | | | | | | | | 3 | 2 |
| CO3 | 3 | 2 | 3 | | | | | | | | | | 3 | 3 |
| CO4 | 3 | 2 | 3 | | | | | | | | | | 3 | 3 |
| CO5 | 3 | 2 | 2 | | | | | | | | | | 3 | 3 |

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

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT 1 | 15 | 30 | 55 | | | | 100 |
| CAT 2 | 15 | 30 | 55 | | | | 100 |
| CAT 3 | 15 | 30 | 55 | | | | 100 |
| ESE | 15 | 30 | 55 | | | | 100 |

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

**REAL TIME ANALYTICS**
**(Common to AI & DS and AI & ML branches)**

| Programme & Branch | B.TECH. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | 7 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides a comprehensive knowledge about data analysis technologies to build an effective real-time analytics platform. | |
| **Unit - I** | **Streaming Data and analytics** | **9** |
| Introduction to Streaming Data: Sources – Why Streaming Data is Different – Infrastructures and Algorithms. Streaming Analytics Architecture: Real-Time Architecture Components – Feature of Real-Time Architecture – Languages for Real-Time programming – A Real-Time Architecture Checklist. | | |
| **Unit - II** | **Processing and Storing Streaming Data** | **9** |
| Processing Streaming Data: Distributed Streaming Data Processing – Processing Data with Storm: Components, Configuring of a Storm Cluster – Distributed Clusters – Local Clusters – Storm Topologies. Storing Streaming Data : Consistent Hashing – No SQL Storage Systems – Other Storage Technologies – Choosing a Technology – Warehousing. | | |
| **Unit - III** | **Visualization and Aggregation** | **9** |
| Visualization: Visualizing Data – Mobile Streaming Applications – Exact Aggregation and Delivery: Timed Counting and Summation – Multi –Resolution Time-Series Aggregation – Stochastic Optimization | | |
| **Unit - IV** | **Statistical Approximation of Streaming Data and Sketching** | **9** |
| Statistical Approximation of Streaming Data: Sampling from a streaming Population – Biased Streaming Sampling. Sketching : Registers and Hash Functions – Working with Sets – The Bloom Filter – Distinct Value Sketches – The Count-Min Sketch – Other Applications | | |
| **Unit - V** | **Real-Time Models, Monitoring and Forecasting** | **9** |
| Real-Time Models and Monitoring: Simple Time-Series Models – Linear Models – Logistic Regression – Neural Network Models – Forecasting: Exponential Smoothing Methods – Regression Methods - Neural Network Methods. Monitoring: Outlier Detection - Change Detection | | |

**Lecture: 45, Total: 45**

**TEXT BOOK:**


1. Ellis, Byron. “Real-time analytics: Techniques to analyze and visualize streaming data”, John Wiley & Sons, 1st Edition, 2014 for Unit I, II, III, IV and V.


**REFERENCE:**


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

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

## ETHICS OF AI

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

| | | |
|---|---|---|
| Preamble | This course locates ethical analysis of artificial intelligence. It also interrogates artificial intelligence within the context of related modes of technological innovation, including machine learning, Big Data, and robotics. | |
| **Unit - I** | **Introduction** | **9** |
| The Artificial Intelligence of the Ethics of Artificial Intelligence - The Ethics of the Ethics of AI - Ethical Issues in Our Relationship with Artificial Entities. | | |
| **Unit - II** | **Frameworks and Modes** | **9** |
| AI Governance by Human Rights - The Incompatible Incentives of Private-Sector AI - Normative Modes: Codes and Standards - The Role of Professional Norms in the Governance of Artificial Intelligence | | |
| **Unit - III** | **Concepts and Issues** | **9** |
| Moral Framework of Justice in Artificial Intelligence - Accountability in Computer Systems – Transparency - Responsibility and Artificial Intelligence - The Concept of Handoff as a Model for Ethical Analysis. | | |
| **Unit - IV** | **Perspectives and Approaches** | **9** |
| Perspectives on Ethics of AI - Social Failure Modes in Technology and the Ethics of AI - Social Failure Modes in Technology and the Ethics of AI - Integrating Ethical Values and Economic Value. | | |
| **Unit - V** | **Cases and Applications** | **9** |
| Ethics of Artificial Intelligence in Transport - The Case for Ethical AI in the Military - The Ethics of AI in Biomedical Research, Patient Care, and Public Health - Ethics of AI in Law - Ethical AI in Criminal Law | | |

**Lecture: 45, Total: 45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Markus D. Dubber, Frank Pasquale, and Sunit Das, “Ethics of AI”, 1st edition, Oxford University Press, USA, 2020. for Unit I, II, III, IV and V. |

**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 Ethics of artificial intelligence in relation to cognitive fields of ethical inquiry | Applying (K3) |
| CO2 | articulates the AI ethics, in the context of different normative evaluation and governance frameworks. | Applying (K3) |
| CO3 | tackles central concepts and issues that may serve as points of departure for reflecting on the ethical dimensions and challenges of artificial intelligence | Applying (K3) |
| CO4 | illustrates various perspectives and approaches of AI Ethics | Applying (K3) |
| CO5 | demonstrate the ethics of artificial intelligence in various cases and its applications | Applying (K3) |

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

## NEURAL MACHINE TRANSLATION

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

| | | |
|---|---|---|
| Preamble | This course provides knowledge on basics of computer organization, introduces various arithmetic operations and discusses the performance issues of processor, memory and I/O units. | |
| **Unit – I** | **Introduction** | **9** |
| Regular Expressions – Words - Corpora - Text Normalization - Minimum Edit Distance. N-gram Language Models: N-Grams - Evaluating Language Models - Generalization and Zeros – Smoothing - Kneser-Ney Smoothing - The Web and Stupid Backoff - Advanced: Perplexity's Relation to Entropy | | |
| **Unit – II** | **Classification** | **9** |
| Naive Bayes Classifiers - Training the Naive Bayes Classifier - Worked example - Optimizing for Sentiment Analysis - Naive Bayes for other text classification tasks - Naive Bayes as a Language Model - Evaluation: Precision, Recall, F-measure - Test sets and Cross-validation - Statistical Significance Testing | | |
| **Unit - III** | **Regression** | **9** |
| Classification: the sigmoid - Learning in Logistic Regression - The cross-entropy loss function - Gradient Descent – Regularization - Multinomial logistic regression - Interpreting models - Advanced: Deriving the Gradient Equation. | | |
| **Unit - IV** | **Vector Semantics and Embeddings** | **9** |
| Lexical Semantics - Vector Semantics - Words and Vectors - Cosine for measuring similarity - TF-IDF: Weighing terms in the vector - Applications of the tf-idf vector model - Optional: Pointwise Mutual Information (PMI) - Word2vec - Visualizing Embeddings .- Semantic properties of embeddings - Bias and Embeddings - Evaluating Vector Models | | |
| **Unit - V** | **Models and Speech Tagging** | **9** |
| Units - The XOR problem - Feed-Forward Neural Networks - Training Neural Nets - Neural Language Models. Parts of Speech Tagging: English Word Classes - The Penn Treebank Part-of-Speech Tagset - Part-of-Speech Tagging - HMM Part-of-Speech Tagging - Maximum Entropy Markov Models – Bidirectionality - Part-of-Speech Tagging for Morphological Rich Languages, | | |

**Lecture: 45, Total: 45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Daniel Jurafsky, and James H. Martin "Speech and Language Processing An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", 2nd Edition, Pearson Education India;, 2013. for Unit I, II, III, IV and V. |

**REFERENCES:**

| | |
|---|---|
| 1. | Philipp Koehn, "Neural Machine Translation", 1st edition, Cambridge University Press, United Kingdom, 2020. |
| 2. | 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 the regular expression and n-gram models | Applying (K3) |
| CO2 | make use of Classification to solve the problem | Applying (K3) |
| CO3 | make use of Regression to solve the problem | Applying (K3) |
| CO4 | create Vector Semantics by learning representations of the meaning of words | Applying (K3) |
| CO5 | apply the Neural language models to the simple task of language modeling: | Applying (K3) |

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 20 | 60 | 20 | | | | 100 |
| CAT2 | 20 | 50 | 30 | | | | 100 |
| CAT3 | 20 | 55 | 25 | | | | 100 |
| ESE | 20 | 40 | 40 | | | | 100 |

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

**MULTI VARIATE DATA ANALYSIS**

| Programme & Branch | B.Tech. & Artificial Intelligence & Machine Learning | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| **Prerequisites** | **Multivariate Data Analysis** | **7** | **PE** | **3** | **0** | **0** | **3** |

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

**Lecture: 45, Total: 45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Joesph F. Hair Jr., William C. Black, Barry J. Babin, Rolph E.Anderson "Multivariate Data Analysis", Annabel Ainscow, Eigth Edition (2019). for Unit I, II, III, IV and V. |

**REFERENCES:**

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

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

## COGNITIVE SCIENCE AND ANALYTICS

| Programme & Branch | B.TECH. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Data analytics | 7 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Preamble** | To impart knowledge on cognitive science and various analytical methods | |
| **Unit – I** | **Introduction to Cognitive Science** | **9** |
| The Foundation of Cognitive Computing - Design Principles for Cognitive Systems: Components of a Cognitive System - Building the Corpus- Bringing Data into the Cognitive System - Machine Learning - Hypotheses -Generation and Scoring - Presentation and Visualization Services.<br>1. | | |
| **Unit - II** | **Natural Language Processing, Big Data and Cognitive Computing** | **9** |
| Natural Language Processing in Support of a Cognitive System - The Relationship Between Big Data and Cognitive Computing: Dealing with Human-Generated Data - Defining Big Data - The Architectural Foundation for Big Data - Analytical Data Warehouses - Hadoop - Data in Motion and Streaming Data - Integration of Big Data with Traditional Data. | | |
| **Unit - III** | **Taxonomies and Ontologies, Cloud and Distributed Computing** | **9** |
| Representing Knowledge in Taxonomies and Ontologies - Applying Advanced Analytics to Cognitive Computing - The Role of Cloud and Distributed Computing in Cognitive Computing. | | |
| **Unit - IV** | **1. The Process of Building Cognitive Applications** | **9** |
| The Business Implications of Cognitive Computing - IBM's Watson as a Cognitive System - The Process of Building a Cognitive Application - Smarter Cities: Cognitive Computing in Government. | | |
| **Unit - V** | **Applications and case studies** | **9** |
| Building a Cognitive Healthcare Application -Emerging Cognitive Computing Areas - Future Applications for Cognitive Computing. | | |

**Lecture: 45, Total: 45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Judith S. Hurwitz, Marcia Kaufman, Adrian Bowles. Cognitive Computing and Big Data Analytics. 1st edition, Wiley, 2015. for Unit I, II, III, IV and V. |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1: | describe the basic concepts of cognitive science | Understanding (K2) |
| CO2: | interpret the principles of Natural Language Processing and Big Data with Cognitive Computing | Understanding (K2) |
| CO3: | exploreTaxonomies and Ontologies and Cloud and Distributed Computing in cognitive environment | Understanding (K2) |
| CO4: | implement Watson for Cognitive system and develop applications | Applying (K3) |
| CO5: | demonstrate case studies of applying cognitive computing for various real life problems | Applying (K3) |

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT 1 | 40 | 60 | | | | | 100 |
| CAT 2 | 40 | 45 | 15 | | | | 100 |
| CAT 3 | 40 | 45 | 15 | | | | 100 |
| ESE | 40 | 45 | 15 | | | | 100 |

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

**GRAPH THEORY AND ITS APPLICATIONS**
**(Common to AI & DS and AI & ML branches)**

| Programme& Branch | B.Tech. & Artificial Intelligence and Data Science | 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. | | |

**Lecture:45, Total:45**

**TEXT BOOK:**


1. NarsinghDeo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall, New Delhi, 2010. for Unit I, II, III, IV and V.


**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 | | | | | | | | | | 3 | 2 |
| CO2 | 3 | 1 | | | | | | | | | | | 3 | 2 |
| CO3 | 3 | 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 | 10 | 50 | 40 | | | | 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)**

**SEMESTER VIII**

**SOFTWARE DEFINED NETWORKS**
**(Common to AI & DS and AI & ML branches))**

| Programme& Branch | B.Tech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Computer Networks | 8 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides an insight on programmability protocols, interfaces, controllers and its applications in various environments like data centers and service provider networks. | |
| **Unit - I** | **Introduction to SDN** | **9** |
| Introduction: Basic packet switching terminology – The modern data center – Traditional switch architecture – Autonomous and dynamic forwarding table. Evolution of switches and control planes – Cost – Data center innovation – Data center needs. The Genesis of SDN: The evolution of networking technology – Forerunners of SDN – Getting started with mininet and experimenting with mininet. | | |
| **Unit - II** | **SDN and OpenFlow** | **9** |
| Fundamental characteristics of SDN – SDN operation – SDN devices – SDN controllers – Alternate SDN methods. The OpenFlow specification: OpenFlow overview – OpenFlow 1.0 and OpenFlow basics - OpenFlow 1.1 Additions - OpenFlow 1.2 Additions - OpenFlow 1.3 Additions – OpenFlow Limitations. NetApp Development: Simple forwarding in OpenDayLight controller. | | |
| **Unit - III** | **SDN Interfaces** | **9** |
| Alternative definitions of SDN: Potential drawbacks of open SDN – SDN via APIs- SDN via hypervisor based overlays – SDN via opening up the device – Network Functions virtualization – Alternatives overlap and ranking. SDN open source: Open source licensing issues – OpenFlow source code – Switch implementation – Controller implementations – Orchestration and Network virtualization – Simulation, Testing and Tools – OpenStack – Applying SDN open source | | |
| **Unit - IV** | **SDN in the Data center** | **9** |
| Data center definition – Data center demands – Tunneling technologies for the data center – Path technologies in the data center – SDN and shortest path complexity – Ethernet fabrics in the data center – SDN use cases in the data center – Open SDN versus Overlays in the data center – Real-world data center implementation. | | |
| **Unit - V** | **SDN environments and applications** | **9** |
| SDN in other environment – Wide area networks – Service provider and carrier networks – Campus networks – Hospitality networks – Mobile networks – In-Line network functions – Optical networks. SDN Applications: Reactive versus Proactive applications – A simple reactive Java application – Creating network virtualization tunnels – offloading flows in the data center – Access control for the campus – Traffic engineering for the service providers –NetApp Development: A simple Firewall. | | |

**Lecture:45, Total:45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Paul Goransson and Chuck Black, "Software Defined Networks: A Comprehensive Approach", 1st Edition, Morgan Kaufmann, 2014. |

**REFERENCES:**

| | |
|---|---|
| 1. | SiamakAzodolmolky, "Software Defined Networking with OpenFlow", Packet Publishing, 1st Edition, 2013. |
| 2. | Thomas D. Nadeau and Ken Gray, "SDN: Software Defined Networks", O'Reilly Media, 1st Edition, 2013. |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | apply the programmability in the network using software defined network | Applying (K3) |
| CO2 | model a networking task using OpenFlow protocol | Applying (K3) |
| CO3 | demonstrate the networking application using software defined network interfaces and open source tools | Applying (K3) |
| CO4 | employ the software defined network architecture in the data centers | Applying (K3) |
| CO5 | design and develop various applications of SDN | Applying (K3) |

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

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

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

**SOFTWARE QUALITY AND TESTING**
**(Common to AI & DS and AI & ML branches)**

| Programme& Branch | B.Tech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Software Engineering | 8 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course focuses on the implementation of appropriate functionality that satisfies the requirements/needs of its targeted client/users for the intended software system, product, or service correctly and efficiently. | |
| **Unit - I** | **Software Quality Assurance and Review Techniques** | **9** |
| Defining Quality – Importance of Quality –Quality Control Vs Quality assurance –Quality assurance at each phase of SDLC - Need for SQA group in an Organization. Structured walkthroughs –Inspections –Various roles and responsibilities involved in Inspections –Making review successful. | | |
| **Unit - II** | **Software Measurement and Metrics** | **9** |
| Product quality – Models for software product Quality – Process Quality Aspects. Measurement and Metrics: Introduction – Measurement during software life cycle context –Defect metrics – Metrics for software maintenance– Requirements related metrics – Measurements and process improvement – Measurement principles. | | |
| **Unit - III** | **Basics of Testing** | **9** |
| Introduction – Definition– Testing Approaches – Essentials – features and principles of software Testing. Testing Environment: Assessing Capabilities – Staff Competency and User Satisfaction – Creating an environment supportive of software testing – Building the software testing process: Testing Guidelines. | | |
| **Unit - IV** | **Software Testing process** | **9** |
| Overview of Software Testing Process – Organizing for testing: Workbench – Input – Procedure. Developing the test plan:Workbench – Input – Procedure.Verification testing: Workbench – Input – Procedure. Validation testing :Workbench – Input – Procedure. | | |
| **Unit - V** | **Analyzing and reporting** | **9** |
| Analyzing and reporting test results: Workbench – Input – Procedure. Testing software system security – Testing client/server systems – Testing web-based systems – Using Agile Methods to Improve Software Testing. | | |

**Lecture:45, Total:45**

**TEXT BOOK:**


1. Nina S. Godbole, "Software Quality Assurance Principles and Practice", 2nd Edition, Narosa Publishing House, 2017 for Unit I, II, III, IV and V.
2. Perry William, "Effective Methods for Software Testing", 3rd Edition, Wiley, India, 2013 (Units 3,4,5)

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | apply quality assurance steps at each phase of SDLC and conduct reviews and inspections | Applying (K3) |
| CO2 | apply the concepts, metrics, and models in software quality assurance | Applying (K3) |
| CO3 | apply the step by step activities and set up environment for software testing | Applying (K3) |
| CO4 | develop procedures and workbenches for various testing process | Applying (K3) |
| CO5 | apply testing for client server, web based and software security systems and identify the agile methods for improving the testing process | Applying (K3) |

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**SOFTWARE PROJECT MANAGEMENT**
**(Common to AI & DS and AI & ML branches)**

| Programme& Branch | B.Tech.& Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 8 | PE | 3 | 0 | 0 | 3 |

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

**Lecture:45, Total:45**

**TEXT BOOKS:**


1. Bob Hughes, Mike Cotterell and Rajib Mall, “Software Project Management”, 6th Edition, Tata McGraw Hill, New Delhi, 2017. for Unit I, II, III, IV and V.
2. Pankaj Jalote, “Software Project Management in Practice”, 8th Edition, Pearson, 2002.
3. Watts S. Humphrey, “PSP: A self-improvement process for software engineers”, 1stEdition, Addison-Wesley, 2005.

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**CYBER FORENSICS**
**(Common to AI & DS and AI & ML branches)**

| Programme& Branch | B.Tech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 8 | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course imparts fundamental principles and techniques for digital forensics investigation and security management. | |
| **Unit - I** | **Computer Forensics and Investigations** | **9** |
| Understanding computer forensics - Preparing Computer investigations – Taking a systematic approach –Assessing the case – Planning Investigation – Securing evidence– Procedures for Corporate High-Tech investigations – Conducting an Investigation – Completing the case. | | |
| **Unit - II** | **Data Acquisition** | **9** |
| Understanding storage formats for digital evidence – Determining the best acquisition method - Contingency planning for image acquisitions – Using Acquisition tools: Windows XP Write-protection with USB Devices – Validating Data Acquisitions: Windows Validation Methods – Performing RAID Data Acquisitions – Using Remote Network Acquisition tools – Using other Forensics Acquisition tools. | | |
| **Unit - III** | **Processing Crime and Incident Scenes** | **9** |
| Identifying Digital Evidence – Collecting Evidence in Private Sector Incident Scenes –Processing Law Enforcement Crime Scenes – Preparing for a Search –Securing a Computer Incident or Crime Scene –Seizing Digital Evidence at the Scene –Storing Digital Evidence –Obtaining a Digital Hash –Reviewing a Case. | | |
| **Unit - IV** | **Computer Forensics Tools, Analysis and Validation** | **9** |
| Evaluating Computer Forensics Tool Needs –Computer Forensics Software Tools – Computer Forensics Hardware Tools – Validating and Testing Forensic Software – Computer Forensics Analysis and Validation: Determining Data Collection and Analysis –Validating Forensic Data –Addressing Data-Hiding Techniques –Performing Remote Acquisitions. | | |
| **Unit - V** | **Recovering Graphics Files, Email Investigations** | **9** |
| Recognizing a Graphics File– Understanding Data Compression – Locating And Recovering Graphic Files- Identifying Unknown File Formats– Understanding Copyright Issues –Investigating Email Crimes And Violations- Understanding Email Servers– Using Specialized Email Forensics Tools. | | |

**Lecture:45, Total:45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Nelson Bill, Phillips Amelia and Steuart Christopher, “Guide to Computer Forensics and Investigations”, 3rd Edition, Cengage Learning, 2017. for Unit I, II, III, IV and V. |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | apply systematic approach for digital forensic investigation | Applying (K3) |
| CO2 | carry out acquisition of data using various tools | Applying (K3) |
| CO3 | determine the seizure of digital evidence in a crime scene | Applying (K3) |
| CO4 | make use of forensic tools in forensic examination | Applying (K3) |
| CO5 | carry out investigationusing E-mail and graphic files | Applying (K3) |

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**AGILE METHODOLOGIES FOR SOFTWARE DEVELOPMENT**
**(Common to AI & DS and AI & ML branches)**

| Pogramme& Branch | B.Tech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 8 | 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. | | |
| **Unit - III** | **Scrum Planning and Collective Commitment:** | **9** |
| User stories – Conditions of Satisfaction – Story Points and Velocity – Burndown Charts – Planning and Running a Sprint – GASP – Scrum Values Revisited – Practices Do Work Without the Values – Company Culture Compatible with Scrum Values. | | |
| **Unit - IV** | **XP and Incremental Design:** | **9** |
| Primary Practices of XP – The XP values help the team change their mindset – An effective mindset starts with the XP values – Understanding the XP principles – Feedback Loops – Code and Design – Make Code and Design Decisions at the Last Responsible Moments – Incremental Design and the Holistic XP. | | |
| **Unit - V** | **Lean, Kanban and Agile Coach:** | **9** |
| Lean Thinking – Commitment, Options Thinking and Set Based Development – Create Heroes and Magical Thinking – Eliminate Waste – Value Stream Map – Deliver As Fast As Possible – WIP Area Chart – Pull Systems – The Principles of Kanban – Improving Your Process with Kanban – Measure and Manage Flow – Little's Law – Emergent Behavior with Kanban – The Agile Coach – Shuhari - The Principles of Coaching. . | | |

**Lecture:45; Total 45**

**TEXT BOOK:**


1. Andrew Stellman and Jennifer Greene, "Learning Agile: Understanding Scrum, XP, Lean and Kanban", First Edition, O'Reilly Media Inc, 2015. for Unit I, II, III, IV and V.


**REFERENCES**


1. Eric Brechner, "Agile Project Management with Kanban", First 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 with practices like user stories, story points, project velocity and visualization tools | Applying (K3) |
| CO4 | model applications using XP practices and incremental design | Applying (K3) |
| CO5 | make use of Lean thinking to empower a team, eliminate waste, and deliver software fast and learn how 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 | | 3 | 2 |
| CO2 | 3 | 2 | 1 | | | | | | 1 | 1 | 1 | | 3 | 2 |
| CO3 | 3 | 2 | 1 | | | | | | 1 | 1 | 1 | | 3 | 2 |
| CO4 | 3 | 2 | 1 | | | | | | 1 | 1 | 1 | | 2 | 2 |
| CO5 | 3 | 2 | 1 | | | | | | 1 | 1 | 1 | | 3 | 2 |

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

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT 1-50 marks | 30 | 40 | 30 | | | | 100 |
| CAT 2-50 marks | 10 | 50 | 40 | | | | 100 |
| CAT 3-50 marks | 25 | 45 | 30 | | | | 100 |
| ESE -100 marks | 20 | 40 | 40 | | | | 100 |

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

**OPEN ELECTIVE**
**DEEP LEARNING FOR ENGINEERING APPLICATIONS**

| Programme& Branch | BE/BTech All branches except AI&ML and AI&DS | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Python Programming | 4 | OE | 3 | 0 | 2 | 4 |

| | | |
|---|---|---|
| Preamble | This course is designed to impart the skills required to build deep neural network architectures for various applications. | |
| **Unit - I** | **Neural Networks** | **9** |
| Introduction – Basic Architecture of Neural Networks – Training Neural Network with Backpropagation - Practical Issues in Neural Network Training - Power of Function Composition – Common Neural Architectures – Neural Architectures : Binary Classification Models – Multiclass Models | | |
| **Unit - II** | **Training Deep Neural Networks** | **9** |
| Introduction – Backpropagation- Setup and Initialization Issues – Vanishing and Exploding Gradient Problems – Gradient Descent Strategies – Batch Normalization - Bias- Variance Trade-Off – Generalization Issues in Model Tuning and Evaluation | | |
| **Unit - III** | **Convolution Neural Networks** | **9** |
| Introduction – Basic Structure of Convolutional Network – Training a Convolutional Network - Case Studies of Convolutional Architectures - Applications of Convolutional Networks | | |
| **Unit - IV** | **Python Frameworks for Deep Learning** | **9** |
| Introduction to TensorFlow- working with keras – steps in deep Learning Models-load data-preprocess data-define the model-compile the Model-fit the Model-Evaluate the Model-Prediction-Multilayer Perceptron-CNN in Tensor Flow-CNN in Keras | | |
| **Unit - V** | **Case Studies** | **9** |
| Image classifier for MNIST data - CIFAR data - Malaria Diseases detection - Heart disease detection - Leaf disease detection – Covid Identification | | |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Study the methods in Tensorflow / Keras / OpenCV library |
| 2. | Create a multi-layer neural network and apply it to MNIST dataset. |
| 3. | Create a Multi-layer neural network to perform binary classification |
| 4. | Test the performance of multi-layer neural network with various activation and loss functions and tune the performance with hyper parameters |
| 5. | Develop a hand written character recognition application using CNN |
| 6. | Implement CNN for malaria disease detection |
| 7. | Implement CNN for heart disease detection |
| 8. | Develop a CNN model for Covid detection |

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

**TEXT BOOK:**


| | |
|---|---|
| 1. | Charu C. Aggarwal, “Neural networks and deep learning”, *Springer,* 2018. for Unit I, II, III. |
| 2. | Navin Kumar Manaswi, “Deep Learning with Applications using Python”, Apress, 2018. for Unit IV and V. |


**REFERENCES:**


| | |
|---|---|
| 1. | Ian Goodfellow, YoshuaBengio, and Aaron Courvill, “Deep Learning”, MIT Press, USA, 2016. |
| 2. | Josh Patterson and Adam Gibson, “Deep Learning – A Practitioner’s Approach”, First Edition, O’Reilly Series, August 2017. |
| 3. | Indra den Bakker, “Python Deep Learning Cookbook”, First Edition, Packt Publishing, October 2017. |

**REFERENCES/MANUAL/SOFTWARE:**

| | |
|---|---|
| 1. | Operating System : Linux / Windows |
| 2. | Software: Python / Keras / Tensorflow / OpenCV |
| 3. | Laboratory Manual |

| **COURSE OUTCOMES:**<br>On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | use Artificial Neural Network .concepts to solve real world problems | Applying (K3) |
| CO2 | solve simple real world problems using deep neural networks. | Applying (K3) |
| CO3 | exemplify the concepts of CNN models and apply it for solving problems. | Applying (K3) |
| CO4 | use python frameworks for implementing CNN | Applying (K3) |
| CO5 | demonstrate the application of deep learning for real world problems | Applying (K3) |
| CO6 | perform classifications using Multi-neural Networks | Applying (K3)<br>Precision (S3) |
| CO7 | demonstrate the performance of Multi-neural Networks on different parameters | Applying (K3)<br>Precision (S3) |
| CO8 | implement CNN models related to various applications | Applying (K3)<br>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 | | | | | | | | | | | |
| CO2 | 3 | 2 | 2 | | | | | | | | | | | |
| CO3 | 3 | 2 | 2 | | | | | | | | | | | |
| CO4 | 3 | 2 | 2 | | | | | | | | | | | |
| CO5 | 3 | 2 | 2 | | | | | | | | | | | |
| CO6 | 3 | 2 | 2 | 2 | 2 | | | | | | | | | |
| CO7 | 3 | 2 | 2 | 2 | 2 | | | | | | | | | |
| CO8 | 3 | 2 | 2 | 2 | 2 | | | | | | | | | |

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

**ASSESSMENT PATTERN - THEORY**

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

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

## COMPUTER VISION

| Programme& Branch | BE/BTech All branches except AI&ML and AI&DS | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Python Programming | 5 | OE | 3 | 0 | 2 | 4 |

| | | |
|---|---|---|
| Preamble | This course aims to provide a broad view on analysis and processing of images and video | |
| **Unit - I** | **Introduction to computer vision** | **9** |
| Computer vision – Geometric Primitives and transformations: Primitives – 2D Transformations – 3D Transformations – 3D Rotations – 3D to 2D Projections – Lens distortions - Photometric image formation: Lighting – Reflectance and shading – Optics – The digital camera : Sampling and aliasing – Color - Compression | | |
| **Unit - II** | **Image Processing** | **9** |
| Point operators : – pixel transforms – color transforms – compositing and matting – histogram equalization linear filtering: separable filtering – examples of linear filtering – Band pass and steerable filters – Non linear filtering - Marphology | | |
| **Unit - III** | **Feature detection and matching** | **9** |
| Points and patches: feature detectors – feature descriptors – feature matching – feature tracking – Application: performance driven animation – Edges: Edge detection – edge linking – Application: Edge editing and enhancement – Lines: Successive approximation – Hough transforms – Vanishing points. | | |
| **Unit - IV** | **Segmentation** | **9** |
| Active contours: snakes – dynamic snakes and CONDENSATION – scissors – level sets – Split merge: watershed – region splitting – region merging – Graph based segmentation – probabilistic aggregation – Mean shift and mode finding – K means and mixtures of Gaussians – mean shift | | |
| **Unit - V** | **Motion** | **9** |
| Structure from motion: Triangulation – Two-frame structure from motion – factorization – bundle adjustment – constrained structure and motion. Dense motion estimation: Translational alignment – parametric motion – spline-based motion – optical flow – layered motion. Image stitching: motion models – global alignment – compositing. | | |

**List of Exercises / Experiments:**

| | |
|---|---|
| 1. | Perform edge editing and edge enhancement using edge detection mechanism. |
| 2. | Experiment the line detection technique using mathematical approach |
| 3 | Implement a snake-based contour tracker |
| 4 | Implement the intelligent scissors (live-wire) interactive segmentation algorithm |
| 5 | Implement the region segmentation algorithm using K Means and mean shift |
| 6 | Develop a motion pictures using bundle adjuster |
| 7 | Create optical flow of motion from the continuous image frames |
| 8 | Experiment the video denoising technique in your own motion clips |

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

**TEXT BOOK:**


| | |
|---|---|
| 1. | Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer, 2010, for Unit I, II, III, IV and V. |


**REFERENCES:**


| | |
|---|---|
| 1. | D. L. Baggio et al., “Mastering OpenCV with Practical Computer Vision Projects”, Packt Publishing, 2012. |
| 2. | Jan Erik Solem, “Programming Computer Vision with Python: Tools and algorithms for analyzing images”, O'Reilly Media, 2012. |
| 3. | Rajalingappaa Shanmugamani, “Deep Learning for Computer Vision”, Packt Publishing, 2018. |

**REFERENCES/MANUAL/SOFTWARE:**

| | |
|---|---|
| 1. | Operating System : Linux / Windows |
| 2. | Software: Python / Keras / Tensorflow / OpenCV |
| 3. | Laboratory Manual |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | use geometric primitives to perform transformations. | Applying (K3) |
| CO2 | apply linear and non linear filters and perform image processing | Applying (K3) |
| CO3 | use various techniques in feature detection and matching with images | Applying (K3) |
| CO4 | apply the various levels of segmentation and interpret the results at various levels | Applying (K3) |
| CO5 | apply the motion techniques in video analytics to understand various transformations. | Applying (K3) |
| CO6 | experiment the basic feature detection and matching techniques | Applying (K3) Precision (S3) |
| CO7 | implement image segmentation using the respective models | Applying (K3) Precision (S3) |
| CO8 | create videos using image motion techniques | 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 | | | | | | | | | | | |
| CO2 | 3 | 2 | 2 | | | | | | | | | | | |
| CO3 | 3 | 2 | 2 | | | | | | | | | | | |
| CO4 | 3 | 2 | 2 | | | | | | | | | | | |
| CO5 | 3 | 2 | 2 | | | | | | | | | | | |
| CO6 | 3 | 2 | 2 | 2 | 3 | | | | | | | | | |
| CO7 | 3 | 2 | 2 | 2 | 3 | | | | | | | | | |
| CO8 | 3 | 2 | 2 | 2 | 3 | | | | | | | | | |

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

**ASSESSMENT PATTERN - THEORY**

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

## ARTIFICIAL INTELLIGENCE FOR DATA SCIENCE

| Programme& Branch | BE/BTech All branches except AI&ML and AI&DS | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 6 | OE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | The course focuses on the methodology of how to translate a data driven business problem into an effective solution by using the powerful AI technologies according to the Data Science paradigm. | |
| **Unit - I** | **The AI-Based Data Science Workflow and Data Preparation:** | **9** |
| The AI-Based Data Science Workflow: Overview of Workflow - Key Steps of AI-Based Data Science Workflow - Project Organization. Data Preparation: Data Collection - Visual Data Exploration - Data Preprocessing. | | |
| **Unit - II** | **Data Analysis and Model Development:** | **9** |
| Data Analysis: Translation of Data into Insight - Multivariate Data Analysis - Variable Selection - Feature Extraction - Data Visualization. Model Development: Advantages of mathematical models - Key features of a good model - Fighting Overfitting the Data - Model Generation | | |
| **Unit - III** | **Revolution of AI and ML, Prediction using Regression** | **9** |
| Introduction to Machine Learning – Machine Learning vs Classical Programming – The ability to predict – Introduction to Regression – Regression Models – Linear Regression Model and Machine Learning – Evaluating Model Quality using different metrics | | |
| **Unit - IV** | **Non-Linear Models and Feature Engineering** | **9** |
| Non-Linear Models – Feature Engineering - Insurance cost modeling problem – Reasons for Model Errors – Rectification of Model Errors – Overfitting and Underfitting – Deriving Data to Train the Model – Train/Test Split | | |
| **Unit - V** | **Classification Problems and Confusion Matrix** | **9** |
| Introduction to Classification – Approach followed by Classification Algorithms – A Visual Representation of Logistic Regression – Evaluating Classification Model Accuracy – Classification with Logistic Regression –Confusion Matrix. | | |

**Lecture:45; Total: 45**

**TEXT BOOK:**


| | |
|---|---|
| 1. | Arthur K. Kordon “Applying Data Science: How to Create Value with Artificial Intelligence”. Springer Nature, Switzerland, 1st edition, 2020. for Unit I, II. |
| 2. | Sujit Bhattacharyya, Subhrajit Bhattacharyya, “Practical Handbook of Machine Learning”, Career Launcher Infrastructure Pvt Ltd and G.K. PublicationsPvt Ltd, First Edition, 2021. for Unit III, IV and V. |


**REFERENCES:**


| | |
|---|---|
| 1. | Avrim Blum, John Hopcroft and Ravindran Kannan. “Foundations of Data Science”. Cambridge University Press, 1st edition, England, 2020. |
| 2. | Dr. LavikaGoel, “Artificial Intelligence: Concepts and Applications ”. Wiley India PvtLtd., 1st edition, India, 2021. |

| | **COURSE OUTCOMES:**<br>On completion of the course, the students will be able to | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | adapt the data science workflow for finding solution to a given problem | Applying (K3) |
| CO2 | perform data analysis and apply modeling techniques for a given problem | Applying (K3) |
| CO3 | use regression models to solve problems | Applying (K3) |
| CO4 | apply feature engineering techniques and estimate model errors | Applying (K3) |
| CO5 | use the metrics and evaluate the performance of machine learning algorithms | Applying (K3) |

**Mapping of COs with POs and PSOs**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | | | | | | | | | | | |
| 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 | 5 | 60 | 35 | | | | 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)**

## BUSINESS ANALYTICS

| Programme& Branch | BE/BTech All branches except AI&ML and AI&DS | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | 8 | OE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Preamble** | To impart knowledge on various analytical methods for achieving Business Intelligence | |
| **Unit – I** | **Foundations of Business Analytics** | **9** |
| Definition - Impacts and Challenges - Analytic Foundations - Descriptive, Predictive, and Prescriptive Analytics - Model Assumptions – Modern Business Analytics – Data for Business Analytics – Models in Business Analytics - Problem solving with analytics | | |
| **Unit - II** | **Competitive advantage, Statistical Qualification and Diagnostics** | **9** |
| Developing competitive advantage: Identifying gaps – assessing business needs. Statistical Qualifications - Statistical Diagnostics - Statistical Review. | | |
| **Unit - III** | **Building blocks for Supporting analytics and Sampling** | **9** |
| Data Collection – Methodology for Anecdotal sampling – Design of Samples- Design of Experiments – Data Software – Data Management. **Sampling and Estimation:** Statistical Sampling - Sampling Methods- Estimating Population parameters. | | |
| **Unit - IV** | **Data Visualization and Descriptive Statistics** | **9** |
| **Data Visualization:** Tools and Software - Creating Charts in Microsoft Excel - Excel Data Visualization Tools - **Descriptive Statistics :** Metrics and Data Classification - Frequency Distributions - Cross-Tabulations - Descriptive Statistical Measures - Populations and Samples- Measures of Location - Using Measures of Location in Business Decisions - Measures of Dispersion - Excel Descriptive Statistics Tool. | | |
| **Unit - V** | **Statistical Inference and Regression models** | **9** |
| **Statistical Inference:** Hypothesis Testing - Hypothesis-Testing Procedure- One-Sample Hypothesis Tests. **Trend lines and Regression Analysis:** Modeling Relationships and Trends in Data Simple Linear Regression - Finding the Best-Fitting Regression Line - Using Regression Models for Prediction | | |

**Lecture: 45, Total: 45**

**TEXT BOOKS:**

| | |
|---|---|
| 1. | James R. Evans. Business Analytics, 3rd edition, Pearson, 2020. for Unit I, IV and V. |
| 2 | Randy Bartlett. A Practitioner's Guide To Business Analytics, 1st edition, McGrawHill, 2013. for Unit II, III. |

**REFERENCES:**

| | |
|---|---|
| 1. | U Dinesh Kumar. Business Analytics: The Science of Data - Driven Decision Making, 1st edition, Wiley, 2017. |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | BT Mapped (Highest Level) |
|---|---|---|
| CO1: | select the type of analytics needed for solving a problem | Applying (K3) |
| CO2: | assess the need and perform diagnostics for a business problem | Applying (K3) |
| CO3: | use the building blocks while performing analytics and apply sampling techniques | Applying (K3) |
| CO4: | use tools and methods for data Visualization and summarize data using descriptive Statistics | Applying (K3) |
| CO5: | interpret and making inference on results and use regression models for prediction | Applying (K3) |

**Mapping of 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 % |
|---|---|---|---|---|---|---|---|
| CAT 1 | 20 | 45 | 35 | | | | 100 |
| CAT 2 | 20 | 45 | 35 | | | | 100 |
| CAT 3 | 20 | 45 | 35 | | | | 100 |
| ESE | 20 | 45 | 35 | | | | 100 |

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

**HONOURS IN IOT**

**INTRODUCTION TO IOT**

| Programme & Branch | BTech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | NIL | | | 3 | 0 | 0 | 3 |

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

**Lecture:45, Total: 45**

**TEXT BOOK:**


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


**REFERENCES:**


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

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 45 | 55 | | | | | 100 |
| CAT2 | 35 | 65 | | | | | 100 |
| CAT3 | 20 | 55 | 25 | | | | 100 |
| ESE | 20 | 55 | 25 | | | | 100 |

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

## IOT ARCHITECTURE AND ITS PROTOCOLS

| Programme & Branch | BTech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Introduction to IOT | | | 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. | | |

**Lecture:45, Total: 45**

**TEXT BOOKS:**


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. (Unit-1)
2. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 1st edition, New York, 2013. (Unit-2,3,4)
3. Sudip Misra, Anandarup Mukherjee, Arijit Roy. “Introduction to IoT”. Cambridge University Press, 1st edition, United Kingdom, 2021.(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 | Understanding (K2) |
| CO2 | interpret the Pillars of IoT and IoT applications | Understanding (K2) |
| CO3 | describe the technological aspects of the DCM layers of the IoT value chain and IoT middleware | Understanding (K2) |
| CO4 | examine the possibility of creating a unified IoT middleware architecture based on existing protocol standard | Understanding (K2) |
| 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 | 1 | 1 | | | | | | | | | 3 | 1 |
| CO2 | 3 | 2 | 1 | 1 | | | | | | | | | 3 | 1 |
| CO3 | 3 | 2 | 1 | 1 | | | | | | | | | 3 | 1 |
| CO4 | 3 | 2 | 1 | 1 | | | | | | | | | 3 | 1 |
| CO5 | 3 | 2 | 1 | 1 | | | | | | | | | 3 | 1 |

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

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 45 | 55 | | | | | 100 |
| CAT2 | 35 | 65 | | | | | 100 |
| CAT3 | 20 | 55 | 25 | | | | 100 |
| ESE | 20 | 55 | 25 | | | | 100 |

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

**COGNITIVE IOT**

| Programme & Branch | BTech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | | | | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Preamble** | To impart the knowledge ofcognitive Internet of Things in various domains | |
| **Unit – I** | **Introduction** | **9** |
| Introduction to Cognitive Device - Cognitive Devices as Human Assistants - Cognitive Things in an Organization - Reuse and Monetization -Intelligent Observations – Organization of Knowledge and Problem-Solving | | |
| **Unit - II** | **Architecture and Interfaces** | **9** |
| Installation, Training, Maintenance, Security and Infrastructure - Machine-to-Machine Interfaces - Man-to-Machine Interfaces - Assisting in Human Communications. | | |
| **Unit - III** | Cognitive IoT Paradigm | **9** |
| Describing the Cognitive IoT Paradigm - Demystifying the Cognitive Computing Paradigm – Basics of Cloud computing - The Cognitive IoT: The Platforms, Technologies, and their Use cases - Delineating the Key Capabilities of Cognitive Cloud Environments. | | |
| **Unit - IV** | | **9** |
| Machine Learning (ML) Algorithms for enabling the Cognitive Internet of Things (CIoT) - Unsupervised and Semi-Supervised Machine Learning Algorithms for Cognitive IoT Systems - Deep Learning Algorithms for Cognitive IoTSolutions - Computer Vision (CV) Technologies and Tools for Vision-based Cognitive IoT Systems. | | |
| **Unit - V** | | **9** |
| Natural Language Processing (NLP) Methods for Cognitive IoT Systems - Design of a Secure Infrastructure for Cognitive IoT platforms and Applications - Revolutionizing Manufacturing using Cognitive IoT Technologies - Edge AI – Consumer, Social and Industry Use Cases | | |

**Lecture:45, Total: 45**

**TEXT BOOKS:**

| | |
|---|---|
| 1 | Arvind Sathi. Cognitive (Internet of) Things. Palgrave Macmillan, 1st edition, 2016 (Units I, II) |
| 2. | Pethuru Raj, Anupama C. Raman, Harihara Subramanian. Cognitive Internet of Things Enabling Technologies, Platforms, and Use Cases.Auerbach Publications, 1st edition, 2022 (Units III , IV, V) |

**REFERENCES:**

| | |
|---|---|
| 1 | ArshdeepBahga and Vijay Madisetti, Cloud Computing: A Hands-on Approach, 1st edition, CreateSpace Independent Publishing Platform, 2013. |
| 2. | Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange and Stefan Meissner, Enabling things to talk –Designing IoT solutions with the IoT Architecture Reference Model, 1st edition ,Springer Open, 2016. |

| **COURSE OUTCOMES:**<br>On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1: | gain insights of cognitive devices and their applications | Understanding (K2) |
| CO2: | understand different types of interfaces and organizations in cognitive things | Understanding (K2) |
| CO3: | develop knowledge on significance of Cognitive IoT | Understanding (K2) |
| CO4: | implement different computational intelligent techniques for Cognitive IoT | Applying (K3) |
| CO5: | design cognitive IoT architectures using advanced methods | Understanding (K2) |

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT 1 | 40 | 45 | 15 | | | | 100 |
| CAT 2 | 40 | 45 | 15 | | | | 100 |
| CAT 3 | 40 | 45 | 15 | | | | 100 |
| ESE | 40 | 45 | 15 | | | | 100 |

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

## INDUSTRIAL AND MEDICAL IOT

| Programme & Branch | BTech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | | | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course deals with introduction to Industrial and medical IoT and how IoMT is used to for remote healthcare | |
| **Unit - I** | **Industrial IoT** | **9** |
| Introduction to IoT- key technologies- I-IoT- IoT Analytics and AI- Industrial process – CIM pyramid architecture -devices and networks- I-IoT data Flow | | |
| **Unit - II** | **Industrial Data Flow** | **9** |
| I-IoT dataflow-Industrial protocols-Supervisory control and Data Acquisition-Discovering OPC-Understanding I-IoT Edge-Implementing I-IoT dataflow-OPC UA Simulation server- | | |
| **Unit - III** | **Implementing I-IoT** | **9** |
| Developing Industrial I-IoT and Architecture-Implementing custom Industrial IoT Platform -Implementing a cloud Industrial IoT solution with AWS | | |
| **Unit - IV** | **Internet of Medical things** | **9** |
| Introduction-IoMT- IoMT Medical Devices- Remote Patient monitoring- privacy of IoT -based health records - remote Health Care: wearable smart devices - Communication technologies | | |
| **Unit - V** | **IoMT Applications** | **9** |
| Smart Assistance for Elderly Individuals -Parkinson's Disease handling using IoMT- Machine Learning with IoMT | | |

**Lecture:45, Total: 45**

**TEXT BOOK:**


1. Giacomo Veneri,Antonio Capsso, "Hands-On Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0,Packt Publishing Ltd, 1st edition,2018
2. D.Jude Hemanth,J.Anitha,George A. Tsihrintzis "Internet of Medical things- remote healthcare systems and applications", Springer, 1st edition, 2021.


**REFERENCES:**


1. Ismail Butun,"Industrial IoT Challenges, Design Principles, Applications, and Security", Springer Publications,1st edition, 2020.

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**IOT AND MACHINE LEARNING**

| Programme & Branch | BTech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | | | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Preamble** | To impart knowledge on various mechanisms of integrating IoT devices and Machine Learning algorithms | |
| **Unit – I** | **Introduction** | **9** |
| 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** |
| Prediction using linear regression - Logistic regression for classification - Ensemble learning - Improving machine learning model | | |
| **Unit - III** | **Deep Learning for IoT** | **9** |
| 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** |
| 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** |
| Generative Models for IoT - Distributed AI for IoT - AI for the Industrial IoT - Processing different types of data - Computing in the cloud | | |

**Lecture:45, Total: 45**

**TEXT BOOKS:**


1. Hantao Huang, Hao Yu. Compact and Fast Machine Learning Accelerator for IoT Devices. Springer, 1st edition, 2019.
2. Amita Kapoor. Hands-On Artificial Intelligence for IoT. Packt Publishing, 1st edition, 2019.


**REFERENCES:**


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

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

| Test / Bloom's Category* | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT 1 | 40 | 50 | 10 | | | | 100 |
| CAT 2 | 40 | 45 | 15 | | | | 100 |
| CAT 3 | 40 | 50 | 10 | | | | 100 |
| ESE | 40 | 45 | 15 | | | | 100 |

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

## PRIVACY AND SECURITY IN IOT

| Programme & Branch | BTech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | | | 3 | 0 | 0 | 3 |

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

**Lecture:45, Total: 45**

**TEXT BOOK:**


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


**REFERENCES:**


1. Zaigham Mahmood, Security, Privacy and Trust in the IoT Environment", Springer ,1st edition2019.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | describe Attacks and Protection Mechanisms in IoT Devices | Understanding (K2) |
| CO2 | explain Defence Mechanisms Against Attacks | Understanding (K2) |
| CO3 | summarize Protocol for UAV Remote Identification | Understanding (K2) |
| CO4 | design Cyber-Security IoT Infrastructure | Understanding (K2) |
| CO5 | implement Security and privacy mechanisms | Applying (K3) |

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

**HONOURS IN BLOCKCHAIN**

**INTRODUCTION TO BLOCKCHAIN**

| Programme & Branch | BTech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | | | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course provides technical fundamentals of Blockchain, and hands on development aspects of Blockchain applications | |
| **Unit - I** | **Introduction** | 9 |
| Overviw of blockchain – Centralized vs Decentralized Systems – Layers of Blockchain – Importance – Blockchain Uses and Use Cases – Laying the Blockchain Foundation . | | |
| **Unit - II** | **Working of Blockchain** | **9** |
| Game Theory – Prisoner"s Dilemma – Byzantine Generals" Problem – The Blockchain – Merkle Trees – Properties of Blockchain Solutions – Blockchain Transactions – Distributed consensus mechanisms – Blockchain applications – Scaling blockchain. | | |
| **Unit - III** | **Bitcoin and Altcoins** | **9** |
| History of Bitcoin – bitcoin is volatile – key and address- transactions – blocks – bitcoin network : types of nodes – Network discovery wallets – Altcoins: Introducing Altcoins – alternative currency – acquiring cryptocurrency. | | |
| **Unit - IV** | **Ethereum and Introduction to Hyperledger** | **9** |
| Bitcoin to Ethereum – Ethereum Blockchain – Ethereum Smart Contracts – Ethereum Virtual Machine and Code Execution – Ethereum Ecosystem – Swarm – Whisper – DApp – Development components – Hyperledger: Introduction – Projects. Fabric – Sawtooth lake – Iroha – Blockchain explorer – Fabric chaintool – Fabric SDK Py-Corda | | |
| **Unit - V** | **Blockchain Application Development** | **9** |
| Decentralized Applications – Blockchain Application Development – Interacting with Bitcoin Blockchain – Sending Transactions – Creating a Smart Contract – Executing Smart Contract Functions – Public vs. Private Blockchains – Decentralized Application Architecture – Building an Ethereum DApp. | | |

**Lecture:45, Total:45**

**TEXT BOOK:**


1. Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, “Beginning Blockchain: A Beginner"s Guide to Building Blockchain Solutions”, APress, 1st Edition, 2018. (Units 1,2,4,5)
2. Brenn Hill, Samanyu Chopra, Paul Valencourt, “Blockchain Quick Reference: A guide to exploring decentralized blockchain application development”, Packt publishing, 1st Edition, 2018.(Unit – 3)


**REFERENCES:**


1. Elad Elrom,”The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects”, Apress, 2019

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

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

## CRYPTOGRAPY

| Programme & Branch | BTech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| **Prerequisites** | **Nil** | | | **3** | **0** | **0** | **3** |

| | | |
|---|---|---|
| Preamble | This course describes cryptographic algorithms deployed for offering confidentiality, integrity, authentication and non repudiation. | |
| **Unit - I** | **Introduction** | 9 |
| Computer Security Concepts – The OSI Security Architecture – Security Attacks – services and mechanisms – Model for Network Security – Classical encryption techniques: symmetric cipher model – substitution techniques – transportation techniques - steganography | | |
| **Unit - II** | **Block ciphers and Data Encryption standard** | **9** |
| Block cipher Structure – data encryption standard – the strength of DES - DES Example – block cipher design principles – Finite fields: Groups – rings – fields - Advanced encryption standard – Block cipher operation. | | |
| **Unit - III** | **Asymmetric cipher** | **9** |
| Public key cryptography and RSA – Other Public key cryptosystems – Diffie-Hellman Key Exchange – Elgamal Cryptographic System – Elliptic Curve Arithmetic – Elliptic Curve Cryptography | | |
| **Unit - IV** | **Cryptographic Data Integrity Algorithms** | **9** |
| Cryptographic hash functions – Message authentication codes: Message Authentication Requirements – Message Authentication Functions – Requirements for Message Authentication Codes – Security of MACs – MACs Based on Hash Functions: HMAC – Digital signatures: Elgamal Digital Signature Scheme – Schnorr Digital Signature Scheme – NIST Digital Signature Algorithm – Elliptic Curve Digital Signature Algorithm. | | |
| **Unit - V** | **Network and Internet Security** | **9** |
| Network access control and cloud security –Transport level security – Wireless network security – Electronic mail security – IP security – Intruder – Firewalls | | |

**Lecture:45, Total:45**

**TEXT BOOK:**

1. William Stallings, "Cryptography and Network Security", 7th Edition, Pearson Education, 2017. (Unit 1-5)

**REFERENCES:**

1. Christof Paar and Jan Pelzl, “Understanding Cryptography: A Textbook for Students and Practitioners”, Springer, 2009

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | interpret the basic security architecture and classical symmetric key techniques in cryptography | Applying (K3) |
| CO2 | apply various block ciphers and data encryption standars to solve the problems | Applying (K3) |
| CO3 | make use of various public key cryptography techniques for solving real time problems | Applying (K3) |
| CO4 | explore hashing and digital signature techniques | Applying (K3) |
| CO5 | determine the appropriate security protocols and standards for the given application | Applying (K3) |

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

| **ASSESSMENT PATTERN - THEORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | 20 | 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)**

## BITCOIN TECHNOLOGY

| Programme & Branch | BTech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | | | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | The course focuses on the basics of Bitcoin technology and various technologies involved. | |
| **Unit - I** | **Introduction:** | **9** |
| Introduction to Bitcoin and How Bitcoin works: Transactions, Blocks, Mining and the Blockchain – Bitcoin Transactions – Constructing a Transaction – Bitcoin Mining – Mining transactions in Blocks – Bitcoin Core: The Reference Implementation – Bitcoin Development Environment – Compiling Bitcoin Core from the Source Code – Running a Bitcoin Core Node – Bitcoin Core API. | | |
| **Unit - II** | **Keys, Addresses, Wallets and Transactions:** | **9** |
| Keys, Addresses: Introduction – Bitcoin Addresses – Implementing Keys and Addresses in Python – Advanced Keys and Addresses - Wallets: Wallet Technology Overview – Wallet Technology Details - Transactions: Transactions in Detail – Transaction Outputs and Inputs – Transaction Scripts and Script Language – Digital Signatures (ECDSA) – Bitcoin Addresses, Balances and other Abstractions. | | |
| **Unit - III** | **Advanced Transactions and Bitcoin Network:** | **9** |
| Advanced Transactions and Scripting: Multisignature – Pay-to-Script-Hash(P2SH) – Data Recording Output (RETURN) – Timelocks –Scripts with Flow Control - The Bitcoin Network: Peer-to-Peer Network Architecture – Nodes Types and Roles – The Extended Bitcoin and Relay Networks – Network Discovery – Full Nodes – Exchanging “Inventory” – SPV Nodes – Bloom Filters – How SPV Nodes Use Bloom Filters – SPV Nodes and Privacy. | | |
| **Unit - IV** | **Blockchain and Consensus:** | **9** |
| The Blockchain: Structure of a Block – Block Header and Identifiers – The Genesis Block – Linking Blocks in the Blockchain – Merkle Trees - Merkle Trees and SPV – Bitcoin’s Test Blockchains - Mining and Consensus: Decentralized Consensus – Independent Verification of Transactions – Mining Nodes – Aggregating Transactions into Blocks – Constructing the Block Header and validating the Block - Assembling and Selecting Chains of Blocks – Mining and the Hashing Race – Consensus Attacks – Changing the Rules. | | |
| **Unit - V** | **Applications:** | **9** |
| Bitcoin Security: Security principles – User Security Best Practices – Blockchain Applications: Building Blocks(Primitives) – Applications from Building Blocks – Colored Coins – Counterparty – Payment Channels and State Channels – Routed Payment Channels (Lightning Network). | | |

**Lecture:45, Total: 45**

**TEXT BOOK:**

| | |
|---|---|
| 1. | Andreas M. Antonopoulos, “Mastering Bitcoin Programming the Open Blockchain”, Second Edition, O’Reilly Media, Inc., 2017. (Units I to V) |

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | understand the Bitcoin basics and use it for creating transactions. | Applying (K3) |
| CO2 | apply the concepts of Keys, Addresses and Wallet for security applications. | Applying (K3) |
| CO3 | develop scripts to provide security in a Bitcoin network. | Applying (K3) |
| CO4 | explore and apply Blockchain technology and Consensus . | Applying (K3) |
| CO5 | apply Blockchain to provide security for real time applications. | Applying (K3) |

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

## BLOCKCHAIN AND CRYPTOCURRENCY TECHNOLOGIES

| Programme & Branch | BTech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Nil | | | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | To understand blockchain concepts, working functionality and its main application cryptocurrency. which is new global money for the Internet age. | |
| **Unit - I** | **Introduction** | **9** |
| Distributed Database - Two General Problem - Byzantine General problem and Fault Tolerance - Hadoop Distributed File System - Distributed Hash Table - ASIC resistance - Turing Complete - Hash function - Digital Signature - ECDSA, Memory Hard Algorithm - Zero Knowledge Proof | | |
| **Unit - II** | **Blockchain** | **9** |
| Blockchain Network - Mining Mechanism - Distributed Consensus - Merkle Patricia Tree - Gas Limit - Transactions and Fee - Anonymity – Reward - Chain Policy - Life of Blockchain application - Soft & Hard Fork - Private and Public blockchain | | |
| **Unit - III** | **Distributed Consensus** | **9** |
| Nakamoto consensus - Proof of Work - Proof of Stake - Proof of Burn - Difficulty Level - Sybil Attack - Energy utilization and alternate–Real time Case Study - Play with Go-ethereum | | |
| **Unit - IV** | **Cryptocurrency** | **9** |
| History - Distributed Ledger - Bitcoin protocols - Mining strategy and rewards - Ethereum – Construction – DAO - Smart Contract – GHOST – Vulnerability – Attacks – Sidechain–Namecoin – Real time Case Study - Smart Contract Construction | | |
| **Unit - V** | **Cryptocurrency Regulation** | **9** |
| Stakeholders - Roots of Bitcoin - Legal Aspects - Cryptocurrency Exchange - Black Market and Global Economy - Hashcash implementation - Toy application using Blockchain - Mining puzzles | | |

**Lecture:45, Total: 45**

**TEXT BOOK:**


1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016)

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | To know about distributed database | Applying (K3) |
| CO2 | To explore blockchain concept | Applying (K3) |
| CO3 | To understand the concepts of consensus | Applying (K3) |
| CO4 | To learn the basics of cryptocurrency | Applying (K3) |
| CO5 | To utilize cryptocurrency technologies in real time scenarios | Applying (K3) |

**Mapping of COs with POs and PSOs**

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

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

**ASSESSMENT PATTERN - THEORY**

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

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

## BLOCKCHAIN APPLICATION DEVELOPMENT THROUGH SMART CONTRACTS

| Programme & Branch | BTech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Introduction to Blockchain | | | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course enables the students to develop the applications through smart contracts | |
| **Unit - I** | **Introduction to Ethereum Blockchain** | **9** |
| History of Blockchain-Characteristic of a Blockchain: Decentralized Networks-Consensus Protocols-Transaction Processing-Transaction Finality. **Ethereum Fundamentals**: Ether and Gas-Accounts-Contracts-Blocks and Transactions. **Decentralized Applications:** Tokens- Supply Chain -Permanent Records -Evaluating Blockchain for Application | | |
| **Unit - II** | **Smart contract development** | **9** |
| Ethereum Clients-Installing MetaMask-Installing Node.js-Installing the Truffle Suite- First Smart Contract Development. **Deploying and Interacting with Contracts:** Contract Compilation and Deployment-Setting Up the UI-Deploying to Ganache-Deploying to Goerli with Parity-Deploying to Rinkeby with Infura. | | |
| **Unit – III** | **Application Development** | **9** |
| The Fundraiser Application-Application Overview - Initializing Fundraisers - Editing the Beneficiary-Making Donations-Withdrawing Funds- Fallback Functions. **FundraiserFactory :** Migrating FundraiserFactory -Creating Fundraisers - Viewing Available Fundraisers-Setting Up the UI | | |
| **Unit – IV** | **Interacting Smart Contracts through Web** | **9** |
| **Web3:** Frontend-Web3-Blockchain- Web3 Methods. Connecting the UI to Our Contracts: React -Truffle. **Larger DApp :** Starting with React Truffle Box-React and Material UI-Fundraiser UI | | |
| **Unit – V** | **Securing Smart Contracts** | **9** |
| Smart Contract Security- Types of Smart Contract Vulnerabilities: Unprotected Function - Transaction Ordering Dependence - Integer Overflow and Underflow – Reentrancy- Block Gas Limit - Timestamp Dependence. **Contract for an External Audit preparation:** External Auditing - Auditing Companies -Solidified | | |

**Lecture:45, Total:45**

**TEXT BOOK**


1. Solorio, K., Kanna, R., & Hoover, D. H. Hands-on Smart Contract Development with Solidity and Ethereum: From Fundamentals to Deployment. O'Reilly Media, 2019. Unit -1,2,3,4,5


**REFERENCE BOOK**


1. Zand, M., Wu, X. B., & Morris, M. A. Hands-On Smart Contract Development with Hyperledger Fabric V2. O'Reilly Media, 2021.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | explore smart contract fundamentals, ethereum protocol, solidity programming language, ethereum virtual machine. | Applying (K3) |
| CO2 | develop smart contract using solidity and Interacting with Contracts | Applying (K3) |
| CO3 | deploy and test the smart contracts using Truffle framework tools | Applying (K3) |
| CO4 | make use of web3 to connect the smart contract to an application | Applying (K3) |
| CO5 | demonstrate smart contract security with free online resourse for smart contract security auditing | Applying (K3) |

**Mapping of 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 |
| CO2 | 3 | 2 | 1 | | | | | | | | | | 2 | 3 |
| CO3 | 3 | 2 | 1 | | | | | | | | | | 2 | 3 |
| CO4 | 3 | 2 | 1 | | | | | | | | | | 2 | 3 |
| CO5 | 3 | 2 | 1 | | | | | | | | | | 2 | 3 |

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

**ASSESSMENT PATTERN - THEORY**

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

## PRACTICAL ASPECTS OF BLOCKCHAIN

| Programme & Branch | BTech. & Artificial Intelligence and Data Science | Sem. | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| Prerequisites | Introduction to Blockchain | | | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| Preamble | This course intended the students to study the basics of Blockchain technology. During this course learner will explore various aspects of Blockchain technology like application in various domains. | |
| **Unit - I** | **Blockchain Basics and Nodes** | **9** |
| Introduction to Cryptoeconomics and blockchain- Overloading Cryptocurrencies- Blockchain P2P Network. **Blockchain Node:** Running a Blockchain Node- Bitcoin Core API | | |
| **Unit - II** | **Creating Blockchain, Bitcoin Wallets and Transactions** | **9** |
| Basic P2P Network creation- Genesis Block and Sharing Blocks creation -Registering Miners and Creating New Blocks-Storing Blocks in LevelDB-Creating a Blockchain Wallet-Creating an API-Creating a Command-Line Interface. **Bitcoin Wallets and Transactions:** Bitcoin Core RPC Resources -Bitcoin Wallet-Transactions- Bitcoin Colored Coins | | |
| **Unit – III** | **Ethereum Wallets, NEO Blockchain and Smart Contracts** | **9** |
| Ganache Simulated Full-Node Client- IntelliJ IDEA Plugin for Solidity- Truffle Suite- Compile with Remix- Private Ethereum Blockchain with Geth- Connect the Mist Ethereum Wallet to Private Network- MetaMask. **NEO Blockchain and Smart Contracts :** NEO's High-Level Blockchain Architecture- Setting Up Local Environment- Create a Local NEO Private Testnet- Publish a Smart Contract on a Private Testnet | | |
| **Unit – IV** | **Hyperledger** | **9** |
| Hyperledger Overview- Hyperledger Fabric- Installing Hyperledger Fabric and Composer- Hyperledger Composer- "Hello, World" with Playground- Deploying on a Local Hyperledger Fabric Network- Running "hello-network" Network- Error Troubleshooting | | |
| **Unit – V** | **Build Dapps with Angular** | **9** |
| Dapp-Angular- Smart Contract transfer -Link with the Ethereum Network- MetaMask connection-Test Dapp Functionality | | |

**Lecture:45, Total: 45**

**TEXT BOOK**


1. Elrom, E. (2019). The Blockchain Developer: A Practical Guide for Designing. Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects. Unit -1,2,3,4,5


**REFERENCE BOOK**


1. Krishnan, S., Balas, V. E., Golden, J., Robinson, Y. H., Balaji, S., & Kumar, R. (Eds.). (2020). Handbook of research on blockchain technology. Academic Press.

| **COURSE OUTCOMES:** On completion of the course, the students will be able to | | **BT Mapped (Highest Level)** |
|---|---|---|
| CO1 | make use of the structure and mechanism of blockchain to address the basic security. | Applying (K3) |
| CO2 | deploy Blockchain and create a Bitcoin Wallets and Transactions. | Applying (K3) |
| CO3 | create Ethereum Wallets, NEO Blockchain and publish a Smart Contract on a Private Testnet | Applying (K3) |
| CO4 | solve the business network issues using Hyperledger Composer. | Applying (K3) |
| CO5 | build Dapps with Angular and link with the Ethereum Network | Applying (K3) |

| **Mapping of COs with POs and PSOs** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| CO1 | 3 | 2 | 1 | 2 | 2 | | | | | | | | 2 | 3 |
| CO2 | 3 | 2 | 1 | 2 | 2 | | | | | | | | 2 | 3 |
| CO3 | 3 | 2 | 1 | 2 | 2 | | | | | | | | 2 | 3 |
| CO4 | 3 | 2 | 1 | 2 | 2 | | | | | | | | 2 | 3 |
| CO5 | 3 | 2 | 1 | 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 | 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)**