
SCHEME OF INSTRUCTION AND SYLLABUS

**B.Tech in Computer Science and Engineering
(Artificial Intelligence and Machine Learning)**

Regulation:VR20

w.e.f.2022-23



Department of Computer Science and Engineering

**VELAGAPUDI RAMAKRISHNA
SIDDHARTHA ENGINEERING COLLEGE**

(An Autonomous, ISO 9001:2015 Certified Institution)

(Approved by AICTE, Accredited by NAAC with 'A+' Grade,
Affiliated to JNTUK, Kakinada)

(Sponsored by Siddhartha Academy of General & Technical Education)

Vijayawada, Andhra Pradesh - 520007, INDIA.

www.vrsiddhartha.ac.in



Institute Vision

To nurture excellence in various fields of engineering by imparting timeless core values to the learners and to mould the institution into a centre of academic excellence and advanced research.

Institute Mission

To impart high quality technical education in order to mould the learners into globally competitive technocrats who are professionally deft, intellectually adept and socially responsible. The institution strives to make the learners inculcate and imbibe pragmatic perception and proactive nature so as to enable them to acquire a vision for exploration and an insight for advanced enquiry.

Department Vision

The department vision is clearly defined and is in line with the college's vision. The vision of the department is "To evolve as a centre of academic excellence and advanced research in Computer Science and Engineering discipline."

Department Mission

This mission of the department is concise and supports the college's mission. The mission of the Computer Science and Engineering department is "To inculcate students with profound understanding of fundamentals related to discipline, attitudes, skills, and their application in solving real world problems, with an inclination towards societal issues and research."



Program Educational Objectives (Undergraduate)

We have program educational objectives for our Computer Science and Engineering program. Program educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

Our program educational objectives are:

The graduates of the program will

1. Have knowledge and analytical skills, including mathematics, science and basic engineering.
2. Have in-depth learning skills to function productively as leadership role or as supportive members in multidisciplinary teams with effective communication.
3. Have extensive knowledge in state-of-the-art frameworks in Artificial Intelligence to design industry accepted AI solutions using modern tools for allied domains with realistic constraints or pursue higher studies and continue to develop their professional knowledge.
4. Practice the profession with ethics, integrity, leadership and social responsibility.



Program Outcomes

On successful completion of the B.Tech in CSE (AI&ML) programme the student will be able to:

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 - *Lifelong 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

PSO1: Develop software applications or solutions as per the needs of Industry and society.

PSO2: Adopt new and fast emerging technologies in computer science and engineering.



Curricular Framework for Honors Program

1. Students of a department/discipline are eligible to opt for Honors program offered by the same department/discipline.
2. A student shall be permitted to register for Honors program at the beginning of 4th semester provided that the student must have acquired a minimum of 8.0 CGPA upto end of 2nd semester without any backlogs. In case of the declaration of the 3rd semester results after the commencement of the 4th semester and if a student fails to score the required minimum of 8.0 CGPA, his/her registration for Honors Program stands cancelled and he/she shall continue with the regular program.
3. Students can select the additional and advanced courses from their respective branch in which they are pursuing the degree and get an honors degree in the same. For example, if a Mechanical Engineering student completes the selected advanced courses from same branch under this scheme, he/she will be awarded B.Tech. (Honors) in Mechanical Engineering.
4. In addition to fulfilling all the requisites of a regular B.Tech program, a student shall earn 20 additional credits to be eligible for the award of B.Tech (Honors) degree. This is in addition to the credits essential for obtaining the undergraduate degree in major discipline (i.e. 160 credits).
5. 20 additional credits to be acquired, 16 credits shall be earned by undergoing specified courses listed as pools, with four courses, each carrying 4 credits. The remaining 4 credits must be acquired through two MOOCs, which shall be domain specific, each with 2 credits and with a minimum duration of 8 or 12 weeks as recommended by the Board of Studies.
6. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. The courses offered in each pool shall be domain specific courses and advanced courses.
7. The concerned BoS shall decide on the minimum enrolments (20) for offering Honors program by the department. If minimum enrolments criteria are not met then the students shall be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the Department in consultation with BoS.

8. Each pool can have theory as well as laboratory courses. If a course comes with a lab component, that component has to be cleared separately. The concerned BoS shall explore the possibility of introducing virtual labs for such courses with lab component.
9. MOOC courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Students have to acquire a certificate from the agencies approved by the BoS with grading or marks or pass/fail in order to earn 1 credit for 4 week course. If the MOOC course is a pass/fail course without any grades, the grade to be assigned will be as decided by the college/academic council.
10. The concerned BoS shall also consider courses listed under professional electives of the respective B.Tech programs for the requirements of B.Tech (Honors). However, a student shall be permitted to choose only those courses that he/she has not studied in any form during the Program.
11. If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a “pass (P)” grade and also choose to omit the mention of the course as for the following: All the courses done under the dropped Honors will be shown in the transcript. None of the courses done under the dropped Honors will be shown in the transcript.
12. In case a student fails to meet the CGPA requirement for degree with Honors at any point after registration, he/she will be dropped from the list of students eligible for degree with Honors and they will receive regular B.Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.
13. Honors must be completed simultaneously with a major degree program without exceeding 8 credits per semester. A student cannot earn Honors after he/she has already earned bachelor’s degree.



Curricular Framework for Minor Program

1. Students who are desirous of pursuing their special interest areas other than the chosen discipline of Engineering may opt for additional courses in minor specialization groups offered by a department other than their parent department. For example, If Mechanical Engineering student selects subjects from Computer Science and Engineering under this scheme, he/she will get major degree of Mechanical Engineering with minor degree of Computer Science and Engineering.

Student can also opt for industry relevant tracks of any branch to obtain the Minor Degree, for example, a B.Tech Mechanical student can opt for the industry relevant tracks like Data Mining track, IoT track, Machine learning track etc.

2. The BOS concerned shall identify as many tracks as possible in the areas of emerging technologies and industrial relevance / demand. For example, the minor tracks can be the fundamental courses in CSE, ECE, EEE, CE, ME etc or industry tracks such as Artificial Intelligence (AI), Machine Learning (ML), Data Science (DS), Robotics, Electric vehicles, Robotics, VLSI etc.
3. The list of disciplines/branches eligible to opt for a particular industry relevant minor specialization shall be clearly mentioned by the respective BoS.
4. There shall be no limit on the number of programs offered under Minor. The University/Institution can offer minor programs in emerging technologies based on expertise in the respective departments or can explore the possibility of collaborating with the relevant industries/agencies in offering the program.
5. The concerned BoS shall decide on the minimum enrolments for offering Minor program by the department. If a minimum enrolments criterion is not met, then the students may be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BoS.
6. A student shall be permitted to register for Minors program at the beginning of 4th semester subject to a maximum of two additional courses per semester, provided that the student must have acquired 7.75 CGPA (Cumulative Grade point average) upto the end of 2nd semester without any history of backlogs. It is expected that the 3rd semester results may be announced after the commencement of the 4th semester. If a student fails to acquire 7.75 CGPA upto 3rd semester or failed

in any of the courses, his registration for Minors program shall stand cancelled. An CGPA of 7.75 has to be maintained in the subsequent semesters without any backlog in order to keep the Minors registration active.

7. A student shall earn additional 20 credits in the specified area to be eligible for the award of B. Tech degree with Minor. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e. 160 credits).
8. Out of the 20 credits, 16 credits shall be earned by undergoing specified courses listed by the concerned BoS along with prerequisites. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. If a course comes with a lab component, that component has to be cleared separately. A student shall be permitted to choose only those courses that he/she has not studied in any form during the Program.
9. In addition to the 16 credits, students must pursue at least 2 courses through MOOCs. The courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Student has to acquire a certificate from the agencies approved by the BoS with grading or marks or pass/fail in order to earn 1 credit for 4 week course If the MOOC course is a pass/fail course without any grades, the grade to be assigned as decided by the university/academic council.
10. Student can opt for the Industry relevant minor specialization as approved by the concerned departmental BoS. Student can opt the courses from Skill Development Corporation (APSSDC) or can opt the courses from an external agency recommended and approved by concerned BOS and should produce course completion certificate. The Board of studies of the concerned discipline of Engineering shall review such courses being offered by eligible external agencies and prepare a fresh list every year incorporating latest skills based on industrial demand.
11. A committee should be formed at the level of department to evaluate the grades/marks given by external agencies to a student which are approved by concerned BoS. Upon completion of courses the departmental committee should convert the obtained grades/mark to the maximum marks assigned to that course. The controller of examinations can take a decision on such conversions and may give appropriate grades.
12. If a student drops (or terminated) from the Minor program, they cannot convert the earned credits into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a “pass (P)” grade and also choose to omit the mention of the course as for the following: All the courses done under the dropped Minor will be shown in the transcript. None of the courses done under the dropped Minor will be shown in the transcript.

13. In case a student fails to meet the CGPA requirement for B.Tech degree with Minor at any point after registration, he/she will be dropped from the list of students eligible for degree with Minors and they will receive B.Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.
14. Minor must be completed simultaneously with a major degree program without exceeding 8 credits per semester. A student cannot earn the Minor after he/she has already earned bachelor's degree.

SCHEME OF INSTRUCTION

B. Tech in CSE (Artificial Intelligence and Machine Learning)

Scheme of Instruction - VR20

Semester I

| S. No. | Course Code | Course Category | Course Name | Contact Hours | | | 26 |
|--------|-------------|-------------------------------|---|---------------|---|----|------|
| | | | | L | T | P | C |
| 1 | 20BS1101B | Basic Science | Mathematics for Machine Learning | 3 | 0 | 0 | 3 |
| 2 | 20BS1102A | Basic Science | Applied Physics (CSE/IT/ AI&DS,AI&ML) | 3 | 0 | 0 | 3 |
| 3 | 20ES1103 | Engineering Science | Programming for Problem Solving | 3 | 0 | 0 | 3 |
| 4 | 20ES1104 | Engineering Science | Basics of Electrical Engineering | 3 | 0 | 0 | 3 |
| 5 | 20HS1105 | Humanities and Social Science | Technical English and Communication Skills | 2 | 0 | 0 | 2 |
| 6 | 20BS1151A | Basic Science | Engineering Physics Laboratory | 0 | 0 | 3 | 1.5 |
| 7 | 20ES1152 | Engineering Science | Programming for Problem Solving Laboratory | 0 | 0 | 3 | 1.5 |
| 8 | 20HS1153 | Humanities and Social Science | Technical English and Communication Skills Laboratory | 0 | 0 | 3 | 1.5 |
| 9 | 20ES1154 | Engineering Science | Computing and Peripherals Laboratory | 0 | 0 | 2 | 1 |
| 10 | 20MC1106 | Mandatory Course | Technology and Society | 1 | 0 | 0 | - |
| Total | | | | 15 | 0 | 11 | 19.5 |
| 11 | 20MC1107 | Mandatory Course | Induction Program | | | | - |

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B. Tech in CSE (Artificial Intelligence and Machine Learning)

Scheme of Instruction - VR20

Semester II

| S. No. | Course Code | Course Category | Course Name | Contact Hours | | | 27 |
|--------|-------------|---------------------|---|---------------|---|----|------|
| | | | | L | T | P | C |
| 1 | 20BS2101B | Basic Science | Probability and Statistics for Machine Learning | 3 | 0 | 0 | 3 |
| 2 | 20BS2102 | Basic Science | Engineering Chemistry | 3 | 0 | 0 | 3 |
| 3 | 20ES2103C | Engineering Science | Programming Essentials in Python | 3 | 0 | 0 | 3 |
| 4 | 20ES2104A | Engineering Science | Basics Electronics Engineering | 3 | 0 | 0 | 3 |
| 5 | 20ES2105 | Engineering Science | Engineering Graphics | 1 | 0 | 4 | 3 |
| 6 | 20BS2151B | Basic Science | Engineering Chemistry Laboratory | 0 | 0 | 3 | 1.5 |
| 7 | 20ES2152C | Engineering Science | Programming Essentials in Python Laboratory | 0 | 0 | 3 | 1.5 |
| 8 | 20ES2153 | Engineering Science | Engineering Workshop | 0 | 0 | 3 | 1.5 |
| 9 | 20MC2106 | Mandatory Course | Professional Ethics and Practice | 1 | 0 | 0 | |
| Total | | | | 14 | 0 | 13 | 19.5 |

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B.Tech in CSE (Artificial Intelligence and Machine Learning)

Scheme of Instruction - VR20

Semester III

| S. No. | Course Code | Course Category | Course Name | Contact Hours | | | 28 |
|--------|-------------|------------------------------------|-----------------------------------|---------------|---|----|------|
| | | | | L | T | P | C |
| 1 | 20BS3101A | Basic Science | Discrete Mathematics | 3 | 0 | 0 | 3 |
| 2 | 20ES3102 | Engineering Science | Digital Logic and Computer Design | 3 | 0 | 0 | 3 |
| 3 | 20AI&ML3303 | Program Core | Artificial Intelligence | 3 | 0 | 0 | 3 |
| 4 | 20AI&ML3304 | Program Core | Java Programming | 3 | 0 | 0 | 3 |
| 5 | 20AI&ML3305 | Program Core | Data Structures | 3 | 0 | 0 | 3 |
| 6 | 20AI&ML3351 | Program Core Lab-1 | Artificial Intelligence Lab | 0 | 0 | 3 | 1.5 |
| 7 | 20AI&ML3352 | Program Core Lab-2 | Java Programming Lab | 0 | 0 | 3 | 1.5 |
| 8 | 20AI&ML3353 | Program Core Lab-3 | Data Structures Lab | 0 | 0 | 3 | 1.5 |
| 9 | 20TP3106 | Soft Skills - 1 | Logic and Reasoning | 0 | 0 | 2 | 1 |
| 10 | 20MC3107A | Mandatory Course (AICTE suggested) | Environmental Studies | 2 | 0 | 0 | - |
| Total | | | | 17 | 0 | 11 | 20.5 |

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B.Tech in CSE (Artificial Intelligence and Machine Learning)

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Semester IV

| S. No. | Course Code | Course Category | Course Name | Contact Hours | | | C |
|--|-------------|------------------------------------|-------------------------------------|---------------|---|----|------|
| | | | | L | T | P | |
| 1 | 20BS4101G | Basic Science | Linear Algebra | 3 | 0 | 0 | 3 |
| 2 | 20AI&ML4302 | Program Core | Design and Analysis of Algorithms | 3 | 0 | 0 | 3 |
| 3 | 20AI&ML4303 | Program Core | Advanced Java Programming | 3 | 0 | 0 | 3 |
| 4 | 20AI&ML4304 | Program Core | Computer Networks | 2 | 0 | 0 | 2 |
| 5 | 20HS4105 | Humanities and Social Sciences | Universal Human Values | 3 | 0 | 0 | 3 |
| 6 | 20AI&ML4309 | Program Core | Operating Systems | 2 | 0 | 0 | 2 |
| 7 | 20AI&ML4351 | Program Core Lab - 1 | AI-Powered Tools Laboratory | 0 | 0 | 2 | 1 |
| 8 | 20AI&ML4352 | Program Core Lab - 2 | Advanced Java Programming Lab | 0 | 0 | 3 | 1.5 |
| 8 | 20AI&ML4353 | Program Core Lab - 3 | Computer Networks Lab | 0 | 0 | 2 | 1 |
| 9 | 20TP4106 | Soft Skills - 2 | English for Professionals | 0 | 0 | 2 | 1 |
| 10 | 20AI&ML4607 | Skill Oriented Course - 1 | Industry Standard Coding Practice-1 | 1 | 0 | 2 | 2 |
| 11 | 20MC4108B | Mandatory Course (AICTE suggested) | Indian Constitution | 2 | 0 | 0 | - |
| Total | | | | 19 | 0 | 11 | 22.5 |
| Summer Internship 6 weeks (Mandatory) during summer vacation (EPICS) | | | | | | | |
| Honors/ Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also) | | | | 3 | 1 | 0 | 4 |

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B.Tech in CSE (Artificial Intelligence and Machine Learning)**Scheme of Instruction - VR20***Semester V*

| | | | | Contact Hours | | | 33 |
|--|-------------|---------------------------------------|---|---------------|---|----|------|
| S. No. | Course Code | Course Category | Course Name | L | T | P | C |
| 1 | 20AI&ML5301 | Program Core | Database Systems | 3 | 0 | 0 | 3 |
| 2 | 20AI&ML5302 | Program Core | Machine Learning | 3 | 0 | 0 | 3 |
| 3 | 20HS5103 | Humanities and Social Sciences | Engineering Economics and Management | 2 | 0 | 0 | 2 |
| 4 | 20AI&ML5404 | Program Elective I | Program Elective I | 3 | 0 | 0 | 3 |
| 5 | 20AI&ML5205 | Open Elective I | Open Elective I | 2 | 0 | 2 | 3 |
| 6 | 20AI&ML5351 | Program Core Lab - 1 | Database Systems Laboratory | 0 | 0 | 3 | 1.5 |
| 7 | 20AI&ML5352 | Program Core Lab - 2 | Machine Learning Laboratory | 0 | 0 | 3 | 1.5 |
| 8 | 20HS5153 | Humanities and Social Sciences | English Communication Skills Laboratory | 0 | 0 | 2 | 1 |
| 9 | 20TP5106 | Soft Skills - 3 | Personality Development | 0 | 0 | 2 | 1 |
| 10 | 20AI&ML5354 | Internship/ Project (6 weeks) | Engineering Projects in Community Service (EPICS) | 0 | 0 | 3 | 1.5 |
| 11 | 20AI&ML5607 | Skill Oriented Course - 2 | Industry Standard Coding Practice-II | 1 | 0 | 2 | 2 |
| 12 | 20MC5108A | Humanities Elective (AICTE suggested) | Humanities Elective | 2 | 0 | 0 | - |
| Total | | | | 16 | 0 | 17 | 22.5 |
| Honors/ Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also) | | | | 3 | 1 | 0 | 4 |

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| List of Humanities Elective Courses | |
|-------------------------------------|---------------------------------------|
| 20MC5108A1 | Foreign Languages (German/French) |
| 20MC5108A2 | Biology for Engineers |
| 20MC5108A3 | Human Rights & Legislative Procedures |
| 20MC5108A4 | Philosophy |
| 20MC5108A5 | Law for Engineers |
| 20MC5108A6 | Sanskrit Bhasa |
| 20MC5108A7 | Yoga & Meditation |
| 20MC5108A8 | Psychology |

B.Tech in CSE (Artificial Intelligence and Machine Learning)**Scheme of Instruction - VR20***Semester VI*

| S. No | Course Code | Course Category | Course Name | Contact Hours | | | 28 |
|--|-------------|------------------------------------|--|---------------|---|----|------|
| | | | | L | T | P | C |
| 1 | 20AI&ML6301 | Program Core | Neural Networks & Deep Learning | 3 | 0 | 0 | 3 |
| 2 | 20AI&ML6302 | Program Core | Automata & Compiler Design | 3 | 0 | 0 | 3 |
| 3 | 20AI&ML6303 | Program Core | Software Engineering | 2 | 0 | 0 | 2 |
| 4 | 20AI&ML6404 | Program Elective II | Program Elective II | 3 | 0 | 0 | 3 |
| 5 | 20AI&ML6205 | Open Elective II | Open Elective II | 2 | 0 | 2 | 3 |
| 6 | 20AI&ML6351 | Program Core Lab-1 | Neural Networks & Deep Learning Laboratory | 0 | 0 | 3 | 1.5 |
| 7 | 20AI&ML6352 | Program Core Lab-2 | Automata & Compiler Design Laboratory | 0 | 0 | 3 | 1.5 |
| 8 | 20AI&ML6353 | Program Core Lab-3 | Software Engineering Laboratory | 0 | 0 | 3 | 1.5 |
| 9 | 20TP6106 | Soft Skills - 4 | Quantitative Aptitude | 0 | 0 | 2 | 1 |
| 10 | 20AI&ML6554 | Internship/ Project | Mini Project - I | 0 | 0 | 2 | 1 |
| 11 | 20MC6107B | Mandatory Course (AICTE suggested) | Innovation, IPR and Entrepreneurship | 2 | 0 | 0 | 0 |
| Total | | | | 15 | 0 | 15 | 20.5 |
| Industrial/ Research Internship six weeks (Mandatory) during summer vacation | | | | | | | |
| Honors/ Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also) | | | | 3 | 1 | 0 | 4 |

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B.Tech in CSE (Artificial Intelligence and Machine Learning)

Scheme of Instruction - VR20

Semester VII

| S. No. | Course Code | Course Category | Course Name | Contact Hours | | | 29 |
|--|-------------|-----------------------|---------------------------------|---------------|---|----|-----|
| | | | | L | T | P | C |
| 1 | 20AI&ML7301 | Program Core | Natural Language Processing | 2 | 0 | 2 | 3 |
| 2 | 20AI&ML7402 | Program Elective III | Program Elective III | 3 | 0 | 0 | 3 |
| 3 | 20AI&ML7403 | Program Elective IV | Program Elective IV | 3 | 0 | 0 | 3 |
| 4 | 20AI&ML7404 | Program Elective V | Program Elective V | 3 | 0 | 0 | 3 |
| 5 | 20AI&ML7205 | Open Elective III | Open Elective III | 0 | 0 | 0 | 3 |
| 6 | 20AI&ML7206 | Open Elective IV | Open Elective IV | 0 | 0 | 0 | 3 |
| 7 | 20AI&ML7607 | Advanced Skill Course | Corporate Readiness Skills | 1 | 0 | 2 | 2 |
| 8 | 20AI&ML7551 | Internship/ Project | Mini Project II | 0 | 0 | 3 | 1.5 |
| 9 | 20AI&ML7552 | Internship/ Project | Industrial/ Research Internship | 0 | 0 | 3 | 1.5 |
| Total | | | | 17 | 0 | 12 | 23 |
| Industrial/ Research Internship six weeks (Mandatory) during summer vacation | | | | | | | |
| Honors/ Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also) | | | | 3 | 1 | 0 | 4 |

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Note: Open Elective III and Open Elective IV are self-learning. Students may opt from any MOOCs (12 Weeks) platforms. They have to submit the certificate before the last instruction day of VII semester. Course selection for MOOCs is subject to approval by the Head of the Department.

B.Tech in CSE (Artificial Intelligence and Machine Learning)

Scheme of Instruction - VR20

Semester VIII

| | | | | | | | Contact Hours | 24 |
|--------|-------------|-----------------------|---|---|---|----|---------------|----|
| S. No. | Course Code | Course Category | Course Name | L | T | P | C | |
| 1 | 20AI&ML8551 | Internship/ Project** | Major Project and Internship (6 Months) | 0 | 0 | 24 | 12 | |
| Total | | | | 0 | 0 | 24 | 12 | |

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Note: The student should undergo internship and simultaneously she should work on a project with well-defined objectives. At the end of the semester the student should submit an internship completion certificate and a project report.

If any of our associated company comes forward to offer an emerging course that will be offered as an industry offered course in V, VI or VII semesters under program elective with the approval of BoS. This is incorporated to enhance student skills and employability in cutting edge technologies.

Program Electives

Scheme of Instruction - VR20

Semester V

| S. No. | Course Type | Course Code | Course Name | L | T | P | C |
|--------|--------------------|--------------|---|---|---|---|---|
| 1 | Program Elective I | 20AI&ML5404A | Feature Engineering | 3 | 0 | 0 | 3 |
| 2 | Program Elective I | 20AI&ML5404B | Cryptography and Network Security | 3 | 0 | 0 | 3 |
| 3 | Program Elective I | 20AI&ML5404C | Distributed Systems | 3 | 0 | 0 | 3 |
| 4 | Program Elective I | 20AI&ML5404D | MERN Technologies | 3 | 0 | 0 | 3 |
| 5 | Program Elective I | 20AI&ML5404E | Any course suggested by the Industry Expert | 3 | 0 | 0 | 3 |

Semester VI

| S. No. | Course Type | Course Code | Course Name | L | T | P | C |
|--------|---------------------|--------------|---|---|---|---|---|
| 1 | Program Elective II | 20AI&ML6404A | Big Data Analytics | 3 | 0 | 0 | 3 |
| 2 | Program Elective II | 20AI&ML6404B | Cyber Security | 3 | 0 | 0 | 3 |
| 3 | Program Elective II | 20AI&ML6404C | Augmented Reality & Virtual Reality | 3 | 0 | 0 | 3 |
| 4 | Program Elective II | 20AI&ML6404D | Backend Technologies | 3 | 0 | 0 | 3 |
| 5 | Program Elective II | 20AI&ML6404E | Any course suggested by the Industry Expert | 3 | 0 | 0 | 3 |

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Program Electives
Scheme of Instruction - VR20
Semester VII

| S. No. | Course Type | Course Code | Course Name | L | T | P | C |
|--------|----------------------|--------------|---|---|---|---|---|
| 1 | Program Elective III | 20AI&ML7402A | Computer Vision | 3 | 0 | 0 | 3 |
| 2 | Program Elective III | 20AI&ML7402B | Generative AI Models and Prompt Engineering | 3 | 0 | 0 | 3 |
| 3 | Program Elective III | 20AI&ML7402C | Robotics Programming | 3 | 0 | 0 | 3 |
| 4 | Program Elective III | 20AI&ML7402D | Any course suggested by the Industry Expert | 3 | 0 | 0 | 3 |
| 5 | Program Elective III | 20AI&ML7402E | UI&UX design | 3 | 0 | 0 | 3 |

Semester VII

| S. No. | Course Type | Course Code | Course Name | L | T | P | C |
|--------|---------------------|--------------|---|---|---|---|---|
| 1 | Program Elective IV | 20AI&ML7403A | Information Retrieval Systems and Analytics | 3 | 0 | 0 | 3 |
| 2 | Program Elective IV | 20AI&ML7403B | Cyber Forensics | 3 | 0 | 0 | 3 |
| 3 | Program Elective IV | 20AI&ML7403C | Cloud Computing | 3 | 0 | 0 | 3 |
| 4 | Program Elective IV | 20AI&ML7403D | Framework and Micro-services | 3 | 0 | 0 | 3 |
| 5 | Program Elective IV | 20AI&ML7403E | Any course suggested by the Industry Expert | 3 | 0 | 0 | 3 |

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Program Electives

Scheme of Instruction - VR20

Semester VII

| S. No. | Course Type | Course Code | Course Name | L | T | P | C |
|--------|--------------------|--------------|--|---|---|---|---|
| 1 | Program Elective V | 20AI&ML7404A | Reinforcement Learning | 3 | 0 | 0 | 3 |
| 2 | Program Elective V | 20AI&ML7404B | Blockchain Technologies | 3 | 0 | 0 | 3 |
| 3 | Program Elective V | 20AI&ML7404C | Software Project Management | 3 | 0 | 0 | 3 |
| 4 | Program Elective V | 20AI&ML7404D | DevOps | 3 | 0 | 0 | 3 |
| 5 | Program Elective V | 20AI&ML7404E | Any course suggested by the Industry Expert Networks | 3 | 0 | 0 | 3 |

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List of Open Electives

Scheme of Instruction - VR20

Semester V

| S. No. | Course Code | Course Type | Course Name | L | T | P | C |
|--------|--------------|-----------------|--------------------------------------|---|---|---|---|
| 1 | 20AI&ML5205A | Open Elective I | Designing Autonomous AI | 2 | 0 | 2 | 3 |
| 2 | 20AI&ML5205B | Open Elective I | Artificial Intelligence for Robotics | 2 | 0 | 2 | 3 |
| 3 | 20AI&ML5205C | Open Elective I | Computational Intelligence | 2 | 0 | 2 | 3 |
| 3 | 20AI&ML5205D | Open Elective I | Data Analytics | 2 | 0 | 2 | 3 |

Semester VI

| S. No. | Course Code | Course Type | Course Name | L | T | P | C |
|--------|--------------|------------------|---|---|---|---|---|
| 1 | 20AI&ML6205A | Open Elective II | Internet of Things | 2 | 0 | 2 | 3 |
| 2 | 20AI&ML6205B | Open Elective II | Data Warehousing | 2 | 0 | 2 | 3 |
| 3 | 20AI&ML6205C | Open Elective II | Data Visualization | 2 | 0 | 2 | 3 |
| 4 | 20AI&ML6205D | Open Elective II | Internet Technologies For Non CSE /AI&DS/CSE(AI&ML)/IT branches only opt. | 2 | 0 | 2 | 3 |

[L - Lecture, T - Tutorial, P - Practical, C - Credits]

Open Electives

Scheme of Instruction - VR20

Semester VII

| S. No | Course Code | Course Type | Course Name | L | T | P | C |
|-------|--------------|-------------------|---|---|---|---|---|
| 1 | 20AI&ML7205A | Open Elective III | Programming in Modern C++ (Offered by IIT Kharagpur) | 0 | 0 | 0 | 3 |
| 2 | 20AI&ML7205B | Open Elective III | Social Networks (Offered by IIT Ropar) | 0 | 0 | 0 | 3 |
| 3 | 20AI&ML7205C | Open Elective III | Ethical Hacking (Offered by IIT Kharagpur) | 0 | 0 | 0 | 3 |
| 4 | 20AI&ML7205D | Open Elective III | Any MOOCS course approved by the department | 0 | 0 | 0 | 3 |

Semester VII

| S. No | Course Code | Course Type | Course Name | L | T | P | C |
|-------|--------------|------------------|---|---|---|---|---|
| 1 | 20AI&ML7206A | Open Elective IV | Foundations of R Software (NPTL Course-Offered by IIT Kanpur) | 0 | 0 | 0 | 3 |
| 2 | 20AI&ML7206B | Open Elective IV | Advanced Computer Architecture (NPTL Course-Offered by IIT Delhi) | 0 | 0 | 0 | 3 |
| 3 | 20AI&ML7206C | Open Elective IV | Privacy and Security in Online Social Media (Offered by IIIT Hyderabad) | 0 | 0 | 0 | 3 |
| 4 | 20AI&ML7206D | Open Elective IV | Any MOOCS course approved by the department | 0 | 0 | 0 | 3 |

[L - Lecture, T - Tutorial, P - Practical, C - Credits]

Honors in CSE(Artificial Intelligence and Machine Learning)

| S. No | Course Code | Course Type | Course Name | L | T | P | C |
|--|--------------|-------------|---|---|---|---|----|
| 1 | 20AI&MLH4801 | Honors | Mathematical Model for Machine Learning | 3 | 1 | 0 | 4 |
| 2 | 20AI&MLH5801 | Honors | Edge Computing and AI for IOT | 3 | 1 | 0 | 4 |
| 3 | 20AI&MLH6801 | Honors | High Performance Computing | 3 | 1 | 0 | 4 |
| 4 | 20AI&MLH7801 | Honors | Quantum Computing | 3 | 1 | 0 | 4 |
| Two MOOCS Courses @2 Credits each, other than the courses listed above need to be taken. | | | | | | | 4 |
| Total | | | | | | | 20 |

SEMESTER I

20BS1101B

MATHEMATICS FOR MACHINE LEARNING

| | | | |
|-----------------|--|-------------------------|-------|
| Course Category | Basic Science | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | Differentiation, Integration, Curve Tracing | Continuous Evaluation | 30 |
| | | Semester End Evaluation | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Solve linear system of equations and determine eigen values and eigen vectors..
2. Solve differential equations of different orders .
3. Apply mean values theorems and Lagrange's method of undetermined multipliers where ever necessary .
4. Minimize and maximize the linear programming problems .

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 3 | 2 | | | 1 | | | | | | | | | | | 3 | 1.2.1 |
| 2 | 3 | 2 | | | 1 | | | | | | | | | | | 3 | 2.6.3, 2.8.1 |
| 3 | 3 | 2 | | | 1 | | | | | | | | | | | 3 | 5.4.1, 5.4.2 |
| 4 | 3 | 2 | | | 1 | | | | | | | | | | | 4 | 5.4.1, 5.4.2 |

COURSE CONTENT

UNIT I

Matrices: Rank of a Matrix-Consistency of Linear System of Equations- Linear-Transformations-Vectors, Eigen values and Eigen vectors- Properties of Eigen values-Finding Inverse and Powers of a Matrix by Cayley-Hamilton Theorem- Reduction to Diagonal form-Reduction of Quadratic form to Canonical form-Nature of a Quadratic form- Complex matrices .

UNIT II

Differential Equations: Differential Equations of First Order and first degree-Exact Differential Equations-Equations Reducible to Exact Equations. Linear Differential Equations of Higher Order: Definitions- Operator D- Rules for finding the Complementary Function- Inverse Operator- Rules for finding Particular Integral- Working Procedure.

UNIT III

Differential Calculus: Fundamental Theorems-Rolle's Theorem- Lagrange's Mean Value Theorem- Cauchy's Mean Value Theorem and Taylor's Theorem- Expansions of functions-Maclaurin's Series and Taylor's Series. CurvatureRadius of Curvature-Maxima and minima of functions of Two variables-Lagrange's method of undetermined multipliers.

UNIT IV

Linear Programming: Method of Variation of Parameters, Method of Undetermined Coefficients, Equations Reducible to Linear Equations with Constant Coefficients: Cauchy's Homogeneous Linear Equation, Legendre's Linear Equation, Linear Dependence of Solutions, Simultaneous Linear Equations with Constant Coefficients.

TEXTBOOKS

1. B S Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2019.

REFERENCE BOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th Edition, 2015.
2. B.V.Ramana, Higher Engineering Mathematics, Tata MC Graw Hill, 1st Edition, 2007.
3. N.P.Bali, Dr.ManishGoyal, A Text Book of Engineering Mathematics, Laxmi Publications, 9th Edition,2014.
4. S.D.Sarma, Operations Research, KedarNath Ram Nath, Meerut.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Math Lectures from MIT, Stanford,IIT's, www.nptelvideos.com/mathematics/, Last accessed on: 24/04/2022.
2. Prof. Swagato K. Ray, Prof. Shobha Madan, Dr. P. Shunmugaraj, <https://nptel.ac.in/courses/122104017>. Last accessed on: 24/04/2022.
3. Prof. P.D. Srivastava, Dr. P. Panigrahi, Prof. Somesh Kumar, Prof. J. Kumar, <https://nptel.ac.in/courses/111105035>, Last accessed on: 24/04/2022.
4. Engineering Mathematics Open Learning Project, Loughborough University, <http://www.3.ul.ie/~mlc/support/Loughborough%20website/>.

20BS1102A

APPLIED PHYSICS

| | | | |
|-----------------|----------------------|-------------------|-------|
| Course Category | Basic Science | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 10 + 2 level Physics | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the importance of quantum mechanics.
2. Analyse and understand various types of lasers and their applications.
3. Elaborate different types of optical fibers and understand the concept of Superconductivity.
4. Understand the fabrication of nanomaterials and carbon Nanotubes.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 3 | | | | | | | | | | | | | | | | |
| 2 | 3 | | 2 | | | | | | | | | | | | | | |
| 3 | 3 | | 1 | | | | | | | | | | | | | | |
| 4 | 3 | | | | 2 | | | | | | | | | | | | |

COURSE CONTENT

UNIT I

Quantum Mechanics: Dual nature of light, Matter waves and Debroglie's hypothesis, Davisson-Germer's experiment, G. P. Thomson experiment, Heisenberg's uncertainty principle and its applications (Non existence of electron in nucleus, Finite width of spectral lines), One dimensional time independent and time dependent Schrödinger's wave equations, physical significance of wave function, Particle in a box (One dimension).

UNIT II

Lasers: Introduction, Characteristics of laser, Basic Principles of lasers (absorption, spontaneous emission, stimulated emission), Requirements of lasers (pumping, population inversion, cavity resonance), Einstein's coefficients, different types of lasers: solid-state lasers (Ruby, Neodymium), gas lasers (He-Ne, CO₂), Semiconductor laser, applications of lasers in science, engineering and medicine.

UNIT III

Fibre Optics: Introduction, Fundamentals of optic fibre, Propagation of light through optical fiber, Types of optical fibers, Numerical aperture, Fractional Refractive Index change, Fiber optics in communication and its advantages.

Superconductivity: Introduction, Critical parameters, Flux quantization, Meissner effect, Types of Superconductors, BCS theory, Cooper pairs, London's equation- penetration depth, high temperature super conductors, Applications of superconductors.

TEXTBOOKS

1. Avadhanulu, M. N., & Kshirsagar, P. G, A textbook of engineering physics. S. Chand Publishing, 2014.
2. Palanisamy, P. K, Applied Physics. Scitech Publications (INDIA) Pvt. Ltd, 2008.

REFERENCE BOOKS

1. B. K. Pandey and S. Chaturvedi, Engineering Physics Cengage Learning, Delhi, 2012.
2. M.R. Srinivasan, Engineering Physics, New age international publishers, 1st Edition, 2011.
3. Gaur and Gupta, Engineering Physics, Dhanpatrai publishers, 8th Edition 2008.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. <https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2013/lecture-videos/>
2. <https://ocw.mit.edu/resources/res-6-005-understanding-lasers-and-fiberoptics-spring-2008/laser-fundamentals-i/>
3. <http://nptel.ac.in/courses/112106198/19>
4. <https://www.peterindia.net/NanoTechnologyResources.html>

20ES1103**PROGRAMMING FOR PROBLEM SOLVING**

| | | | |
|-----------------|---------------------|-------------------|-------|
| Course Category | Engineering Science | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | – | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the different types of problem solving approaches.
2. Apply the selections, loops, arrays, and string concepts in C to solve problems.
3. Apply functions and pointer concepts in C to solve problems.
4. Solve problems using enum, structures, unions, and file handling functions.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 3 | 1 | | | | | | | | | | | | | | | |
| 2 | | 2 | 3 | | | | | | | | | | 2 | | | | |
| 3 | | 2 | 3 | | | | | | | | | | 3 | | | | |
| 4 | | 2 | 3 | | | | | | | | | | 3 | | | | |

COURSE CONTENT**UNIT I**

Introduction to computer-based problem solving: Requirement of problem solving by computers, problem definition, Use of examples for problem solving, similarities between problems, Problem solving strategies, steps involved in problem solving.

Program design and implementation issues: Programs and algorithms, top-down design and step-wise refinement, construction of loops-basic programming constructs, Implementation, programming environment.

Algorithms for problem solving: Exchanging values of two variables, Summation of a set of numbers, decimal to binary base conversion, reversing the digit of an integer, to find greatest common divisor (GCD) of two numbers, to verify whether an integer is prime or not, organize a given set of numbers in ascending order, find the square root of an integer, factorial of a given number, generate the Fibonacci sequence for n terms, evaluate $\sin(x)$ as sum of series, to find the value of the power of a number raised by another integer, reverse order elements of an array, find largest

number in an array, print elements of upper triangular matrix, multiplication of two matrices, to compute to roots of a quadratic equation $ax^2+bx+c=0$.

UNIT II

Introduction to the C Language: Background of C program, Identifiers, Types, Variables, Constants, Memory Layout, Input/Output, Programming Examples.

Structure of a C Program: Structure of a C Program: Logical Data and Operators, Expressions, Precedence and Associativity, Evaluating Expressions, Type Conversion, Statements, Storage Class.

Selection: Two-way Selection, Multiway Selection, More Standard Functions.

Repetition: Concept of a Loop Loops In C, Loop Examples, Recursion, The Calculator Program.

Array: Array Concepts in C, Inter-Function Communication, Array Applications, Two Dimensional Arrays, Multidimensional Arrays.

UNIT III

Strings: String Concepts, C Strings, String Input/Output Functions, Arrays of Strings, String Manipulation Functions, String-Data Conversion.

Functions: Functions in C, User Defined Functions, Call by Value, Call Value Reference, Inter-Function Communication, Standard Functions, Scope.

Pointers: Introduction to Pointer, Pointers for Inter-Function Communications, Pointers to Pointers, Compatibility, Lvalue and Rvalue.

Pointer Applications: Arrays and Pointers, Pointer Arithmetic and Arrays, Passing an Array to a Function, Memory Allocations Functions, Array of Pointers.

UNIT IV

Enumerations: The Type Definition (Typedef), Enumerated Types: Declaring an Enumerated Type, Operations on Enumerated Types, Enumeration Type Conversion, Initializing Enumerated Constants, Anonymous Enumeration: Constants, Input/Output Operators.

Structures: Structure Type Declaration, Initialization, Accessing Structures, Operations on Structures, Complex Structures, Structures and Functions, Sending the Whole Structure, Passing Structures through Pointers.

Unions: Referencing Unions, Initializers, Unions and Structures, Internet Address, Programming Applications.

File Handling: Files, Streams, Standard Library Input/Output Functions, Formatting Input/output Functions and Character Input/Output Functions, Command-Line Arguments.

TEXTBOOKS

1. Programming and Problem Solving Through "C" Language By HarshaPriya, R. Ranjeet, Firewall media, 2006.
2. Behrouz A. Forouzan and Richard F. Gilberg, Computer Science A Structured Programming Approach Using C, Cengage Learning, 3rd Edition.

REFERENCE BOOKS

1. Anil B. Chaudhuri, Flowchart and Algorithm Basics: The Art of Programming, Mercury Learning & Information, 2020.
2. R.G. Dromey, How to Solve it By Computer, Prentice-Hall International Series in Computer Science, 1982.
3. Yashwant Kanetkar, Let us C, BPB Publications, 16th Edition 2017.
4. Kernighan and Ritchie, The C programming language, The (Ansi C Version), PHI, 2nd Edition.
5. Paul J. Dietel and Harvey M. Deitel, C: How to Program, Prentice Hall, 8th Edition, Jan 19, 2021.
6. K.R.Venugopal, Sundeep R. Prasad, Mastering C, McGraw Hill, 2nd Edition, 2015.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Computer Science and Engineering - Noc:problem Solving Through Programming in C, <https://nptel.ac.in/courses/106/105/106105171/>
2. Computer Science and Engineering - Noc:introduction To Programming in C <https://nptel.ac.in/courses/106/104/106104128/>
3. C For Everyone: Structured Programming. <https://www.coursera.org/learn/c-structured-programming>
4. Advanced C Programming Course Tim Academy-Jason Fedin, <https://www.udemy.com/-course/advanced-c-programming-course/>

20ES1104

BASICS OF ELECTRICAL ENGINEERING

| | | | |
|-----------------|---------------------|-------------------|-------|
| Course Category | Engineering Science | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | – | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Analyze Electric Circuit fundamentals.
2. Understand the basic concepts of Alternating Quantities and Magnetic Circuits.
3. Analyze the basic concepts of Electric Machines.
4. Understand Measuring Instruments & Solar Photo Voltaic System concepts.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 3 | 3 | | | 1 | | | | | | | | | | | | |
| 2 | 3 | 2 | | | 1 | | | | | | | | | | | | |
| 3 | 3 | 2 | | | 1 | | | | | | | | | | | | |
| 4 | 3 | 2 | | | 1 | | | | | | | | | | | | |

COURSE CONTENT

UNIT I

Introduction to Electrical Engineering: Electric Current, Electromotive force, Electric power and energy, Basic circuit components- Resistors-Inductors-Capacitors. Electromagnetic Phenomenon and Related Laws, Kirchhoff's laws.

Network Analysis: Network sources- Ideal independent voltage source, Ideal independent current source, Dependent sources, Practical voltage and current sources, Source conversion, Voltage and Current division rule, series and parallel connection of R, L and C, Star-Delta or, Delta- Star transformation. Mesh and Nodal Analysis (with independent sources only).

UNIT II

Alternating Quantities: Introduction, Generation of a.c. voltages, Waveforms and Basic Definitions, Relationship between frequency, speed and number of poles, Root Mean Square and Average values of alternating current and voltages, Form Factor and Peak Factor, Phasor representation of alternating quantities.

Magnetic Circuits: Introduction, Magnetic Circuits, Magnetic Field Strength (H), Magneto motive Force, Permeability, Reluctance, Analogy between Electric and Magnetic Circuits, Magnetic potential drop, Magnetic circuit computations, Self and Mutual Inductance, Energy in Linear Magnetic Systems (Derivation for pure inductor).

UNIT III

DC Machines: Introduction, Construction of dc machines, Armature Windings, Generation of dc voltage and torque production in a dc machine, Operation of a dc machine as a generator, Operation of dc machine as a motor.

Induction Motors: Introduction, Constructional features of three-phase induction motors, Principle of operation of three-phase induction motor- Slip and rotor frequency, Voltage and current equations and equivalent circuit of an induction motor.

UNIT IV

Measuring Instruments: Introduction, Classification of instruments, Operating Principles, Essential features of measuring instruments, Ammeters and Voltmeters, Measurement of power.

Solar photovoltaic Systems: Solar cell fundamentals, characteristics, classification, module, panel and array construction, Maximizing the solar PV output and load matching, Maximum Power Point Tracker Basic Algorithm and Flowchart, PV system components, solar PV systems and solar PV applications.

TEXTBOOKS

1. T.K. Nagasarkar and M.S. Sukhja, Basic Electric Engineering, 2nd Edition, Oxford University press 2011.

REFERENCE BOOKS

1. B.H.Khan, Non Conventional Energy Resources, 2nd Edition, Mc.Graw Hill Education Pvt Ltd., New Delhi, 2013.
2. Ashfaq Hussain, Haroon Ashfaq, Fundamentals of Electric Engineering, 4th Edition, Dhanpat Rai & Co, 2014.
3. I.J.Nagarath and Kothari, Theory and Problems of Basic Electric Engineering, PHI Pvt. Ltd., 2nd Edition, 2016.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. <http://nptel.ac.in/courses/108108076/>

20HS1105

TECHNICAL ENGLISH AND COMMUNICATION SKILLS

| | | | |
|-----------------|---|---|-----------------|
| Course Category | Humanities and Social Science | Credits | 2 |
| Course Type | Theory | L-T-P | 2-0-0 |
| Prerequisites | Basic understanding of the language skills viz Listening, Speaking, Reading and Writing, including Sentence construction abilities. | Continuous Eval Semester End Eval Total Marks | 30 70 100 |

COURSE OUTCOMES

1. Develop administrative and professional compilations with felicity of expression.
2. Demonstrate Proficiency in advanced reading and context oriented writing.
3. Apply the elements of functional English with sustained understanding for authentic use of language in any given academic and/or professional environment.
4. Execute tasks in Technical communication with competence.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | | | | | | 2 | | | | 3 | | | | | | | |
| 2 | | | | | | 2 | | | 2 | 3 | | | | | | | |
| 3 | | | | | | 2 | | | 2 | 3 | | | | | | | |
| 4 | | | | | | | | | | 3 | | | | | | | |

COURSE CONTENT

UNIT I

Professional Writing Skills

Professional Letters: Business, Complaint and Transmittal – Purpose, Style and format with special reference to Block Format and Modified Block Format.

Paragraph and Essay Writing: Linkers, Descriptive and Analytical with illustrations.

Effective Writing Practice: Appropriateness. Brevity, clarity, cogency and coherence with guided and semi-controlled compilations including the use of Idiomatic expressions.

UNIT II

Reading comprehension and Discourse development Skills

Analytical and critical reading: Critical, creative and lateral thinking- language and thinking – thinking process and and language development.

Effective reading Strategies: Skimming, Scanning, Eye span, fixation, taming Regression, and Issues and Challenges of Vocalization and sub-vocalization.

Context-oriented Dialogue/ Argument writing: Extending Invitation, Reciprocation, Acceptance, Concurrence, Disagreeing without being disagreeable- Discourse/dialogue Development and identification of inconsistencies in pre-prepared dialogues.

UNIT III

Vocabulary and Functional English

Vocabulary for Competitive examinations: A list of 500 High frequency words Synonyms, Antonyms, Matching Homonyms, Homophones and nearer words along with Root words.

Verbal analogies: Single Unit – Synonym Relation, Antonym relation, Object-Operator relation, Object-Obstacle/obstruction relation, Sequence Relation, Place-Monument Relation, Science- area of activity relation, Profession- Tool relation, Gender relation, Diminutive relation, etc.

Functional Grammar: with special reference to Tense, Concord, Articles, pronoun-referent, Prepositions, use of Gerund, Parallelism, etc. (A Representative collection of 100 sentences).

UNIT IV

Technical Communication skills

Technical Proposal writing: Characteristics, Proposal Superstructure, Checklist, Formal Proposal.

Technical Vocabulary: Basic explanations and Description.

Technical Report writing: Informational Reports and Feasibility Report- Types, Components, Style and Formats.

TEXTBOOKS

1. Martin Cutts, Oxford guide to Plain English, 7th Impression, Oxford University Press, 2011.
2. M. Ashraf Rizvi, Effective Technical Communication, Tata McGraw-Hill, New Delhi, 2005.
3. John Langan, College Writing Skills, McGraw Hill, IX Edition, 2014.
4. Eclectic Learning materials offered by the Department

REFERENCE BOOKS

1. Randolph Quirk, Use of English, Longman, I Edition (1968) Reprinted 2004.

2. Thomson A.J & A.V, Martinet, Practical English Grammar, III Edition, Oxford University Press,2001.
3. V.Sethi and P.V. Dhamija, A Course in Phonetics and Spoken English, II Edition, PHI, 2006.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. <https://www.britishcouncil.org/english>
2. www.natcorp.ox.ac.uk/Wkshops/Materials/specialising.xml?ID=online
https://www.uni-marburg.de/sprachenzentrum/selbstlernzentrum/.../apps_for_sl.pdf

20MC1106 TECHNOLOGY AND SOCIETY

| | | | |
|-----------------|--------------------|-------------------|-------|
| Course Category | Mandatory Course | Credits | – |
| Course Type | Mandatory Learning | L-T-P | 1-0-0 |
| Prerequisites | – | Continuous Eval | 100 |
| | | Semester End Eval | – |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the origins of technology and its role in the history of human progress.
2. Know the Industrial Revolution and its impact on Society.
3. Interpret the developments in various fields of technology till Twentieth Century.
4. Distinguish the impacts of Technology on the Environment and achievements of great scientists.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 3 | | | | | | | 1 | | | | | | | | | |
| 2 | 3 | | | | 2 | | 1 | | | | | | | | | | |
| 3 | 3 | | | | | | | 1 | | | | | | | | | |
| 4 | 3 | | | | 2 | | 1 | | | | | | | | | | |

COURSE CONTENT

UNIT I

Introduction: Origins of technology, The Agriculture revolution, Technological contributions of ancient civilizations- Mesopotamians, Egyptians, Greeks, Romans, Indians and Chinese.

UNIT II

Industrial revolution: The social and political background, The technical background, Steam: The power behind the Industrial Revolution, The revolution in Textile Industry, The Impact of Industrial Revolution on Society.

UNIT III

The Flowering of modern technology: Manufacturing Technologies, Prime Movers, Internal Combustion Engines, Production of Metals and Alloys, The Birth of Electrical Technology, Twentieth Century: The Flowering of modern technology like information technology and biotechnology, and its implications on society.

UNIT IV

Technology, Science and Society: Impact of technology on society, The Impacts of Technology on the environment, Sustainable development.

Achievements of famous scientists: (World): Einestein, Newton, Faraday, Graham Bell, Edison, S.Hawking. (India): CV Raman, S.Chandrasekhar, Aryabhata, Homi J Bhabha, Vikram Sarabhai, APJ Abdulkalam, S.Ramanujan, M.Visweswarayya.

TEXTBOOKS

1. Dr. R.V.G Menon, “Technology and Society”, Pearson Education, 2011.

REFERENCE BOOKS

1. Quan-Haase, A., “ Technology and Society: Inequality, Power, and Social Networks”, Oxford University Press, 2013.

20BS1151A

ENGINEERING PHYSICS LABORATORY

| | | | |
|-----------------|---------------|-------------------|-------|
| Course Category | Basic Science | Credits | 1.5 |
| Course Type | Laboratory | L-T-P | 0-0-3 |
| Prerequisites | – | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Use function generator, spectrometer and travelling microscope in various experiments.
2. Test optical components using principles of interference and diffraction of light.
3. Determine the V-I characteristics of solar cell and photo cell and appreciate the accuracy in measurements.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | | | | 3 | | | | | | | | | | | | | |
| 2 | | | | 3 | | | | | | | | | | | | | |
| 3 | 2 | | | 3 | | | | | | | | | | | | | |

COURSE CONTENT

- Week 1:** Photo cell-Study of V-I Characteristics, determination of work function.
Week 2: Newton's Rings-Radius of curvature of plano convex lens.
Week 3: Compound pendulum-Measurement of 'g'.
Week 4: LCR circuit- Study of Resonance.
Week 5: AC Sonometer –Verification of vibrating laws.
Week 6: Solar cell–Determination of Fill Factor.
Week 7: Diffraction grating-Wavelength of laser light.
Week 8: Optical fiber-Study of attenuation and propagation characteristics.
Week 9: Diffraction grating-Measurement of wavelength of mercury source.
Week 10: Hall effect –Hall coefficient measurement.
Week 11: Figure of merit of a galvanometer.
Week 12: Variation of magnetic field along the axis of current-carrying circular coil.

TEXTBOOKS

1. Madhusudhan Rao, "Engineering Physics Lab Manual", Isted., Scitech Publications, 2015.

2. Ramarao Sri, ChoudaryNityanand and Prasad Daruka, "Lab Manual of Engineering Physics" ., Vth ed., Excell Books, 2010.

E-RESOURCES

1. <http://plato.stanford.edu/entries/physics-experiment>.
2. <http://www.physicsclassroom.com/The-Laboratory>.
3. <http://facstaff.cbu.edu/~jvarrian/physlabs.html>.

VIRTUAL LAB REFERENCES

1. <http://vlab.amrita.edu/?sub=1&brch=201&sim=366&cnt=1>
2. <http://vlab.amrita.edu/?sub=1&brch=195&sim=840&cnt=1>
3. <http://vlab.amrita.edu/?sub=1&brch=282&sim=879&cnt=1>

20ES1152**PROGRAMMING FOR PROBLEM SOLVING LABORATORY**

| | | | |
|-----------------|---------------------|-------------------|-------|
| Course Category | Engineering Science | Credits | 1.5 |
| Course Type | Laboratory | L-T-P | 0-0-3 |
| Prerequisites | – | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Implement the use of programming constructs in a structural programming language.
2. Apply the selections, loops, arrays, and string concepts in C to solve problems.
3. Apply functions, pointer, and Enum concepts in C to solve problems.
4. Solve problems using structures, Unions, and file handling functions.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 1 | | 3 | | | | | | | | | | | | | | |
| 2 | | 1 | 3 | | | | | | | | | | 1 | | | | |
| 3 | | 1 | 3 | | | | | | | | | | 3 | | | | |
| 4 | | 1 | 3 | | | | | | | | | | 3 | | | | |

COURSE CONTENT***Week 1: Introduction to C Programming***

1. The Structure of C Program with a sample program.
2. Use identifiers, data types, format specifiers, constants, and variables declaration and initialization to write simple C programs.
3. Write simple C programs using preprocessor commands and simple I/O statements.

Week 2: Data Types and Variable Declarations

1. Use void, integral and floating point data types in different scenarios to write programs.
2. Use various primitive data types for performing different mathematical operations.
3. Programs to perform mathematical operations using various operators in C.

Week 3: Selection – Making Decisions

1. Write programs using the if...else selection statements.

2. Use nested if...else statement to solve problems that need multi-level selection making decisions.
3. Write programs that use switch...case and else...if multi way statements to select one out of several options.

Week 4: Looping Constructs and Their Applications

1. To have a clear idea on loop initialization, validation and updation.
2. Write programs using the while, for, or do...while loops.
3. To understand the logic and adopt best looping construct for different kinds of problems.
4. Design and develop programs based on Iterative loops using While, Do While, For and Nested For.

Week 5: Unconditional Control Transfer Statements

1. Write programs using of (break, and continue) unconditional control transfer statements.
2. Use the goto statement to transfer the control from one part to another part of a program.
3. Use of return statement to end the execution of a called function.

Week 6: Arrays and Their Applications

1. To utilize one dimensional and multi-dimensional arrays to solve problems that use set(s) of similar type input data.
2. To write programs that perform multiple classical operations like searching, sorting, updation, or deletion on array elements.

Week 7: Strings, String I/O and Manipulation Functions

1. To write programs that work on read, write and manipulate fixed length and variable-length strings and/or arrays of strings
2. To write programs that use predefined string I/O functions.
3. To write programs that use string manipulation functions from the string library.

Week 8: Concepts of User Defined Functions

1. Design and develop programs depending on functions both user defined and standard library functions in C with different approaches.
2. To write a program using more than one function with or without parameters and function return type.

Week 9: Pointers and Their Applications

1. Programs on declaration of pointers and their usage in C.
2. Programs to relate between arrays and pointers and use them efficiently in a program.
3. To pass pointers as an argument to a function, and use it efficiently in a program.
4. To write programs using static and dynamic memory allocation.

Week 10: Structure, Union, and Enumeration

1. Programs to define, declare and access structure and union variables.
2. Design and develop programs to work with pointers to access data within a structure.
3. Programs to pass structure as an argument to a function.
4. To write C programs using enumeration data types, an easiest way of mapping symbolic names to integer values.

Week 11: File Handling Operations

1. Programs to open and close text and binary files using file I/O commands.
2. Write programs to perform read and write operations using the formatting I/O and character I/O functions.
3. Apply file positioning, status and system commands based on a problem requirements. functions

Week 12: Command Line Arguments

1. To use command line arguments to pass inputs in a single line while executing a program through the DOS command prompt or Linux terminal.
2. To use atoi function to convert a default string value argument to an integer value inside the main function in a program.
3. To use atof function to convert a default string value argument to a float value inside the main function in a program.

TEXTBOOKS

1. Behrouz A. Forouzan and Richard F. Gilberg, “Computer Science A Structured Programming Approach Using C”, CENGAGE Learning, Third Edition.

REFERENCE BOOKS

1. Anil B. Chaudhuri, “Flowchart and Algorithm Basics: The Art of Programming”, Mercury Learning Information, 2020.
2. R.G. Dromey, “How to Solve it By Computer”, Prentice-Hall International Series in Computer Science,1982.
3. YashwantKanetkar , “Let us C” , BPB Publications, 16th Edition 2017.
4. Kernighan and Ritchie, “The C programming language”, The (Ansi C Version), PHI, second edition.
5. Paul J. Dietel and Harvey M. Deitel, “C: How to Program”, Prentice Hall, 8th edition (Jan 19, 2021).
6. K.R.Venugopal, Sundeep R. Prasad, “Mastering C”, McGraw Hill, 2nd Edition, 2015.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Computer Science and Engineering - Noc:problem Solving Through Programming in C. [online] <https://nptel.ac.in/courses/106/105/106105171/>

2. Computer Science and Engineering - Noc:introduction To Programming in C. [online] <https://nptel.ac.in/courses/106/104/106104128/>
3. C For Everyone: Structured Programming. [online] <https://www.coursera.org/learn/c-structured-programming>
4. Advanced C Programming CourseTim Academy-Jason Fedin. [online] <https://www.udemy.com/course/advanced-c-programming-course/>

20HS1153

TECHNICAL ENGLISH AND COMMUNICATION SKILLS LABORATORY

| | | | |
|-----------------|--|---|-----------------|
| Course Category | Humanities and Social Science | Credits | 1.5 |
| Course Type | Practical | L-T-P | 0-0-3 |
| Prerequisites | Basic understanding of the language skills viz listening, speaking, reading and Writing, including Sentence construction abilities | Continuous Eval Semester End Eval Total Marks | 30 70 100 |

COURSE OUTCOMES

1. Develop active and authentic listening comprehension skills relevant for the professional world.
2. Execute web related (On-line) communication with felicity of expression.
3. Apply relevant speech patterns including standard pronunciation.
4. Demonstrate Proficiency in Interpersonal Communication with fluency and accuracy.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | | | | | | 3 | | | | 3 | | | | | | | |
| 2 | | | | | | | | | 2 | 3 | | | | | | | |
| 3 | | | | | | | | | | 3 | | | | | | | |
| 4 | | | | | | | | | 2 | 3 | | | | | | | |

COURSE CONTENT

UNIT I

Listening Skills

Exposure to structured and open talks: Active listening, Appreciative listening, Biased listening, Critical listening Empathetic listening, Judgmental listening.

Content-oriented Listening Skills: Short Conversations- 5-10 minutes duration- components, statistics, nominal and other references.

Concept oriented/ purposive Listening skills: Long Conversations- 10-30 minutes duration.

Problems in comprehension & retention: Note-taking practice – Listening tests.

Overcoming Barriers to listening: Physical & psychological – Steps to overcome them with demonstration and practice.

UNIT II

Professional and On-line drafting skills

Professional drafting skills: Circular, Notice, Executive summary.

E-mail etiquette: Awareness with Illustrations and practice.

Elements of Chat-room interaction: Courtesy, techniques of argumentation.

Written Response to web-content: Conciseness with accountability.

Data interpretation: Compiling analytical, comparative and critical observations by interpreting graphs, charts, etc.

UNIT III

Phonetics and Speech patterns

Speech Mechanism: Organs of speech and patterns of articulation of speech sounds

Vowels, Consonants and Diphthongs: Transcription using International Phonetic Alphabet

Word Stress and Rhythm: Practice

Intonation pattern practice: Tones, Tone group boundaries and Tonal variations

Strong forms and weak forms in Connected speech: Illustrations and Practice

UNIT IV

Interpersonal Spoken communication skills

Fluency and accuracy in speech: Improving self-expression

Listener oriented speaking: Interpersonal Conversation- Manner and Temper.

Developing persuasive speaking skills: Role play

Overcoming Barriers to speaking: Building self-confidence– through Conversation practice.

Improving responding capacity: Extempore speech practice.

TEXTBOOKS

1. Garner, Bryan A, HBR Guide to Better Business Writing, Harvard Business Review Press, Boston, Massachusetts, 2013.
2. Exercises in Spoken English, Prepared by Department of Phonetics and Spoken English, CIEFL,(Currently English and Foreign Languages University) OUP, 21st Impression, 2003.

REFERENCE BOOKS

1. Randolph Quirk, Use of English, Longman, I Edition (1968) Reprinted 2004.
2. Thomson A.J & A.V, Martinet, Practical English Grammar, III Edition, Oxford

University Press,2001

3. V.Sethi and P.V. Dhamija, A Course in Phonetics and Spoken English, II Edition, PHI, 2006

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. ODll Language Learner's Software, Orell Techno Systems
2. Visionet Spears Digital Language Lab software Advance Pro
3. www.natcorp.ox.ac.uk, British National Corpus

20ES1154**COMPUTING AND PERIPHERALS LABORATORY**

| | | | |
|-----------------|---------------------|-------------------|-------|
| Course Category | Engineering Science | Credits | 1 |
| Course Type | Laboratory | L-T-P | 0-0-2 |
| Prerequisites | – | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Able to assemble a PC and install operating system and other software.
2. Able to trouble shoot hardware and software issues.
3. Able to configure network settings to connect to internet.
4. Able to create documents, presentations and spread sheets using office productivity tools.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 3 | 3 | | | | | | | | | | | 1 | | | |
| 2 | 3 | 2 | | | | | | | 3 | | | | 1 | | | |
| 3 | 3 | | | 1 | 2 | | | | | | | | 1 | | | |
| 4 | 3 | | | | | | | | | 2 | | | 1 | | | |

COURSE CONTENT**PC Hardware/Software**

Week 1: Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.

Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also, students need to go through the video, which shows the process of assembling a PC. A video would be given as part of the course content.

Week 2: Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.

Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot with both windows and Linux. Lab instructors should verify the installation and follow it up with a Viva.

Week 3: Hardware Troubleshooting: Students have to be given a PC which does not boot due to improper assembly or defective peripherals. They should identify the problem and fix it to get the computer back to working condition. The work done should be verified by the instructor and followed up with a Viva.

Software Troubleshooting: Students have to be given a malfunctioning CPU due to system software problems. They should identify the problem and fix it to get the computer back to working condition. The work done should be verified by the instructor and followed up with a Viva.

Networks, Internet and World Wide Web

Week 4: Types of Network cables, connectors, crimping straight and crossover cables, identification of network devices (Hubs, Switches, Routers).

Week 5: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally, students should demonstrate, to the instructor, how to access the websites and email.

Week 6: Wifi router configuration, connecting to internet, Static/Dynamic IP address configuration, DNS, Gateway, Security configuration.

Productivity tools

Week 7: Word Orientation: The mentor needs to give an overview of Microsoft (MS) office 2007/ equivalent (FOSS) tool word: Importance of MS office 2007/ equivalent (FOSS) tool Word as word Processors, Details of the three tasks and features that would be covered in word – Accessing, overview of components of toolbars, saving files, Using help and resources, rulers, format painter.

Week 8: Latex: Using LaTeX to create project certificate. Features to be covered: Formatting Fonts, Drop Cap, Applying Text effects, Using Character Spacing, Borders and Colours, Inserting Header and Footer, Using Date and Time option in both LaTeX.

Week 9: Creating project abstract Features to be covered: Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

Excel

Week 10: Excel Orientation: The mentor needs to tell the importance of MS office 2007/ equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the two tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources.

Calculating GPA - Features to be covered: Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking,

Count function, LOOKUP/ VLOOKUP, Sorting, Conditional formatting.

Power Point or Equivalent (FOSS) Tool

Week 11: Students will be working on basic power point utilities and tools which help them create basic power point presentation. Topic covered during this week includes: PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in both LaTeX and Power point. Students will be given model power point presentation which needs to be replicated (exactly how it's asked).

Week 12: Concentrating on the in and out of Microsoft power point. Helps them learn best practices in designing and preparing power point presentation. Topics covered during this week includes: - Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide master, notes etc), Inserting – Background, textures, Design Templates, Hidden slides.

REFERENCE BOOKS

1. LaTeX Companion – Leslie Lamport, PHI/Pearson.
2. Introduction to Computers, Peter Norton, 6/e Mc Graw Hill Publishers.
3. Upgrading and Repairing, PC's 18th e, Scott Muller QUE, Pearson Education
4. Comdex Information Technology course tool kit Vikas Gupta, WILEY Dreamtech
5. IT Essentials PC Hardware and Software Companion Guide Third Edition by David Anfinson and Ken Quamme. – CISCO Press, Pearson Education.
6. PC Hardware and A+ Handbook – Kate J. Chase PHI (Microsoft)

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. <https://dscheme.files.wordpress.com/2016/08/workshop-practice-manual-2016-17-1.pdf>
2. <https://www.protosystech.com/rapid-prototyping.html>
3. <https://www.arduino.cc/en/Tutorial/Foundations>
4. <https://www.tutorialspoint.com/arduino/>

SEMESTER II

20BS2101B

PROBABILITY AND STATISTICS FOR MACHINE LEARNING

| | | | |
|-----------------|--------------------------------------|-------------------|-------|
| Course Category | Basic Science | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | Vectors, Integration, Curve Tracing. | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand Probability, random variables and probability distributions.
2. Understand the probability density functions.
3. Analyze random phenomena of sample to test the hypothesis concerning one mean.
4. Analyze random phenomena of sample to test the hypothesis concerning two mean and regression.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 3 | 2 | | | 1 | | | | | | | | | | | 2 | |
| 2 | 3 | 2 | | | 1 | | | | | | | | | | | 2 | |
| 3 | 3 | 2 | | | 1 | | | | | | | | | | | 4 | |
| 4 | 3 | 2 | | | 1 | | | | | | | | | | | 4 | |

COURSE CONTENT

UNIT I

Probability Theory: Sample Spaces and events -Counting – Probability-The Axioms of Probability- Conditional Probability -Bayes' Theorem.

Probability Distributions Random variables –Binomial distribution - Mean and Variance of a Probability Distribution- The Poisson Approximation to the Binomial Distribution-Poisson Processes.

UNIT II

Probability Densities : Continuous random variables – The Normal Distribution – The Normal approximation to the Binomial Distribution .

Other Probability Densities : The Uniform Distribution – The Log Normal Distribution – The Gamma Distribution-The Beta D

UNIT III

Sampling Distributions : Populations and samples-sampling distribution of the mean-SD Known and Un known-the sampling distribution of the variance. **Inferences Concerning Mean** Point Estimation- Interval Estimation-Maximum error of estimate-Tests of Hypothesis – Null Hypothesis and Tests of Hypothesis – Hypothesis concerning one mean distribution – The Weibull distribution.

UNIT IV

Comparing Two treatments : Comparisons Two independent Large samples - Comparisons Two independent small samples – Matched pair of comparisons.

Regression Analysis : The method of least squares - Multiple Regression- Correlation

TEXTBOOKS

1. Probability and Statistics for Engineers Eighth edition by Richard A.Johnson Prentice Hall of India. 8 th edition

REFERENCE BOOKS

1. Applied Statistics and Probability for Engineers by Douglas C.Montgomery and George C.Runger, Wiley Student Edition
2. Probability Statistics for Engineers Scientist by R.E. Walpole, R.H.MyersS.L.Myers, Sixth Edition, Prentice Hall of India / Pearson Education.
3. Probability and Statistics, Purna Chandra Biswal, Pearson Education Prentice Hall of India 2007.
4. Probability and Statistics by T.K.V.Iyengar, B.Krishna Gandhi, S.Ranganatham, M.V.S.S.N.PrasadS.Chand.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. probweb.berkeley.edu/teaching.html
2. statsci.org/teaching.html
3. video.lectures.nptel.iitm.ac.in

20BS2102

ENGINEERING CHEMISTRY

| | | | |
|-----------------|---|-------------------|-------|
| Course Category | Basic Science | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | Chemistry knowledge at Intermediate level | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

- Analyze various water treatment methods and boiler troubles.
- Apply the concept of phase equilibrium to different materials and the knowledge of working of electrodes and batteries in various technological fields.
- Evaluate corrosion processes as well as protection methods.
- Apply the knowledge of conventional fuels and mechanistic aspects of conducting polymers for their effective and efficient utilisation.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | | 3 | | | | | | | | | | | | | | | |
| 2 | 2 | | | | | | | | | | | | | | | | |
| 3 | | | 3 | | | | | | | | | | | | | | |
| 4 | | | | | 2 | | | | | | | | | | | | |

COURSE CONTENT

UNIT I

Water technology-I: WHO standards - Water treatment for drinking purpose - sedimentation, coagulation, filtration, disinfection by chlorination, break point chlorination and its significance - Desalination of brackish water - principle and process of electrodialysis and reverse osmosis, advantages and disadvantages.

Water technology-II: Boiler troubles - scales-formation, disadvantages and internal conditioning methods - phosphate conditioning, calgon conditioning and sodium aluminate, caustic embrittlement- reasons, mechanism and its control, and boiler corrosion – causes and control.

UNIT II

Integral Calculus: Phase rule and applications: Definition and explanation of the terms – phase, component and degree of freedom, phase rule equation, phase equilibria of single component system – water system, two component system – silver-lead

system, applications of phase rule.

Electrochemistry: Construction and working of Calomel electrode, silver-silver chloride electrode, and principle, construction and working of glass electrode, determination of pH using glass electrode. Chemistry of modern batteries - Li/SOCl₂ battery and Li_xC/LiCoO₂ battery – construction, working and advantages. Fuel cells: General working principle of a fuel cell, examples, chemistry of H₂-O₂ fuel cell.

UNIT III

Corrosion principles: Introduction, definition, reason for corrosion, examples – types of electrochemical corrosion - hydrogen evolution and oxygen absorption – corrosion due to dissimilar metals, galvanic series – differential aeration corrosion – pitting corrosion and concept of passivity.

Corrosion control methods: Cathodic protection- principle and types - impressed current method and sacrificial anode method, anodic protection-principle and method, corrosion inhibitors – types and mechanism of inhibition – principle, process and advantages of electroplating and electroless plating.

UNIT IV

Conducting polymers: Definition, examples, classification-intrinsically conducting polymers and extrinsically conducting polymers- mechanism of conduction of undoped polyacetylene, doping of conducting polymers-mechanism of conduction of p-doped and n-doped polyacetylenes – applications of conducting polymers.

Fuel technology: Fuel-definition, calorific value- lower and higher calorific values and numericals on calculation of HCV and LCV relation, analysis of coal – proximate analysis and ultimate analysis, flue gas analysis by Orsat's apparatus, numericals based on calculation of air required for combustion.

TEXTBOOKS

1. Shikha Agarwal, “Engineering Chemistry – Fundamentals and Applications”, Cambridge University Press, New Delhi, 1st edition (2015).

REFERENCE BOOKS

1. Sunita Rattan , “A Textbook of Engineering Chemistry”, S.K. Kataria Sons, New Delhi, First edition 2012.
2. P.C. Jain , “Engineering Chemistry”, Dhanpat Rai Publishing Company (P) Limited, New Delhi, 15th edition.
3. B.S. Bahl, G. D. Tuli and Arun Bahl, “Essentials of Physical Chemistry”, S. Chand and Company Limited, New Delhi.
4. O. G. Palanna, “ Engineering Chemistry”, Tata McGraw Hill Education Pvt. Ltd., New Delhi.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. <http://www.cip.ukcentre.com/steam.htm>

2. <http://corrosion-doctors.org/Modi;es/mod-basics.htm>
3. <http://nopr.niscair.res.in/bitstream/123456789/5475/1/JSIR>
4. https://chem.libretexts.org/Core/Analytical_Chemistry/Electrochemistry/Basics_of_Electrochemist
5. <http://www.filtronics.com/blog/tertiary-treatment/stages-in-typical-municipal-water-treatment/>
6. NPTEL online course, "Corrosion Part-I" offered by MHRD and instructed by Prof. Kallol Mondal of IIT Kanpur

20ES2103C

PROGRAMMING ESSENTIALS IN PYTHON

| | | | |
|-----------------|--|-------------------|-------|
| Course Category | Engineering Science | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20ES1103 - Programming for Problem Solving | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the python syntax and semantics of control flow statements
2. Apply functions, modules and string handling in Python to solve problems
3. Analyze the methods to create and manipulate programs with Python data structures
4. Analyse the concepts of object-oriented approach to solve problems

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 2 | 2 | 1 | | 2 | | | | | | 1 | | 3 | | | |
| 2 | | | 1 | | 2 | | | | | | 1 | | 1 | | | |
| 3 | | 1 | 1 | | 1 | | | | | | 1 | | 2 | | | |
| 4 | | 3 | 2 | | 2 | | | | | | 2 | | 3 | | | |

COURSE CONTENT

UNIT I

Basics of Python Programming : Features, History, future of python, , writing and executing first python program, Literal constants, variables and identifiers, data types, input operation, comments, reserved words, indentation, operators and expressions, expressions, Type conversion.

Decision control statements: Introduction, Selection/conditional branching statements, Basic loop structures/iterative statements, Nested loops, break, continue and pass statements

Strings: Concatenating, appending and multiplying strings, immutability, String formatting operator, built-in string methods and function, slice operation

UNIT II

Lists: Access and update values in lists, nested and cloning lists, basic list operations, List methods, Using lists as Stack and Queues, list comprehensions, looping in lists, functional programming: filter(), map(), reduce() functions. .

Tuple: Creating tuple, utility of tuples, accessing values in a tuple, updating tuple, deleting elements in tuple, basic tuple operations

Sets and Dictionaries: Creating a Set and set operations, Creating a dictionary, accessing values, add, modify, delete, sort items in a dictionary, looping over a dictionary.

Functions and Modules: Introduction, function declaration and definition, function definition, function call, variable scope and lifetime, the return statement, recursive functions, modules, packages in python.

UNIT III

File and Handling: Introduction, Types of files, Opening and Closing of files, Reading and Writing files, file position, renaming and deleting files, Directory Methods.

Error and Exceptional Handling: Introduction to errors and exceptions, handling exceptions, multiple except blocks, multiple exceptions in a single block, except block without exception, the else clause, raising exceptions, built-in and userdefined exceptions, the finally block.

Regular Expression match(), search(), sub(), findall(), finditer() Functions, Flag Option, Meta-Characters in Regular Expression .

Classes and Objects: Introduction, classes and objects, class method and self argument, init() method, class and object variables, del() method, other special methods, public and private data members, private methods, calling a class method from another class method, built-in class attributes, garbage collection, class and static methods.

UNIT IV

Polymorphism: Introduction, implementing operator overloading, reverse adding, overriding getitem() and setitem() methods, overriding the in operator, overriding miscellaneous functions, overriding the call() method.

Inheritance: Introduction, inheriting classes in python, types of inheritance, composition/containership/complex objects, abstract classes and interfaces, Meta class.

Python Packages for Data Exploration: Introduction to numpy for handling arrays, matplotlib: Controlling the line properties of a chart, creating multiple plots, styling your plots, Box plots, Heatmaps, Scatter plots with histograms, Area plots, Bubble charts .

SELF STUDY

String functions: ord(), chr() functions, in and not in operators.

Standard Library modules, Globals(), Locals(), Reload(), date, time, sys

Comparing, iterating string, the String module, Re-raising exception, Assertions in

python

TEXTBOOKS

1. ReemaThareja, “Python ProgrammingUsing Problem Solving Approach”, Oxford University Press, 2019.
2. Mastering Python for Data Science by Samir Madhavan Released August 2015 Publisher(s):Packt Publishing ISBN: 9781784390150

REFERENCE BOOKS

1. Zed Shah, “Learn PythonThe Hard Way”, Third edition, Addison-Wesley, 2013.
2. Charles Severance, ” Python for Informatics- Exploring Information”, 1st edition Shroff Publishers, 2017.
3. John V. Guttag, “Introduction to Computation and Programming Using Python”, The MIT Press, 2013
4. W.Chun , ”Core Python Programming”, 2nd Edition, Prentice Hall, 2006.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Charles Severance: University of Michigan,Python for Everybody [COURSERA]. (05-01-2021), Available: <https://www.coursera.org/>
2. Prof. SudarshanIyengar, IIT Ropar, Prof. Yayati Gupta, IIIT Dharwad, The Joy of Computing Using Python [NPTEL], (05-01-2021), Available:<https://nptel.ac.in/courses/106/106/106106182/#>
3. Prof KannanMoudgalya, Professor, IIT Bombay, Python 3.4.3, [SWAYAM], (05-01-2021), Available: https://onlinecourses.swayam2.ac.in/aic20_sp33/preview
4. Corey Schafer,Python OOP Tutorials Working with Classes, (05-01-2021), Available: Python OOP Tutorials Working with Classes YouTube

20ES2104A

BASICS ELECTRONICS ENGINEERING

| | | | |
|-----------------|---------------------|-------------------|-------|
| Course Category | Engineering Science | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | – | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Comprehend the fundamentals of electronic components, devices, transducers.
2. Understand and apply the principles of digital electronics.
3. Learn the principles of various communication systems.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 3 | 3 | | | 2 | | | | | | | | | | | | |
| 2 | 3 | 3 | | | | | | | | | | | | | | | |
| 3 | 2 | | | | 2 | | | | | | | | | | | | |

COURSE CONTENT

UNIT I

Electronic Components: Passive components - resistors, capacitors and inductors (properties, common types, I-V relationship and uses). Semiconductor Devices: Semiconductor Devices - Overview of Semiconductors - basic principle, operation and characteristics of PN diode, Zener diode, BJT, JFET, optoelectronic devices (LDR, photodiode, phototransistor, solar cell, photo couplers).

UNIT II

Transducers: Transducers - Instrumentation - general aspects, classification of transducers, basic requirements of transducers, passive transducers - strain gauge, thermistor, Hall-Effect transducer, LVDT, and active transducers - piezoelectric and thermocouple -DHT, ULTRASONIC, PIR sensors.

UNIT III

Digital Electronics: Number systems - binary codes - logic gates Boolean algebra, laws and theorems - simplification of Boolean expression - Implementation of Boolean expressions using logic gates – standard forms of Boolean expression.

UNIT IV

Digital Communication: Block diagram of a basic communication system - frequency spectrum - need for modulation, Types of communication-Analog and Digital communication-Advantages and Disadvantages of Digital Communication, Time and frequency domain representation of signals, Sampling theorem, Nyquist rate and Nyquist interval, Pulse code modulation, Line coding-Variou formats, Generation of digital modulation techniques-ASK, FSK, PSK.

TEXTBOOKS

1. Thyagarajan.T, SendurChelvi.K.P, Rangaswamy, “Engineering Basics: Electrical, Electronics and computer Engineering”, T.R, New Age International, Third Edition, 2007. (UNIT- III)
2. Thomas L. Floyd, “Electronic Devices”, Pearson Education, 9thEdition, 2011. (UNIT- III)
3. Dr. Sanjay Sharma, “Communication Systems(Analog Digital)”, S.K.Kataria Sons (KATSON Books), 6th edition, 2014 (UNIT- IV)

REFERENCE BOOKS

1. M. Morris Mano, Michael D. Ciletti, —Digital Design||, 4th edition, Prentice Hall, 2007.
2. S. Salivahanan, N.Suresh Kumar A. Vallavaraj, “Electronic Devices Circuits”, 2nd Edition, Tata McGraw Hill,2008.
3. Simon Haykin. —Communication Systems, 4th edition, 2000, John Wiley and Sons

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. <https://nptel.ac.in/courses/117/103/117103063/>
2. <https://nptel.ac.in/courses/108/105/108105132/>
3. <https://nptel.ac.in/courses/108/102/108102096/>

20ES2105

ENGINEERING GRAPHICS

| | | | |
|-----------------|---------------------|-------------------|-------|
| Course Category | Engineering Science | Credits | 3 |
| Course Type | Theory and Practice | L-T-P | 1-0-4 |
| Prerequisites | Nil | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the Scales and conics.
2. Draw Orthographic projections of points, Lines and Planes.
3. Draw Orthographic projections of Solids and to understand basics of Auto CAD.
4. Understand the sections, Developments of solids and draw isometric views using Auto CAD.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 3 | | 3 | | | | 3 | | | | | | | | | | |
| 2 | 2 | | 3 | | | | 3 | | | | | | | | | | |
| 3 | 2 | | 3 | | | | 3 | | | | | | | | | | |
| 4 | 1 | | 3 | | | | 3 | | | | | | | | | | |

COURSE CONTENT

UNIT I

Introduction to Engineering Drawing: Principles of Engineering Graphics and their Significance.

Scales: Construction of plain and diagonal Scales.

Conic Sections: Construction of ellipse, parabola and hyperbola (Treatment is limited to Eccentricity or General method only).

UNIT II

Orthographic Projections: Principles of Orthographic Projections –Projections of Points, Lines (Treatment is limited to First Angle Projection) and Projections of Plane regular geometric figures (Up to Plane Inclined to both of the Reference planes).

UNIT III

Projections of Solids: Projections of simple solids such as Cubes, Prisms, Pyramids, Cylinders and Cones with varying positions (Limited to Solid Inclined to one of the Reference planes).

Introduction to AutoCAD: Basic introduction and operational instructions of various commands in AutoCAD. (Internal Evaluation only)

UNIT IV

Sections and Development of Surfaces of Right Angular Solids: Sections and sectional views of right angular solids of Prism, Pyramid and Cone, Development of surfaces of Right Regular Solids of Prism, Pyramid and Cone.

Isometric Projections: Conversion of isometric views into Orthographic Projections of simple castings using Auto CAD. (Treatment is limited to simple objects only, Internal Evaluation only).

TEXTBOOKS

1. BasanthAgrawal C M Agrawal, "Engineering Drawing", McGraw Hill Education Private Limited, New Delhi.
2. N.D. Bhatt "Engineering Drawing", Charotar Publishing House, Anand. 53rd Edition – 2019.

REFERENCE BOOKS

1. K. L. Narayana P. Kannaiah, "Text Book on Engineering Drawing", Scitech publications (India) Pvt. Ltd., Chennai, 2nd Edition - fifth reprint 2006
2. K. Venugopal, "Engineering Drawing and Graphics + Auto CAD", New Age International, New Delhi
3. D M Kulkarni, AP Rastogi, AK Sarkar, "Engineering Graphics with Auto CAD", PHI Learning Private Limited, Delhi Edition – 2013

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. <http://www.youtube.com/watch?v=XCWJ XrkWco>.
2. <http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html#isodrawing>.
3. https://onlinecourses.nptel.ac.in/noc20_me79/preview
- 4 <http://nptel.ac.in/courses/112/103/112103019/>

20BS2151B

ENGINEERING CHEMISTRY LABORATORY

| | | | |
|-----------------|---|-------------------|-------|
| Course Category | Basic Science | Credits | 1.5 |
| Course Type | Laboratory | L-T-P | 0-0-3 |
| Prerequisites | Knowledge of chemistry practicals at Intermediate level | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

- Analyze ores, commercial samples, quality parameters of water samples from different sources.
- Perform quantitative analysis using instrumental methods.
- Apply the knowledge of preparation of polymers, separation of ions, mechanism of corrosion and photochemical reactions.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | | 3 | | | | | | | | | | | | | | | |
| 2 | | | | 2 | | | | | | | | | | | | | |
| 3 | 2 | | | | | | | | | | | | | | | | |

COURSE CONTENT

- Task 1:** Determination of MnO₂ in Pyrolusite/ Iron in Haematite ore.
- Task 2:** Determination of total alkalinity of a water sample.
- Task 3:** Determination of purity of a boric acid sample.
- Task 4:** Conductometric analysis of a strong base using a strong acid.
- Task 5:** Determination of total hardness of a water sample.
- Task 6:** Determination of copper in a given sample.
- Task 7:** Chemistry of blueprinting.
- Task 8:** Determination of Mohr's salt - Permanganometry.
- Task 9:** Determination of Mohr's salt - Dichrometry.
- Task 10:** Comparison of corrosion rates of different metals.
- Task 11:** Determination of available chlorine in a bleaching powder sample.
- Task 12:** Determination of chlorides in a water sample.
- Task 13:** pH metric analysis of a strong base using a strong acid.
- Task 14:** Preparation of urea-formaldehyde resin.
- Task 15:** Separation of ions by paper chromatography.

TEXTBOOKS

REFERENCE BOOKS

1. S.K. Bhasin and Sudha Rani, “Laboratory Manual on Engineering Chemistry”, Dhanpat Rai Publishing Company, New Delhi, 2nd edition.
2. Sunitha Rattan, “Experiments in Applied Chemistry”, S.K. Kataria & Sons, New Delhi, 2nd edition.

20ES2152C**PROGRAMMING ESSENTIALS IN PYTHON LABORATORY**

| | | | |
|-----------------|--|-------------------|-------|
| Course Category | Engineering Science | Credits | 1.5 |
| Course Type | Laboratory | L-T-P | 0-0-3 |
| Prerequisites | 20ES1152 - Programming for Problem Solving | Continuous Eval | 30 |
| | Laboratory | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Demonstrate the usage of Python syntax and semantics in solving the problems.
2. Develop python programs using functions and built in modules.
3. Implement Python data structures to solve the complex problems.
4. Apply object oriented concepts to design solution to real world scenarios.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 2 | 2 | 1 | | 2 | | | | | | | | 3 | | | |
| 2 | | | 1 | | 2 | | | | | | | | 1 | 2 | | |
| 3 | | 1 | 1 | | 1 | | | | | | | | 2 | 2 | | |
| 4 | | 2 | 2 | | 2 | | | | | | | | 3 | | | |

COURSE CONTENT

Implement the following programmes using IDE's (pycharm, jupyter notebook, spyder etc.,)

Week 1: Declaration of variables, identifiers and type conversions

1. Write simple programs by defining variables and assigning values of different basic data types.
2. Write programs to know data type of a variable using Type statement.
3. Write programs to do multiple assignments at a time.
4. Write programs for writing multiple statements in a single line.
5. Use Input statement, type conversion.
6. Use different operators in programs.

Week 2: Python programs on Decision Control Statements, Looping Control Structures

1. Write programs using selection statements.

2. Implement programs on and conditional branching statements.
3. Design and develop programs using Iterative statements- while, for , nested loops.
4. Use Break, continue, pass statements in programs.
5. Understand the usage of else statement in loops with a case study.

Week 3 : Solve the problems using Strings

1. Apply string formatting operator
2. Use built-in string methods and functions

Week 4: Programs on the implementation of methods and operations on List and Tuple data structures

1. Define a list and write programs to access and modify elements of a list.
2. Practice basic list operations, methods.
3. Write programs to use list as a stack and queue.

Week 5: Implement programs to solve the problems using Python other data structures: Tuples and Dictionaries

1. Write programs to define a dictionary and write programs to modify values, adding new keys.
2. Apply looping over a dictionary.
3. Use built in dictionary methods, functions.
4. Create a tuple and assign values.
5. Use basic tuple operations and comparisons.

Week 6: Identify the need and importance in the creation of Python Functions and Modules

1. Write programs to defining and calling Functions.
2. Understand Scope of a variable and Use global statement.
3. Differentiate fruitful and void functions through a case study.
4. Apply recursive and Lambda functions .
5. Understand different kinds of arguments through a case study.
6. Installing and usage of standard library modules
7. Use python packages

Week 7: File and Exception Handling

1. Write a simple exception handling program with try- except.
2. Write a program for catching multiple exceptions.
3. Demonstrate raising and re raising exceptions .

Week 8: Regular Expressions

Week 9: Implement the Python classes and objects to address the real world scenarios

1. Define classes and objects using python for the real world scenario.
2. Defining constructors and using Self.

3. Understand public and private members.
4. Practice calling class methods from another class.
5. Write built in functions to check, get, set and delete attributes.

Week 10: Develop the programs to implement Inheritance and Polymorphism.

1. Demonstrate different inheritance types.
2. Apply polymorphism and method overriding.
3. Create abstract classes.
4. Demonstrate the usage of Polymorphism in the overloading of Operators

Week 11: Write the programs on Data Representation and Visualization

TEXTBOOKS

1. ReemaThareja, “Python ProgrammingUsing Problem Solving Approach”, Oxford University Press, 2019.
2. Mastering Python for Data Science by Samir Madhavan Released August 2015 Publisher(s):Packt Publishing ISBN: 9781784390150

REFERENCE BOOKS

1. Zed Shah, “Learn PythonThe Hard Way”, Third edition, Addison-Wesley, 2013.
2. Charles Severance, ” Python for Informatics- Exploring Information”, 1st edition Shroff Publishers, 2017.
3. John V. Guttag, “Introduction to Computation and Programming Using Python”, The MIT Press, 2013
4. W.Chun , ”Core Python Programming”, 2nd Edition, Prentice Hall, 2006.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Charles Severance: University of Michigan,Python for Everybody [COURSERA]. (05-01-2021), Available: <https://www.coursera.org/>
2. Prof. SudarshanIyengar, IIT Ropar, Prof. Yayati Gupta, IIIT Dharwad, The Joy Of Computing Using Python [NPTEL], (05-01-2021), Available:<https://nptel.ac.in/courses/106/106/106106182/#>
3. Prof KannanMoudgalya, Professor, IIT Bombay, Python 3.4.3, [SWAYAM], (05-01-2021), Available: https://onlinecourses.swayam2.ac.in/aic20_sp33/preview
4. Corey Schafer,Python OOP Tutorials Working with Classes, (05-01-2021), Available: Python OOP Tutorials Working with Classes YouTube

20ES2153

ENGINEERING WORKSHOP

| | | | |
|-----------------|---------------------|-------------------|-------|
| Course Category | Engineering Science | Credits | 1.5 |
| Course Type | Laboratory | L-T-P | 0-0-3 |
| Prerequisites | – | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the basic joints using wood and familiarize with various fundamental aspects of house wiring.
2. Prepare basic models using sheet metal and practice joining of metals using arc welding technique.
3. Familiarize with various manufacturing processes such as injection moulding and 3D printing.
4. Understand the preparation of PCB.
5. Understand simple IoT Applications using Arduino.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | | | 2 | | | | | 1 | | | | 3 | 2 | | 1 | | |
| 2 | | | 2 | | | | | 1 | | | | 3 | 2 | 2 | 2 | | |
| 3 | | | 2 | | | | | 1 | | | | 3 | 2 | | 2 | | |
| 4 | | | | | | 1 | | | | | | | | 1 | 1 | | |
| 5 | | | | | | | 2 | | | | | | | 1 | | | |

COURSE CONTENT

PART A

Carpentry

1. Demonstration of Cross half lap and T joints.
2. Demonstration of power tools.

Electrical Wiring

1. Fundamentals of Electric wiring and practice of Series wiring.
2. Practice of stair case wiring and connecting a fluorescent Tube.

Sheet metal and soldering

1. Preparation of complete funnel using sheet metal and practice of soldering.
2. Preparation of a square box using sheet metal and practice of soldering.

Welding

1. Preparation of Corner Joint using arc welding process.
2. Preparation of “T” joint using arc welding process.

Manufacturing processes

1. Preparation of a small plastic part using injection moulding process.
2. Demonstration of manufacturing a simple model using 3D printing process.

Electronic Circuits

To prepare PCB for the given electronic circuit

1. To prepare the layout and printing it on copper clad board.
2. To etch and drill the holes on PCB.

To solder the components on the PCB prepared and test the circuit

1. To identify and solder the components on the PCB prepared.
2. To test the operation of the circuit.

Basic IoT

Demonstration of Arduino board

1. Demonstrate different components and pin configuration of Arduino.
2. To set up Arduino IDE for programming.

To measure Temperature and Humidity

1. Interfacing of temperature and humidity sensor with Arduino.
2. Execute the program on Arduino IDE and display the measured values.

To measure Distance

1. Interfacing of Ultrasonic Sensor with Arduino.
2. Execute the program on Arduino IDE and display the measured value.

PART B

Group Activity: Students must prepare a working model/ assembly using the knowledge gained from the above trades.

TEXTBOOKS

1. Kannaiah P. Narayana K. C., “Manual on Workshop Practice”, Scitech Publications, Chennai, 1999.
2. Venkatachalapathy, V. S., “First year Engineering Workshop Practice”, Ramalinga Publications, Madurai, 1999.

REFERENCE BOOKS

1. Gopal, T.V., Kumar, T., and Murali, G., “A first course on workshop practice – Theory, Practice and Work Book”, Suma Publications, Chennai, 2005

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. <https://dscheme.files.wordpress.com/2016/08/workshop-practice-manual-2016-17-1.pdf>
2. <https://www.protosystech.com/rapid-prototyping.htm>
3. <https://www.arduino.cc/en/Tutorial/Foundations>
4. <https://www.tutorialspoint.com/arduino/>

20MC2106

PROFESSIONAL ETHICS AND PRACTICE

| | | | |
|-----------------|------------------|-------------------|-------|
| Course Category | Mandatory Course | Credits | – |
| Course Type | Theory | L-T-P | 1-0-0 |
| Prerequisites | – | Continuous Eval | 100 |
| | | Semester End Eval | – |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Know the moral autonomy and uses of ethical theories.
2. Understand engineering as experimentation.
3. Understand about safety, risk and professional rights.
4. Know the ethics regarding global issues related to environment, computers and weapon's development. Understand general principles of contracting.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 2 | | | | | | | | | | | | | | | | |
| 2 | | | | | 3 | | | | | | | | | | | | |
| 3 | | | | | 3 | | | | | | | | | | | | |
| 4 | | | | | | | | | | | 2 | | | | | | |

COURSE CONTENT

UNIT I

Engineering Ethics: Senses of 'Engineering Ethics' - variety of moral issues- types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy - Models of Professional Roles -theories about right action - Self-interest - customs and religion- uses of ethical theories.

UNIT II

Engineering as Social Experimentation: Engineering as experimentation – engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study.

UNIT III

Safety, Responsibilities and Rights: Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk – the three mile island and chernobyl case studies. Collegiality and loyalty – respect for authority - - collective bargaining

- confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

UNIT IV

Global Issues: Multinational corporations- Environmental ethics- computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors - moral leadership sample code of Ethics (Specific to a particular Engineering Discipline).

General principles of contracts management: Indian contract act, 1972 and amendments covering general principles of contracting.

TEXTBOOKS

1. Mike Martin and Roland Schinzinger, “Ethics in engineering”, McGraw Hill, New York (1996).
2. Govindarajan M, Natarajan S, Senthil Kumar V. S., “Engineering Ethics”, Prentice Hall of India, New Delhi(2004).

REFERENCE BOOKS

1. Baum, R.J. and Flores, A., “Ethical Problems in Engineering, Center for the studyof the Human Dimensions of Science and Technology”, Rensellae Polytechnic Institute,Troy, New York, 335 pp. eds. (1978)
2. Beabout, G.R., Wennemann, D.J. , “Applied Professional Ethics: A Developmental Approach for Use with Case Studies”, University Press of America Lanham, MD, 175 pp (1994).
3. Dutt (1994) Indian Contract Act, Eastern Law House.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Neeraj Goel IIT Ropar, 18th May 2022, Digital Systems, NPTEL VIDEO, Available: <https://nptel.ac.in/courses/108/106/108106177/>
2. Prof. N.J. Rao, IISc Bangalore, 18th May 2022, Digital systems, NPTELWEB Notes , Available at: <https://nptel.ac.in/courses/106/108/106108099/>

SEMESTER III

20BS3101A DISCRETE MATHEMATICS

| | | | |
|-----------------|-----------------------|-------------------|-------|
| Course Category | Basic Science | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | Set theory, Relations | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

- Analyze of propositional calculus and first order logic.
- Apply the basic and advanced counting techniques.
- Analyze of relations and digraphs and their applications.
- Analyze of graphs and their applications.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|------------------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 3 | 3 | | 1 | | | | | | | | | 1 | | | 4 | 1.2.1, 1.7.1, 2.5.1, 4.6.3, 12.4.2 |
| 2 | 3 | 3 | | 1 | | | | | | | | | 1 | | | 3 | 1.2.1, 2.5.1, 2.5.3, 12.4.2 |
| 3 | 3 | 3 | | 1 | | | | | | | | | 1 | | | 4 | 1.2.1, 2.8.1, 4.4.1, 12.4.2 |
| 4 | 3 | 3 | | 1 | | | | | | | | | 1 | | | 4 | 1.2.1, 2.5.3, 4.4.1, 12.4.2 |

COURSE CONTENT

UNIT I

Propositional Calculus

Fundamentals of Logic: Propositions, Connectives, Propositional functions, Truth Tables, Tautology, Contradiction, Logical equivalences, Normal forms, Logical inferences, Methods of proof of an implication.

First Order Predicate Logic: Predicate, Quantifiers, and Rules of inference for Quantified propositions.

UNIT II

Counting Techniques

Basics of Counting: Sum and product rules, Indirect counting. One to One

Correspondence, Combinations and permutations, Enumerating Combinations and Permutations with and without repetitions.

Advanced Counting Techniques: Sum and product rules, Indirect counting. One to One Correspondence, Combinations and permutations, Enumerating Combinations and Permutations with and without repetitions.

UNIT III

Relations and Digraphs

Relations and basic graphs, Special properties of binary relations, Equivalence relation, Partially ordered sets, Hasse diagrams, Lattices, Operations on relations, Paths and closures, Directed graphs and Adjacency matrices, Transitive closure, Warshall's algorithm.

UNIT IV

Graph Theory

Introduction to graphs, sub graphs, circuits and trees. Sum of degrees theorem, Isomorphism and sub graphs, planar graphs, Euler's formula, Multi graphs and Euler's circuits, Hamiltonian graphs, Grin-berg's theorem, Graph coloring, Chromatic numbers.

TEXTBOOKS

1. Mott, J. L., Kandel, A., & Baker, T. P. (2008). Discrete mathematics for computer scientists & mathematicians (2nd ed.). Prentice-Hall, Inc..

REFERENCE BOOKS

1. Tremblay, J. P., & Manohar, R. (1975). Discrete mathematical structures with applications to computer science. McGraw-Hill, Inc..
2. Rosen, K. H. (2012). Discrete mathematics and its applications (7th ed.). McGraw-Hill, Inc..
3. Malik, D. S., & Sen, M. (2004). Discrete Mathematical Structures: Theory and Application. Course Technology.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Singh, A. (2014, 30 June). Mathematical Logic. NPTEL. <https://nptel.ac.in/courses/111106052>. Last accessed on May 9, 2022.
2. Maity, S. (2020, 13 March). Graph Theory. NPTEL. <https://nptel.ac.in/courses/111106102>. Last accessed on May 9, 2022.
3. Chandran, L. S. (2017, 1 July). Combinatorics. NPTEL. <https://nptel.ac.in/courses/106108051>. Last accessed on May 9, 2022.

20ES3102**DIGITAL LOGIC AND COMPUTER DESIGN**

| | | | |
|-----------------|--------------|-------------------|-------|
| Course Category | Program Core | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | - | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Apply simplification techniques to minimize the Boolean functions.
2. Apply concepts of combinational logic to design MSI and LSI circuits.
3. Apply sequential logic techniques to design Counters and Registers.
4. Understand the organization and design of a basic computer.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|-----------------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 2 | | | | | | | | | | | | | | | 3 | 1.2.1, 1.7.1 |
| 2 | 1 | 2 | 2 | | | | | | | | | | | | | 3 | 1.7.1, 2.7.1, 2.7.2, 3.7.1, 3.8.1 |
| 3 | 1 | 2 | 2 | | | | | | | | | | | | | 3 | 1.7.1, 2.7.1, 2.7.2, 3.7.1, 3.8.1 |
| 4 | | 2 | | | | | | | | | | | | | | 2 | 1.7.1, 2.7.1, 2.7.2, 3.7.1, 3.8.1 |

COURSE CONTENT**UNIT I**

Boolean Functions: Introduction to Boolean Functions, Boolean Functions Simplification - The Map Method, Two and three variable Maps, Four-variable Map, Five variable Map, Product of Sums Simplification, Don't care conditions, The Tabulation Method, Determination of Prime Implicants, Selection of Prime-Implicants.

Combinational Logic: Introduction, Design Procedure, Adders, Subtractors, Code Conversions, Exclusive-or Gates, Parity Generators and Checkers.

UNIT II

Combinational Logic with MSI and LSI: Binary Parallel Adder, Decimal Adder, Magnitude Comparator, Decoders, Demultiplexers, Encoders, Multiplexers.

Programmable Logic: Read only memory (ROM), Programmable Read Only

Memory (PROM), Programmable Logic Array (PLA), Programmable Array Logic (PAL), Introduction to FPGA.

UNIT III

Sequential Logic: Sequential circuits, Classification, Latches, Flip Flops, Triggering of Flip-Flops, Master slave flip-flop, Flip-Flop Excitation tables, flipflop direct inputs. Analysis of Clocked Sequential Circuits, State table, State diagram, state equations, State Reduction and Assignment, Design Procedure, design with unused states.

Registers, Counters: Registers, Shift Registers, Asynchronous Counters, Synchronous Counters, Ring Counter, Johnson Counter, Timing Sequences.

UNIT IV

Register Transfer and Micro-Operations: Register Transfer Language, Register Transfer, Bus and memory Transfers, Arithmetic Micro-operations, Logic Micro-operations, Shift Micro-operations, Arithmetic Logic Shift Unit.

Basic Computer Organization and Design: Instruction codes, Computer Registers, Computer Instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input-Output and Interrupt, Design of Basic Computer, Design of Accumulator Logic.

TEXTBOOKS

1. Mano, M. M. (2016). Digital logic and computer design (1st ed.). Pearson Education India.
2. Mano, M. M. (2007). Computer system architecture (3rd ed.). Pearson Education, Inc..

REFERENCE BOOKS

1. Kumar, A. A. (2013). Switching Theory and Logic Design (2nd ed.). PHI Learning Pvt. Ltd..
2. Mano, A. A., & Ciletti, M. D. (2013). Digital design with an introduction to Verilog HDL (5th ed.). Pearson Education India.
3. Roth Jr, C. H., Kinney, L. L., & John, E. B. (2010). Fundamentals of logic design (6th ed.). Cengage Learning.
4. Stallings, W. (2014). Computer organization and architecture: designing for performance (9th ed.). Pearson Education India.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Goel, N. (2021, 8 June). Digital System Design. NPTEL. <https://nptel.ac.in/courses/108106177>. Last accessed on May 7, 2022.
2. Rao, N. J. (2006, December). Digital Systems. NPTEL. <https://nptel.ac.in/courses/106108099>. Last accessed on May 7, 2022.

20AI&ML3303

ARTIFICIAL INTELLIGENCE

| | | | |
|-----------------|------------------------|-------------------|-------|
| Course Category | Program Core | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20ES2152C: | Continuous Eval | 30 |
| | Programming essentials | Semester End Eval | 70 |
| | in Python Laboratory | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the problem and production system characteristics in Artificial Intelligence.
2. Apply heuristic search techniques to solve AI problems and understand the issues of knowledge representation.
3. Apply knowledge representation and reasoning for real world problems.
4. Apply filler structures for different sentences and know the concepts of connectionist models.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|------------------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 2 | 2 | | | | | | | | | | | | 1 | 2 | 1.2.1, 1.7.1, 2.5.2 |
| 2 | 1 | 2 | 2 | | | | | | | | | | | 1 | 3 | 1.6.1,1.7.1, 2.5.1, 3.5.1 |
| 3 | 1 | 2 | 2 | | | | | | | | | | | 1 | 3 | 1.6.1,1.7.1, 2.5.1, 3.5.1 |
| 4 | 2 | 2 | 2 | | | | | | | | | | | 1 | 3 | 1.6.1,1.7.1, 2.5.1, 2.7.1,3.5.1 |

COURSE CONTENT

UNIT I

Introduction to Artificial Intelligence: The AI Problems, AI Technique, Tic-Tac- Toe, Criteria for Success.

Problems, Problem Spaces And Search: Defining the Problem as a State space Search, Production Systems, Problem Characteristics, Production system characteristics.

UNIT II

Heuristic Search Techniques: Generate-and-test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis.

Knowledge Representation Issues: Representations and Mappings, Approaches to Knowledge Representation, Issues in Knowledge Representation.

UNIT III

Using Predicate Logic: Representing Simple Facts in logic, Representing Instance and Isa Relationships, Computable Functions and Predicates, Resolution.

Representing Knowledge Using Rules: Procedural versus Declarative Knowledge, Logic Programming, Forward versus Backward Reasoning, Matching.

Natural Language Processing: Introduction, syntactic processing.

UNIT IV

Weak Slot-and-Fillers Structures: Semantic Nets, Frames

Strong Slot-and-Fillers Structures: Conceptual Dependency, Scripts..

Connectionist Models: Introduction: Hopfield Networks, Learning in Neural Networks, Applications of Neural Networks.

TEXTBOOKS

1. Elaine Rich, Kevin Knight, & Shivashankar B Nair, “Artificial Intelligence”, McGraw Hill, 3rd ed.,2017

REFERENCE BOOKS

1. S. Russel and P. Norvig, “Artificial Intelligence: A modern Approach”, Prentice Hall, Third edition, 2015
2. Nils J. Nilsson, “Artificial Intelligence: A New Synthesis”, 1st Edition, Morgan-Kaufmann, 1998.
3. R. O. Duda, E. Hart, and D.G. Stork, “Pattern Classification”, Second Edition, John Wiley & Sons, Singapore, 2012.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. An Introduction to Artificial Intelligence By Prof. Mausam—IIT Delhi <https://onlinecourses.nptel.ac.in/nptel/ai/ml/2023/1012023001>
Last accessed on 05-05-2023

20AI&ML3304

JAVA PROGRAMMING

| | | | |
|-----------------|---------------------|-------------------|-------|
| Course Category | Engineering Science | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | – | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the basic concepts of object oriented programming.
2. Apply multiple inheritance through interfaces for a given application.
3. Apply exceptions, thread capabilities and handling files on a given application.
4. Apply functional programming and Collections framework for a given application.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 2 | 3 | | | | | | | | | | | | | | 2 | 1.7.1, 2.5.1, 2.5.2, 2.7.1 |
| 2 | 2 | 2 | 3 | | | | | | | | | | | 2 | 2 | 3 | 1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.7.1, 3.5.1, 3.8.2 |
| 3 | 2 | 2 | 3 | | | | | | | | | | | 2 | 2 | 3 | 1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.6.4, 3.5.1, 3.8.2 |
| 4 | | 2 | 3 | | 2 | | | | | | | | | 2 | 2 | 3 | 2.5.1, 2.5.2, 2.6.3, 2.6.4, 3.5.1, 3.6.2, 3.8.2, 5.4.2 |

COURSE CONTENT

UNIT I

Introduction, History and Evolution of Java: Java history and evolution, Java features, Java's Magic: Byte Code, How Java differs from C and C++.

An Overview of Java: Object Oriented Programming: Two paradigms, Principles of OOP, A First simple Program and Control statements.

Data Types, Variables and Arrays: Java keywords, Primitive types, Integers,

Floating-Point Types, Characters, Booleans, Variables, Operators, Type Conversion, Casting and Arrays.

Introducing Classes and Objects: Class fundamentals, declaring objects, assigning object reference variables, introducing methods, constructors, this keyword, Garbage collection, overloading methods, using objects as parameters, returning objects, static and final keywords, nested and inner classes.

UNIT II

String Handling: The String Constructors, String Buffer Class, String Tokenizer class.

Inheritance: Inheritance basics, using super, multilevel hierarchy, method overriding, dynamic method dispatch, using abstract classes, final with inheritance.

Packages and Interfaces: Defining a package, finding package and CLASSPATH. Access protection, importing packages, Defining an interface, implementing interfaces, nested interfaces, applying interfaces, variables in interfaces.

UNIT III

Exception handling: Exception handling fundamentals, exception types, uncaught exceptions, using try and catch, multiple catch clauses, throw, throws, finally, creating your own exception sub-classes.

I/O streams: Byte Streams- InputStream, OutputStream, FileInputStream, FileOutputStream, Character Streams- Reader, Writer, FileReader, FileWriter.

Multithread Programming: The Java Thread Model, Creating a thread: Implementing Runnable, Extending Thread, creating multiple threads, Thread Priorities, Synchronization: Using Synchronized methods, The synchronized Statement.

UNIT IV

Pragmatic Functional Programming using Lambdas: Introduction to Functional programming, Functional Programming concepts and terminology, Functional Interfaces, Working with Lambda Expressions and Method References.

Collections Framework: Collections overview, Collection interfaces: Collection, List, and Set. Collection Classes: ArrayList, LinkedList, HashSet. Map Classes: Hash-Map, TreeMap

The Stream API: Stream basics, Reduction operations, Using parallel streams, Mapping, Collecting, Iterators and Streams.

TEXTBOOKS

1. Herbert Schildt, "Java The Complete Reference", Eleventh Edition, Oracle Press, . 2019.

REFERENCE BOOKS

1. Herbert Schildt, Dale Skrien, "Java Fundamentals A Comprehension Introduction", Special Indian Edition, McGraw-Hill Education India Pvt. Ltd, 2017.

2. E Balaguruswamy, "Programming with Java", 4th Edition, Mc Graw Hill , 2020.
3. Paul J. Dietel and Dr.Harvey M. Deitel, "Java How to Program", Eleventh Edition, Deitel & Associates, Inc.l , 2018.
4. Timothy Budd, "Understanding Object Oriented Programming with Java ", Updated edition,Pearson Education, 2013.
5. Kathy Sierra & Bert Bates, "Head First Java", 2nd Edition, Oreilly.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Debasis Samanta. (14th,July, 2021), Department of Computer Science &Engineering, I.I.T.,Kharagpur, Swayam, NPTEL. https://onlinecourses.nptel.ac.in/noc21_cs03/preview.
2. Evan Jones, Adam Marcus,Eugene Wu Introduction to Programming in Java; MIT OpenCourseWare, Massachusetts Institute of Technology, May 28, 2021.<https://ocw.mit.edu/courses>
3. Prof. Owen Astrachan, "Object Oriented Programming in Java", Duke University, 21st May 2021. [coursera.org. https://www.coursera.org/specializations/object-oriented-programming](https://www.coursera.org/specializations/object-oriented-programming)
4. Dheeru Mundluru, "Java In-Depth: Become a Complete Java Engineer", Udemy, 14th May 2021. <https://www.udemy.com/course/java-in-depth-become-a-complete-java-engineer/>
5. Prof. Olufisayo Omojokun,"Introduction to Object-Oriented Programming with Java I: Foundations and Syntax Basics", Georgia Institute of Technology, edX, May 2021. <https://www.edx.org/course/introductiontojavaprogrammingfoundations-andsyntaxbasics>

20AI&ML3305

DATA STRUCTURES

| | | | |
|-----------------|--------------|-------------------|-------|
| Course Category | Program Core | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | – | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Apply different approaches to evaluate performance of algorithms, and stack data structure to solve problems.
2. Understand the operations on Queues and linked lists data structures.
3. Apply tree and heap algorithms to solve problems.
4. Apply graph algorithms and hashing techniques to solve problems.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 2 | 2 | | | | | | | | | | | 1 | | 3 | 1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 2.6.4, 2.8.4 |
| 2 | 1 | 1 | 1 | | | | | | | | | | 1 | | 2 | 1.7.1, 2.5.1, 2.5.1 |
| 3 | 1 | 2 | 1 | | | | | | | | | | 1 | | 3 | 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3, 2.8.4 |
| 4 | 1 | 2 | | | | | | | | | | | 1 | | 3 | 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3, 2.8.4 |

COURSE CONTENT

UNIT I

Introduction: Algorithm specification, data abstraction, performance analysis-time complexity, space complexity, asymptotic notations, linear and binary searches complexity analysis. Insertion, Merge sort, Quick sort and their complexity analysis.

Stacks: Definition, representing stacks, ADT stack and its operations: algorithms and their complexity analysis, Applications of stacks: expression conversion and evaluation – corresponding algorithms.

UNIT II

Queues: Queue and its sequential representation, queue as an abstract data type, types of queue: simple queue, circular queue, operations on each types of queues: algorithms.

Linked lists: Representation in memory, singly linked lists: operations and algorithms; linked list representation of stack and queue, doubly linked list: operations and algorithms; circular linked lists: operations their algorithms.

UNIT III

Trees: Tree terminology, representation of trees, binary Tree, complete binary tree, expression trees construction and evaluation; binary tree traversals: inorder, preorder and postorder, binary search trees, operations on binary search trees.

Heap: Min heap and max heap, operations on min Heap and max Heap, Heap sort.

UNIT IV

Graphs: Introduction, graph terminology, representation of graphs, graph traversal algorithms: breadth-first search, depth first search.

Hashing and Collision: Introduction, hash tables, hash functions, different hash functions, collisions: collision resolution by open addressing, collision resolution by chaining, pros and cons of hashing.

TEXTBOOKS

1. Horowitz Sahni and Anderson-Freed “Fundamentals of Data Structures in C”. 2nd Edition, Universities Press, 2008.
2. Reema Thareja, “Data Structures using C”, Second Edition, Oxford University Press, 2011.

REFERENCE BOOKS

1. Richard F. Gilberg & B. A. Forouzan “Data Structures A Pseudocode Approach with C”, Second Edition, CENGAGE Learning.
2. Mark Allen Weiss, “Data structure and Algorithm Analysis in C”. Addison Wesley Publication. 2006.
3. Jean Paul Trembley and Paul G. Sorenson, “An Introduction to Data Structures with Applications”, McGraw Hill, 1984.
4. Thomas Cormen, C.Leiserson, R. L.Rivest & C.Stein, “Introduction to Algorithms”. 3rd Edition, The MIT Press, 2009.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Dr. P. P. Chakraborty, IIT Kharagpur, May 19, 2010, Data Structures, NPTEL, Available: [www.youtube.com/watch v=S47aSEqm_0I](http://www.youtube.com/watch?v=S47aSEqm_0I)
2. Dr. Naveen Garg, IIT Delhi, Sep 24, 2008, Data Strucutres, NPTEL, Available:<http://nptel.iitm.ac.in>, <http://freevideolectures.com/Course/2279/Data-Structures-And-Algorithms>

3. Shai Simonson, Jun 16, 2014, Data Structures, NPTEL, Available: <http://nptel.ac.in/video.php-subjectId=106102064>

20AI&ML3351

ARTIFICIAL INTELLIGENCE LABORATORY

| | | | |
|-----------------|------------------------|-------------------|-------|
| Course Category | Program Core | Credits | 1.5 |
| Course Type | Laboratory | L-T-P | 0-0-3 |
| Prerequisites | 20ES2152C: | Continuous Eval | 30 |
| | Programming essentials | Semester End Eval | 70 |
| | in Python Laboratory | Total Marks | 100 |

COURSE OUTCOMES

1. Apply artificial intelligence techniques to solve problems
2. Apply knowledge representation approaches to solve problems
3. Apply natural language processing on real world scenarios.
4. Apply the concepts of connectionist Models for complex problems.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---------------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 2 | 2 | | | | | | | | | | | 1 | 2 | 3 | 1.2.1, 1.7.1, 2.5.2 |
| 2 | 2 | 2 | 2 | | | | | | | | | | 1 | 2 | 3 | 1.6.1,1.7.1, 2.5.1, 3.5.1 |
| 3 | 2 | 2 | 2 | | | | | | | | | | 1 | 2 | 3 | 1.6.1,1.7.1, 2.5.1, 3.5.1 |
| 4 | 2 | 2 | 2 | | | | | | | | | | 1 | 2 | 3 | 1.6.1,1.7.1, 2.5.1, 2.7.1,3.5.1 |

COURSE CONTENT

Experiments with Standard ICs and FPGA

Task 1: Program to Implement Breadth first search Traversal.

Task 2: Program to Implement Depth first search Traversal.

Task 3: Program to Implement Tic-Tac-Toe game.

Task 4: Program to implement Water jug Problem.

Task 5: Program to implement Monkeys and Bananas problem.

Task 6: Program to implement Hill climbing algorithm.

Task 7: Program to implement Travelling Salesperson problem.

Task 8: Program to represent simple facts in Prolog.

Task 9:

- (a) Program to remove stop words for a given passage from a text file using NLTK.

- (b) Program to implement stemming for a given sentence using NLTK.
- (c) Program to perform POS (Parts of speech) tagging for a given sentence using NLTK.

Task 10: Program to implement a perceptron connectionist model

Project

Program to implement a simple chatbot.

TEXTBOOKS

1. Elaine Rich, Kevin Knight, & Shivashankar B Nair, “Artificial Intelligence”, McGraw Hill, 3rd ed.,2017

REFERENCE BOOKS

1. S. Russel and P. Norvig, “Artificial Intelligence: A modern Approach”, Prentice Hall, Third edition, 2015
2. Nils J. Nilsson, “Artificial Intelligence: A New Synthesis”, 1st Edition, Morgan-Kaufmann, 1998.
3. R. O. Duda, E. Hart, and D.G. Stork, “Pattern Classification”, Second Edition, John Wiley & Sons, Singapore, 2012.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. An Introduction to Artificial Intelligence By Prof. Mausam—IIT Delhi https://onlinecourses.nptel.ac.in/noc22_cs56/preview Last accessed on 05-05-2023

20AI&ML3352

JAVA PROGRAMMING LABORATORY

| | | | |
|-----------------|---------------------|-------------------|-------|
| Course Category | Engineering Science | Credits | 1.5 |
| Course Type | Laboratory | L-T-P | 0-0-3 |
| Prerequisites | – | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Apply the concepts of object oriented programming to solve problems.
2. Apply multiple inheritance through interfaces.
3. Apply exceptions, thread capabilities and handling files.
4. Analyze the use of functional programming and Collections framework.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 2 | 2 | 1 | | 1 | | | | | | | 1 | | 1 | | 3 | 1.7.1, 2.5.1, 2.5.2, 2.7.1, 5.4.1, 5.4.2, 11.4.1 |
| 2 | | 2 | 1 | | 2 | | | | | | | | | 2 | 1 | 3 | 2.5.1, 2.5.2, 2.6.3, 2.7.1, 3.5.1, 3.8.2, 5.4.1, 5.4.2 |
| 3 | | | 2 | | 2 | | | | 1 | | 1 | | | 2 | | 3 | 3.5.1, 3.8.2, 5.4.1, 5.4.2, 9.6.1, 11.4.1 |
| 4 | | | 3 | | 3 | | | | 2 | | 2 | | | 3 | 3 | 4 | 3.8.2, 5.4.1, 5.4.2, 9.6.1, 11.4.1 |

COURSE CONTENT

Task 1: Apply fundamentals of Java data types, variables, operators and control

Task 2: Apply the concepts of Classes and Objects.

Task 3: Apply the concepts of Arrays.

Task 4: Apply the concepts of String and String Tokenizer classes.

Task 5: Apply the concepts of Inheritance and types of Inheritance.

Task 6: Apply the concepts of Method Overloading and Method Overriding.

Task 7: Apply the concepts of Packages.

Task 8: Apply the concepts of Interfaces.

Task 9: Apply the concepts of Exception Handling.

Task 10: Develop a Java application to copy content from one file to another file using I/O Streams.

Task 11: Apply the concepts of Threads and Multithread.

Task 12: Use Collections framework and create a java application.

Project: A group project with unique topics.

TEXTBOOKS

1. Herbert Schildt, “Java The Complete Reference”, Eleventh Edition, Oracle Press, . 2019.

REFERENCE BOOKS

1. Herbert Schildt, Dale Skrien, “Java Fundamentals A Comprehension Introduction”, Special Indian Edition, McGraw-Hill Education India Pvt. Ltd, 2017.
2. E Balaguruswamy, ”Programming with Java”, 4th Edition, Mc Graw Hill , 2020.
3. Paul J. Dietel and Dr.Harvey M. Deitel, “Java How to Program”, Eleventh Edition, Deitel Associates, Inc.l , 2018.
4. Timothy Budd, “Understanding Object Oriented Programming with Java “, Updated edition,Pearson Education, 2013.
5. Kathy Sierra Bert Bates, ”Head First Java”, 2nd Edition, Oreilly.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. DebasisSamanta. (14th,July, 2021), Department of Computer Science & Engineering, I.I.T.,Kharagpur, Swayam, NPTEL. https://onlinecourses.nptel.ac.in/21_cs03/preview.
2. Evan Jones, AdamMarcus,Eugene Wu ”Introduction to Programming in Java”, MIT OpenCourseWare, Massachusetts Institute of Technology, May 28, 2021. <https://ocw.mit.edu/courses>
3. Prof. Owen Astrachan, ”Object Oriented Programming in Java”, Duke University, 21st May 2021. coursera.org <https://www.coursera.org/specializations/object-oriented-programming>
4. DheeruMundluru, ”Java In-Depth: Become a Complete Java Engineer”, Udemy, 14th May 2021. <https://www.udemy.com/course/java-in-depth-become-a-complete-java-engineer/>
5. Prof. OlufisayoOmojokun, ”Introduction to Object-Oriented Programming with Java I: Foundations and Syntax Basics”, Georgia Institute of Technology, edX, May 2021. <https://www.edx.org/course/introduction-to-java-programming-i-foundations-and-syntax-basics> <https://www.edx.org/course/introduction-to-java-programming-i-foundations-and-syntax-basics>

20AI&ML3353

DATA STRUCTURES LABORATORY

| | | | |
|-----------------|--------------|-------------------|-------|
| Course Category | Program Core | Credits | 1.5 |
| Course Type | Laboratory | L-T-P | 0-0-3 |
| Prerequisites | – | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Apply stack and queue data structures to different applications.
2. Understand the operations on queues and linked lists.
3. Understand the operations on binary search tree and heap.
4. Apply different graph traversal algorithms and hashing techniques to solve problems.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 1 | 2 | | | | | | | | | | | | 1 | | 3 | 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3, 2.8.4 |
| 2 | 1 | 2 | | | | | | | | | | | | 1 | | 2 | 1.7.1, 2.5.1, 2.5.2, 2.8.4 |
| 3 | 1 | 2 | | | | | | | | | | | | 1 | | 2 | 1.7.1, 2.5.1, 2.5.2, 2.8.4 |
| 4 | 1 | 2 | | | | | | | | | | | | 1 | | 3 | 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3, 2.8.4 |

COURSE CONTENT

- Task 1:** Searching and sorting techniques: Linear and binary searches.
- Task 2 and 3:** Sorting techniques: Insertion, Merge and Quick sorts.
- Task 3:** Operations on a stack data structure.
- Task 4 and 5** Stack applications (expression conversion and evaluation)
- Task 6:** Operations on queues and circular queues.
- Task 7:** Operations on singly linked list and doubly linked list.
- Task 8:** Operation on circular linked list.
- Task 9:** Binary search tree operations and tree traversal techniques.

Task 10: Operations on heap and heap sort.

Task 11: Graph Traversal algorithms: Depth First Search and Breadth First Search.

Task 12: Hashing: Open and close hashing techniques.

TEXTBOOKS

1. Horowitz Sahni and Anderson-Freed “Fundamentals of Data Structures in C”. 2nd Edition, Universities Press, 2008.
2. Reema Thareja, “Data Structures using C”, Second Edition, Oxford University Press, 2011.

REFERENCE BOOKS

1. Richard F. Gilberg B. A. Forouzan “Data Structures A Pseudocode Approach with C”, Second Edition, CENGAGE Learning.
2. Mark Allen Weiss,”Data structure and Algorithm Analysis in C”. Addison Wesley Publication. 2006.
3. Jean Paul Trembley and Paul G. Sorenson, “An Introduction to Data Structures with Applications”, McGraw Hill, 1984.
4. Thomas Cormen, C.Leiserson, R. L.Rivest & C.Stein, “Introduction to Algorithms”. 3rd Edition, The MIT Press, 2009.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Dr. P. P. Chakraborty, IIT Kharagpur, May 19, 2010, Data Structures, NPTEL, Available: www.youtube.com/watch?v=S47aSEqm_0I. Last accessed on 19 May 2022.
2. Dr. Naveen Garg, IIT Delhi, Sep 24, 2008, Data Structures, NPTEL, Available: <https://nptel.ac.in/courses/106102064>. Last accessed on 19 May 2022.
3. Shai Simonson, Jun 16, 2014, Data Structures, NPTEL, Available: <http://nptel.ac.in/video.php?-subjectId=106102064>. Last accessed on 19 May 2022.

20TP3106

LOGIC AND REASONING

| | | | |
|-----------------|-------------------|-------------------|-------|
| Course Category | Soft Skills - 1 | Credits | 1 |
| Course Type | Learning by Doing | L-T-P | 0-0-2 |
| Prerequisites | – | Continuous Eval | 100 |
| | | Semester End Eval | 00 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Think reason logically in any critical situation.
2. Analyze given information to find correct solution.
3. To reduce the mistakes in day to day activities in practical life.
4. Develop time-management skills by approaching different shortcut methods.
5. Use mathematical based reasoning to make decisions.
6. Apply logical thinking to solve problems and puzzles in qualifying exams in any competitive exam.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 3 | 3 | | | | | | | | | | | | | | | |
| 2 | 3 | 3 | | | | | | | | | | | | | | | |
| 3 | 3 | 3 | | | 1 | | | | | | | | | | | | |
| 4 | 3 | 3 | | 2 | | | | | | | | | | | | | |
| 5 | 3 | 2 | | | | | | | | | | | | | | | |
| 6 | 3 | 3 | | | | | | | | | | | | | | | |

COURSE CONTENT

UNIT I

Series completion, coding-decoding, blood relations, puzzles test

UNIT II

Direction sense test, logical Venn diagrams, number test, ranking test, mathematical operations

UNIT III

Arithmetical reasoning, inserting missing character, syllogism

UNIT IV

Water images, mirror images, paper folding, paper cutting, Embedded figures, dot situation, cubes & dice

TEXTBOOKS

1. R. S. Aggarwal, “ Verbal and non-verbal reasoning”, Revised Edition, S Chand publication, 2017 ISBN:81-219-0551-6

20MC3107A ENVIRONMENTAL STUDIES

| | | | |
|-----------------|------------------|-------------------|-------|
| Course Category | Mandatory Course | Credits | - |
| Course Type | Theory | L-T-P | 2-0-0 |
| Prerequisites | - | Continuous Eval | 100 |
| | | Semester End Eval | 00 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Identify various factors causing degradation of natural resource and control measures.
2. Identify various ecosystem and need for biodiversity.
3. Realize and explore the problems related to environmental pollution and its management.
4. Apply the information and technology to analyze social issues, use acts associated with environment.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 1 | | | | | | | 1 | | | | | 1 | | | |
| 2 | | 1 | 1 | | | | | | | 1 | | | 1 | | | |
| 3 | | | | 1 | 1 | | | | | | | | 1 | | | |
| 4 | | | | | | 1 | 1 | 1 | | | | | 1 | | | |

COURSE CONTENT

UNIT I

The Multidisciplinary Nature of Environmental Studies Definition, scope and importance, need for public awareness.

Natural resources: Renewable and Non-renewable Resources: Natural resources and associated problems.

Forest resources: Use and over-exploitation, deforestation. Timber extraction, mining, dams and their effects on forests and tribal people.

Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.

Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging,

salinity.

Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.

Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT II

Concept of an ecosystem: Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Biodiversity and Its Conservation: Introduction, definition: genetic, species and ecosystem diversity. Bio-geographically classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

UNIT III

Environmental Pollution: Definition, Causes, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, and nuclear hazards.

Solid waste management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.

Disaster management: Floods, earthquake, cyclone and landslides.

UNIT IV

Social Issues and the Environment: From unsustainable to sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns.

Environmental ethics Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, wasteland reclamation, consumerism and waste products.

Environment Protection Act: Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation.

Public awareness: Human population and the environment, population growth, variation among nations, population explosion—family welfare program.

Environment and human health: Human rights, value education, HIV/ AIDS,

women and child welfare, role of Information Technology in environment and human health.

Field Work/ Case Studies: Visit to a local area to document environmental assets — river/ forest/ grassland/ hill/ mountain. Visit to a local polluted site — Urban/ Rural/ Industrial/ Agricultural. Study of common plants, insects, birds. Study of simple ecosystems — pond, river, hill slopes, etc.

Self Study

Water resources, Threats to biodiversity, Solid waste management, role of Information Technology in environment and human health.

TEXTBOOKS

1. Erach Bharucha. 2004, Environmental Studies for undergraduate courses, University Grants Commission, New Delhi, Bharati Vidyapeeth Institute of Environment Education and Research.

REFERENCE BOOKS

1. Anjaneyulu Y. Introduction to Environmental sciences, B S Publications PVT Ltd, Hyderabad
2. Anjireddy.M Environmental science Technology, BS Publications PVT Ltd, Hyderabad
3. Benny Joseph, 2005, Environmental Studies, The Tata McGraw- Hill publishing company limited, New Delhi.
4. Principles of Environmental Science. & Engg. P.Venu Gopala Rao, 2006, Prentice-Hall of India Pvt. Ltd., New Delhi.
5. Ecological and Environmental Studies – Santosh Kumar Garg, Rajeswari Garg (or) Rajani Garg, 2006, Khanna Publishers, New Delhi.
6. Essentials of Environmental Studies, Kurian Joseph & R Nagendran, Pearson Education publishers, 2005
7. A.K Dee – Environmental Chemistry, New Age India Publications
8. Bharucha Erach- Biodiversity of India, Mapin Publishing Pvt.Ltd.

E-RESOURCES AND OTHER DIGITAL MATERIAL

1. Erach Bharucha. 2004, Environmental Studies for undergraduate courses, University Grants Commission, New Delhi, Bharati Vidyapeeth Institute of Environment Education and Research. <https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf>
2. NPTEL Courses - Environmental Studies By Dr.Tushar Banerjee—Devi Ahilya Vaiswavidyalaya, Indore.

SEMESTER IV

20BS4101G

LINEAR ALGEBRA

| | | | |
|-----------------|---------------|-------------------|-------|
| Course Category | Basic Science | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | – | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Examine probability distributions with random variables.
2. Apply random phenomena of sample to test the Hypothesis concerning means.
3. Analyze the Hypothesis concerning variance and proportions.
4. Apply Quality improvement, control charts and reliability to improve Statistical skills.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | |

COURSE CONTENT

UNIT I

Introduction to Vectors: Vectors and Linear Combinations, Lengths and Dot Products, Cross Products, Matrices.

Solving Linear Equations: Vectors and Linear Equations, The Idea of Elimination, Elimination Using Matrices, Rules for Matrix operations, Inverse Matrices, Elimination = Factorization: $A = LU$, Transposes and Permutations.

UNIT II

Vector Spaces and Subspaces:

Spaces of Vectors, the null space of A : Solving $Ax = 0$ and $Rx = 0$, The Complete Solution to $Ax = b$. Independence, Basis and Dimension, Dimensions of the Four Subspaces. **Orthogonality:**

Orthogonality of the Four Subspaces, Projections; Least Squares Approximations; Orthonormal Bases and Gram-Schmidt.

UNIT III

Determinants The Properties of Determinants, Permutations and Cofactors, Cramer's Rule, Inverses, and Volumes, **Eigenvalues and Eigenvectors:** Introduction to Eigenvalues, Diagonalizing a Matrix, Systems of Differential Equations, Symmetric Matrices, Positive Definite Matrices

UNIT IV

The Singular Value Decomposition (SVD): Bases and Matrices in the SVD, Principal Component Analysis (PCA by the SVD) The Geometry of the SVD. **Linear Transformations:**

The Idea of a Linear Transformation, The Matrix of a Linear Transformation, The Search for a Good Basis.

TEXTBOOKS

1. Gilbert Strang: Introduction to Linear Algebra, Wellesley- Cambridge Press, Fifth Edition, 2016.

REFERENCE BOOKS

1. Jin Ho Kwak and Sungpyo Hong, Linear Algebra, Springer, Second edition, 2004.
2. V. Krishnamoorthy et. al., An introduction to linear algebra, Affiliated East West Press, New Delhi.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Linear algebra, Dr K Siva Kumar, IIT Madras, last accessed on 12.12.2023, <https://archive.nptel.ac.in/courses/111/106/111106135/>

20AI&ML4302

DESIGN AND ANALYSIS OF ALGORITHMS

| | | | |
|-----------------|------------------------------|-------------------|-------|
| Course Category | Program Core | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20AIML3305 - Data Structures | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand different types of algorithms, asymptotic notations, and performance analysis techniques.
2. Apply the algorithm design technique – string matching, divide and conquer, and greedy methods for solving different problems.
3. Apply dynamic programming, backtracking and branch and bound techniques to solve different problems.
4. Understand P, NP, NP-Hard, and NP-Complete problems.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 2 | 2 | | | | | | | | | | | | 2 | | 2 | 1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 2.6.4 |
| 2 | 2 | 2 | | | | | | | | | | | | 2 | | 3 | 1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3, 2.8.4 |
| 3 | 2 | 2 | | | | | | | | | | | | 2 | | 3 | 1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3, 2.8.4 |
| 4 | 2 | 1 | | | | | | | | | | | | 1 | | 2 | 1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3 |

COURSE CONTENT

UNIT I

Introduction: Algorithms, algorithms as a technology, recursive and randomized algorithms, growth of functions (Asymptotic notations), recurrences, Solution of Recurrences by substitution, recursion tree method, Master Theorem. Time complexity analysis of Merge and Quick sort. String Matching: Naive string-matching algorithm, Rabin-Karp algorithm

UNIT II

Divide and conquer: General method, Finding the maximum and minimum, Strassen's matrix multiplication. Greedy method: General method, Job sequencing with deadlines, knapsack problem, Huffman codes, Minimum cost spanning tree: Prims and Kruskal's algorithm, shortest path algorithms: Dijkstra

UNIT III

Dynamic Programming: General method, Matrix chain multiplication, longest common subsequence, optimal binary search trees, 0/1 knapsack problem, Traveling salesperson problem. Backtracking: General method, n-queen problem, sum of subsets problem, graph coloring, Hamiltonian cycles, 0/1 knapsack problem.

UNIT IV

Branch and Bound: General method, applications - Traveling salesperson problem, 0/1 knapsack problem: LC branch and bound solution, FIFO branch and bound solution. NP-Hard and NP-Complete problems: Basic concepts, non-deterministic algorithms, P, NP, NP Hard and NP Complete problems with examples, Cook's theorem.

TEXTBOOKS

1. Ellis Horowitz, SatrajSahni and Rajasekharan, "Fundamentals of Computer Algorithms", Galgotia Publications Pvt. Ltd, 2008.
2. T.H.Cormen,C.E.Leiserson, R.L.Rivest and C.Stein, "Introduction to Algorithms", 2/e, PHI Pvt. Ltd., Pearson Education, 2009.

REFERENCE BOOKS

1. Allen Weiss, "Data structures and Algorithm Analysis in C++", Third Edition, Pearson Education, 2007.
2. M.T.Goodrich and R.Tomassia, "Algorithm Design: Foundations, Analysis and Internet examples", John Wiley and sons, 2006.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. N. Garg, IIT Delhi, Dec 31, 2009, Data Structures and Algorithms, NPTEL, Available: <http://nptel.ac.in/courses/106102064/25>.
2. A. G. Ranade, S. Viswanathan, and A. A. Diwan, IIT Bombay, Dec 31, 2009, Design and Analysis of Algorithms, NPTEL, Available: [https://nptel.ac.in/courses/106/101/106101060/\(lastaccessedon12-12-2022\)](https://nptel.ac.in/courses/106/101/106101060/(lastaccessedon12-12-2022))
3. E. Demaine, S. Devadas, and N. Lynch, MIT, Design and Analysis of Algorithms, MIT OpenCourseWare, Available: (last accessed on 12-12-2022) <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-046j-design-and-analysis-of-algorithms-spring-201>

5/(lastaccessedon12-12-2022)

4. Timroughgarden.org.Tim Roughgarden's Online Courses. Available : <http://timroughgarden.-org/videos.html>. (lastaccessedon12-12-2022)

20AI&ML4303

ADVANCED JAVA PROGRAMMING

| | | | |
|-----------------|-------------------------------|-------------------|-------|
| Course Category | Program Core | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20AI&ML3304- Java Programming | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the basics of HTML and XML.
2. Apply the concepts of Java Servlets for developing Dynamic Web Pages.
3. Apply the concepts of Java Server Pages to build a Web Application.
4. Apply Object relational Mapping Technology and basic Spring Concepts

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|----------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 1 | 2 | 3 | | | | | | | | | | 1 | 1 | 2 | 1.7.1, 2.7.1 3.8.2, 3.8.3 |
| 2 | 1 | | 2 | | 3 | | | | | | | | 2 | 1 | 3 | 1.7.1, 3.5.6, 3.8.2, 5.4.2 |
| 3 | 1 | | 2 | | 3 | | | | | | | | 2 | 1 | 3 | 1.7.1, 3.5.6, 3.8.2, 5.4.2 |
| 4 | 1 | | 2 | | 3 | | | | | | | | 2 | 2 | 3 | 1.7.1, 3.5.6, 3.8.2, 5.4.2 |

COURSE CONTENT

UNIT I

HTML – Basic concepts of HTML, The Skeleton of a Web Page, Creating a Form, Tables. XML – Use of XML, The XML Flow, XML Parsers, Browsers and XML, The Design of an XML Document, Nesting Elements, Processing Instructions, Attributes, Create a DTD, Create an XML Schema, Referencing an XML Schema, Create an XSLT.

UNIT II

Java Servlets, Web Applications, Servlets and HTTP Servlets, Filters, Security, Internationalization, Servlet Life Cycle, Servlets for the World Wide Web – Requests, Responses, and Headers, GET and POST, HTTP Response

Codes, Coding a HttpServlet – Deploying a Servlet, Web Application Deployment Descriptor Structure, Servlet Configuration – Limitations of Configuration:web.xml Additions, Client/Server Servlet Programming, HttpServletRequest and HttpServletResponse, HttpServletRequest, Servlet Context – Initial Web Application Parameters, Servlet Event Listeners.

UNIT III

JSP 2.0 Specification– JSP, Java Beans, Custom Tags and JSP Fragments, Expression Language. JSP Lifecycle, Difference between Servlets and JSP, JSP Syntax and Semantics– Elements and Template Data, Two types of Syntax, Scripting Elements, Directives, JSP Configuration, Standard JSP Actions, White Space Preservation, Attributes, Comments, Quoting and Escape Characters, Implicit Objects – pageContext, out, config, page, JSP in XML Syntax – XML Rules, JSP Documents. JavaBeans and JSP Expression Language, JSTL Expression Language, Core Tags– General Purpose Tags, Iteration, Conditionals, URL Manipulation.

UNIT IV

Hibernate: An overview of Object-Relational Mapping (ORM) – Relationships and Cardinality, Object Identity, Cascade, Mapping, In-Memory versus Persisted Objects, Design of Database – Denormalization, Naming Convention, Database Design Disclaimers, DDL Script, HSQLDB, Working with Hibernate. Spring Framework: Overview of Spring – Spring Packing for Development and Deployment, Overview of the Spring Modules, Benefits of using Spring, Fundamental Spring Concepts. Spring Web MVC Framework – Benefits, Spring Web MVC Concepts, Spring Setup, Developing User Interfaces with Spring.

TEXTBOOKS

1. Jim Keogh, “J2EE: The Complete Reference”, McGraw Hill, 2002. (Unit I)
2. Jayson, Falkner, and Jones Kevin. ”Servlets and Java Server Pages: The J2EE Technology Web Tier.”, Addison-Wesley, 2004. (Unit II, III)
3. Hemrajani, Anil. Agile Java Development with Spring, Hibernate and Eclipse. Sams publishing, 2006. (Unit IV)

REFERENCE BOOKS

1. Hans Bergsten, “JavaServer Pages”, 3rd Edition, O’Reilly Media, Inc., 2003.
2. Christian Bauer, Gavin King, “Hibernate in Action”, Manning Publications, 2005.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Java EE: Servlets and JavaServer Pages (JSP) <https://www.linkedin.com/learning/java-ee-servlets-and-javaserver-pages-jspLastaccessedon01-12-2022>

2. Building Cloud Services with the Java Spring Framework <https://in.coursera.org/learn/cloud-services-java-spring-framework> Last accessed on 01-12-2022

20AI&ML4304

COMPUTER NETWORKS

| | | | |
|-----------------|-----------------|-------------------|-------|
| Course Category | Program Core | Credits | 3 |
| Course Type | Theory | L-T-P | 2-0-2 |
| Prerequisites | 20AI&ML3305 | Continuous Eval | 30 |
| | Data Structures | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand fundamentals of concepts of computer networks and reference models.
2. Analyze error and flow control mechanisms in data link layer.
3. Analyze subnetting and various routing protocols of network layer.
4. Analyze transport layer and application layer protocols for specific applications.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 3 | 2 | | | | | | | | | | | 2 | | 2 | 1.7.1, 2.6.4 |
| 2 | 3 | 2 | | | | | | | | | | | 2 | | 4 | 1.7.1, 2.5.2, 2.6.2 |
| 3 | 3 | 2 | | | | | | | | | | | 2 | | 4 | 1.7.1, 2.5.2, 2.6.4 |
| 4 | 3 | 2 | | | | | | | | | | | 2 | | 4 | 1.7.1, 2.6.3 |

COURSE CONTENT

UNIT I

Introduction: Uses of Computer Networks, Network Topology, Network Hardware: LANs, MANs, WANs, Connection oriented vs Connection less.

Reference Models: The OSI Reference Model, TCP/IP Reference Model, the comparison of the OSI and TCP/IP reference models.

Physical Layer: Guided transmission media: Magnetic Media, Twisted Pair, Coaxial Cable, and Fiber Optics, Wireless Transmission: Radio transmission, Infrared and Light Transmission.

UNIT II

Data Link Layer: Design issues - Framing, Error Detection and Correction Hamming Code , CRC, Checksum, Sliding Window Protocols – One bit sliding window, GoBack – N, Selective Repeat.

Medium Access Control Sub layer: Multiple access protocols- Aloha - Slotted Aloha - CSMA, CSMA/CD, Collision Free Protocols, Ethernet: Architecture, Frame Formats – DIX, IEEE 802.3, Wireless LAN: Architecture and Protocol stack, IEEE 802.11 format.

UNIT III

Network Layer: Design Issues: Store and forward, Services to transport layer, Implementation of connection less and connection oriented, VC and Datagram Networks.

Routing Algorithms: Shortest Path, Flooding, DVR, and Link State routing algorithm, Congestion Control Algorithms. IPv4 Protocol, IP address- Classful Addressing – Classless Addressing – Network Address Translation, IPv6-Header, Extension Header

UNIT IV

Transport Layer: UDP Header, TCP Header, Connection establishment, Connection Release, Connection Management, Congestion Control.

Application Layer: The Domain Name System (DNS), and E-Mail - Architecture, Message Format – RFC 5322, MIME, SMTP.

TEXTBOOKS

1. Andrew S Tanenbaum, David J Wetherall “Computer Networks”, 5th edition, Pearson Education.

REFERENCE BOOKS

1. Behrouz A.Fourozan, “Data Communications and Networking”. 4 ed, TATA McGraw Hill.
2. Computer Networking: A Top-Down Approach Featuring the Internet, J.F. Kurose and K.W.Ross, 6th Ed., Pearson Education, 2012

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof Sowmya Kanti Ghosh, IIT Kharagpur, NPTEL Lectures, 18th April 2018, Video Lectures, Available: <https://nptel.ac.in/courses/106/105/106105183/>
2. MIT Open Courseware, MIT, , 14th May 2015, Video Lectures, Available: <http://ocw.mit.edu/courses/electricalengineering-and-computer-science/6-033-computer-systemengineering-spring-2009/video-lectures/>
3. Dheeraj, IIT Kharagpur, 14th May 2015, Lecture Notes, Available: <http://www.cse.iitk.ac.in/users/dheeraj/cs425>

20HS4105

UNIVERSAL HUMAN VALUES – II : UNDERSTANDING HARMONY

| | | | |
|-----------------|--|-------------------|-------|
| Course Category | Humanities and Social Sciences | Credits | 3 |
| Course Type | Mandatory Course (Suggested by AICTE) | L-T-P | 3-0-0 |
| Prerequisites | Universal Human Values - I | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand and aware of themselves and their surroundings (family, society and nature).
2. Handle problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. Exhibit critical ability and become sensitive to their commitment towards their understanding of human values, human relationship and human society.
4. Apply what they have learnt to their own self in different day-to-day settings in real life.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | | | | | | 1 | | | 2 | | | | | | | | |
| 2 | | | 3 | | | | | | | | | | | | | | |
| 3 | | | | | | 2 | | | | | | | | | | | |
| 4 | | | | | | | | | | | | 2 | | | | | |

COURSE CONTENT

UNIT I

Course introduction, need, basic guidelines, content and process for value education

Part-1: Purpose and motivation for the course, recapitulation from UHV-I, Self exploration: what is it?, its content and process, ‘Natural acceptance’ and experiential validation - as the process for self-exploration. Continuous Happiness and Prosperity – A look at basic Human Aspirations.

Part-2: Right understanding, Relationship and Physical Facility – the basic requirements for fulfillment of aspirations of every human being with their

correct priority, Understanding Happiness and Prosperity correctly – A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

(Practice sessions are to be included to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking).

UNIT II

Understanding Harmony in the Human Being – Harmony in Myself

Part-1: Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’. Understanding the needs of Self (‘I’) and ‘Body’ – happiness and physical facility, Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer).

Part-2: Understanding the characteristics and activities of ‘I’ and harmony in ‘I’. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health.

(Practice sessions are to be included to discuss the role others have played in making material goods available to me. Identifying from one’s own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs. dealing with disease).

UNIT III

Understanding Harmony in the Family and Society – Harmony in Human -Human Relationship

Part-1: Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.

Part-2: Understanding the harmony in the society (society being an extension of family); Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society–Undivided Society, Universal Order–from family to world family.

(Practice sessions are to be included to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education, etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students’ lives).

UNIT IV

Part-1: Understanding Harmony in Nature & Existence – Whole existence as Coexistence

Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of Nature – recyclability and self regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

Part-2: Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values, Definitiveness of ethical human conduct, Basis for humanistic education, humanistic constitution and humanistic universal order, Competence in professional ethics: a) ability to utilize the professional competence for augmenting universal human order, b) ability to identify the scope and characteristics of people-friendly and ecofriendly production systems, c) ability to identify and develop appropriate technologies and management patterns for above production systems, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) at the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) at the level of society: as mutually enriching institutions and organizations.

Part-1: Practice sessions are to be included to discuss human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology, etc.

Part-2: Practice exercises and case studies are to be taken up in practice (tutorial) sessions eg. to discuss the conduct as an engineer or scientist, etc.)

TEXTBOOKS

1. Human values and professional ethics, R. R. Gaur, R. Sangal and G. P. Bagaria, Excel Books Private Limited, New Delhi (2010).

REFERENCE BOOKS

1. Jeevan Vidya: Ek Parichaya, A. Nagaraj, Jeevan Vidya Prakashan, Amarkantak (1999).
2. Human Values, A. N. Tripathi, New Age International Publishers, New Delhi (2004).
3. The Story of Stuff: The impact of overconsumption on the planet, our communities, and our health and how we can make it better, Annie Leonard, Free Press, New York (2010).
4. The story of my experiments with truth: Mahatma Gandhi Autobiography, Mohandas Karamchand Gandhi, B. N. Publishing (2008).
5. Small is beautiful: A study of economics as if people mattered, E. F. Schumacher, Vintage Books, London (1993).
6. Slow is beautiful: New Visions of Community, Cecile Andrews, New Society Publishers, Canada (2006).
7. Economy of Permanence, J. C. Kumarappa, Sarva-Seva-Sangh Prakashan, Varanasi (2017).

8. Bharat Mein Angreji Raj, Pandit Sunderlal, Prabhath Prakashan, Delhi (2018).
9. Rediscovering India, Dharampal, Society for Integrated Development of Himalayas (2003).
10. Hind Swaraj or Indian Home Rule, M. K. Gandhi, Navajivan Publishing House, Ahmedabad (1909).
11. India Wins Freedom: The Complete Version, Maulana Abul Kalam Azad, Orient Blackswan (1988).
12. The Life of Vivekananda and the Universal gospel, Romain Rolland, Advaita Ashrama, India (2010).
13. Mahatma Gandhi: The Man who become one with the Universal Being, Romain Rolland, Srishti Publishers Distributors, New Delhi (2002).

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. AICTE – SIP Youtube Channel: https://www.youtube.com/channel/UCo8MpJB_aaVwB4LWLx6AhQ
2. AICTE – UHV Teaching Learning Material: <https://fdp-si.aicte-india.org/download.php#1>

20AI&ML4309 OPERATING SYSTEMS

| | | | |
|-----------------|------------------------------|-------------------|-------|
| Course Category | Program Core | Credits | 2 |
| Course Type | Theory | L-T-P | 2-0-0 |
| Prerequisites | 20AI&ML3305- Data Structures | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the basic components of an Operating System.
2. Apply CPU Scheduling and disk scheduling algorithms to achieve specific criteria.
3. Analyze the mechanisms used for process synchronization and handling deadlocks.
4. Analyze virtual memory techniques Secondary storage management techniques.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 3 | | | | | | | | | | | | 2 | | 2 | 1.7.1 |
| 2 | 3 | 3 | 1 | | | | | | | | | | 2 | | 3 | 1.7.1, 2.6.3, 2.6.4, 2.8.3, 2.8.4 |
| 3 | 3 | 2 | 1 | | | | | | | | | | 2 | | 4 | 1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1 |
| 4 | 3 | 3 | 2 | | | | | | | | | | 2 | | 4 | 1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1 |

COURSE CONTENT

UNIT I

Operating-System Structures: Operating-System Services, User and Operating-System Interface, System Calls: Example, Application Programming Interface, Types of System Calls, System Services

Processes: Process Concept: The Process, Process State, Process Control Block, Threads, Process Scheduling: Scheduling Queues, CPU Scheduling, Context Switch, Operations on Processes: Process Creation, Process Termination, Interprocess Communication, IPC in Shared-Memory Systems, IPC in Message-Passing Systems: Naming, Synchronization, Buffering.

UNIT II

CPU Scheduling: Basic Concepts: CPU-I/O Burst Cycle, CPU Scheduler, Pre-emptive & Nonpreemptive Scheduling, Dispatcher, Scheduling Criteria, Scheduling Algorithms: FCFS, SJF, RR, Priority, Multilevel Queue, Multilevel Feedback Queue Scheduling, Multiple Processor Scheduling: Approaches, Multicore Processors, Load Balancing, Processor Affinity, Heterogeneous Multiprocessing, Real Time CPU Scheduling: Minimizing Latency, Priority Based, Rate Monotonic, Earliest Deadline-First, Proportional Share Scheduling.

Process Synchronization: Background, The Critical-Section Problem, Peterson's Solution, Hardware Support for Synchronization, Mutex Locks.

Semaphores: Semaphore usage, Semaphore Implementation, Monitors: Usage, Implementing using Semaphores, Resuming a Process Liveness: Deadlock, Priority Inversion, Classic Problems of Synchronization: The Bounded-Buffer Problem, The Readers-Writers Problem, The Dining-Philosophers Problem

UNIT III

Deadlocks: System Model, Deadlock in Multithreaded Applications: Livelock, Deadlock Characterization: Necessary conditions, Resource Allocation Graph, Methods for Handling Deadlocks, Deadlock Prevention: Mutual Exclusion, Hold and Wait, No Preemption, Circular Wait, Deadlock Avoidance: Safe State, Resource Allocation Graph Algorithm, Bankers Algorithm, Deadlock Detection: Single Instance of Each Resource type, Several Instances, Detection Algorithm Usage, Recovery from Deadlock: Process and Thread Termination, Resource Preemption.

Main Memory: Background: Basic Hardware, Address Binding, Logical Vs Physical Address Space, Dynamic Loading, Dynamic Linking & Shared Libraries, Contiguous Memory Allocation: Memory Protection, Memory Allocation, Fragmentation, Paging: Basic Method, Hardware Support, Protection, Shared Pages, Structure of the Page Table: Hierarchical, Hashed Page Tables, Inverted Page Tables, Swapping: Standard Swapping, Swapping with Paging, Swapping on Mobile Systems.

UNIT IV

Virtual Memory: Background, Demand Paging: Basic Concepts, Free-Frame List, Performance, Copy-on-Write, Page Replacement: Basic Page Replacement, FIFO, Optimal, LRU, LRU Approximation, Counting Based, Page Buffering, Allocation of Frames: Minimum Number of Frames, Allocation Algorithms, Global vs Local Allocation, Non Uniform Memory Access, Thrashing: Cause of Thrashing, Working-Set Model, Page-Faulty Frequency, Memory Compression. Mass-Storage Structure: HDD Scheduling: FCFS, SCAN, C-SCAN Scheduling. File -System Implementation: Directory Implementation: Linear List, Hash Table, Allocation Methods: Contiguous, Linked, Indexed Allocation, Free-Space Management: Bit Vector, Linked List, Grouping, Counting, Space Maps, Efficiency and Performance

TEXTBOOKS

1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, “Operating System Concepts”, 10th Edition, John Wiley & Sons Pvt. Ltd, 2018.

REFERENCE BOOKS

1. William Stallings, “Operating System: Internals and Design Principles”, 9th Edition, PHI 2018.
2. Andrew S.Tanenbaum, “Modern Operating Systems”, 4th Edition, PHI, 2016.
3. Dhananjay M Dhamdhare, “Operating Systems – A Concept Based Approach”, 3rd Edition, McGraw Hill Publication, 2012
4. Harvery M Deitel, Paul J Deitel & David R Choffnes, ”Operating System”, 3rd Edition, Pearson Education, 2007

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof Santanu Chattopadhyay - NPTEL Course on Operating Sytsems @ <https://nptel.ac.in/courses/106/105/106105214/Availableon25-7-19>
2. Stanford University - Lecture Notes on Operating Systems @ <https://www.scs.stanford.edu/21wi-cs140/notes/Availableon21-05-21>
3. IIT Bombay – Lecture Notes on Operating Systems @ <https://www.cse.iitb.ac.in/~mythili/os/Availableon21-05-21>

20AI&ML4351

AI-POWERED TOOLS LABORATORY

| | | | |
|-----------------|----------------------|-------------------|-------|
| Course Category | Program Core | Credits | 1 |
| Course Type | Laboratory | L-T-P | 0-0-2 |
| Prerequisites | 20ES2152C | Continuous Eval | 30 |
| | Programming | Semester End Eval | 70 |
| | Essentials | Total Marks | 100 |
| | in Python Laboratory | | |

COURSE OUTCOMES

*Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)*

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | |

COURSE CONTENT

Task 1: Design a simple web-interface for email automation for promoting a business. The interface should include the following facilities:

- I. Determine the core functionality: scheduling emails, AI-generated content, recipient management, etc.
- II. Integrate email scheduling functionality within the app to send emails at specified times using AI tool Simplifai.
- III. Creating segmented email lists for various groups of people as per common interests.
- IV. Trigger-based auto-emails for important events.

Task 2: Generate a platform to make a company's conversations with its customers more special. The platform requires to give the following amenities:

- I. To have conversations with ChatGPT using customer voice!
- II. Voice-based audit report summarization.
- III. Able to conduct opinion polls
- IV. Collect the feedback/suggestions from customer voice and convert into text.
- V. Summarize the minutes of meeting (MoM) and email to all the participants.

Task 3: Develop an application that can provide valuable leads to law enforcement agencies with the following features:

- I. Sketch the suspect using DALL-E AI tool with the textual/voice description of facial features such as eyes, nose, hair, etc.,
- II. A partial offence (E.g., Hit-And-Run situation) scene reconstruction using descriptions obtained in investigation.
- III. Able to transform textual descriptions of vehicles or objects related to an offence into visual representations.

Task 4: Facilitate the student with Beautiful.AI power point presentation tool for global content accessibility with the following:

- I. Visualise the statistics using data visualisation tools for easy interpretation by the audience.
- II. Utilize AI transcription services like Otter.ai or Rev for real-time transcription of your spoken words during the presentation.
- III. Integrate AI-powered chatbots like ChatGPT or Dialogflow into your presentation to engage the audience by allowing them to ask questions or participate in interactive sessions.
- IV. Use AR/VR presentations to immerse your audience in a virtual environment where they can interact with data or simulations in a more engaging way.

Task 5: Assist a company HR manager using Paradox AI tool to hire the right candidate for job openings with the following features:

- I. Scan resumes and identify candidates whose qualifications match the job requirements.
- II. Utilizes predictive analytics to forecast employee performance, helping with smarter recruitment decisions.
- III. Assess candidate's facial expressions, tone, and language used by candidates, providing insights into their personality traits, communication skills, and emotional intelligence.

Task 6: Create an e-commerce application using AI tools by streamlining the following facilities:

- I. Website Builders with AI Assistance: Platforms like Wix, Shopify, or Squarespace offer AI-powered tools that can help you create a basic e-commerce website relatively quickly.
- II. AI-Powered Chatbots: Integrate AI chatbot services such as Dialogflow, ChatGPT, or others into your e-commerce platform. It can provide automated customer service, answer common queries, and assist users during their shopping experience.
- III. AI-Based Product Recommendations: Include AI-powered recommendation system (Tagalys) that can suggest products to customers based on their browsing or purchase history. Shopify and other similar platforms have apps that provide this functionality.

Task 7: Create an online boutique store interface involves various components such as:

- I. Website Development Platform: Platforms like Shopify provide tools to create online boutiques.
- II. Enable virtual fitting rooms using TryLive that allow customers to try on clothes virtually.
- III. Size and Fit Prediction: Analyze body measurements and provide accurate size recommendations, reducing returns due to sizing issues using Narvar AI tool.

Task 8: Using streamlined process given below set up an online blog with AI-generated content.

- I. Platform Setup: Sign up on a platform that offers AI-generated content services (e.g., ShortlyAI, Jasper, Writesonic). Customize your blog's theme or choose a template provided by the platform.
- II. AI Content Creation: Use the AI tools provided by the platform to generate content. Input prompts or outlines for the AI to create content based on your blog post structure.
- III. Content Integration: Copy and paste the AI-generated content into your blog platform. Edit and refine the content for coherence, accuracy, and tone.
- IV. Add Media and Final Touches: Insert images or multimedia elements using AI-generated or stock images. Format the content, add headings, and make it visually appealing.
- V. Review and Publish: Proofread the content for any errors or inconsistencies and publish your blog post.

Task 9: Design a user-friendly interface for interior design using AI-powered tools like Mody and Havenly with the following features:

- I. Create 3D models of your room based on photos and measurements given by the user.
- II. Provide design suggestions, allows the user to visualize furniture placement, and provides a 360-degree view of the room.
- III. Users can shop for recommended furniture directly through the designed interface.

Task 10: Create an application to translate the language of video into regional language using AI-powered tools as given below:

- I. Use Sonix AI-powered speech recognition tool to transcribe spoken content into text.
- II. Utilize AI translation services such as DeepL to translate the transcribed text into desired language.
- III. Overlay the translated text as subtitles or captions onto the video.

TEXTBOOKS

1. Nathan Hunter The Art of Prompt Engineering with ChatGPT: GPT-4, Plugins & DALL.E 3 Update, 7th Edition, ChatGPT Trainings, 2023.
2. Dr. Amey Pangarkar 'AI' YO Tools - Leveraging Power of Artificial Intelligence, 1st Edition, Neuflex Talent Solutions, 2023.

REFERENCE BOOKS

1. Tom Taulli Generative AI: How ChatGPT and Other AI Tools Will Revolutionize Business, 1st Edition, APress Publisher, 2023.
2. Diego Galar Pascual Artificial Intelligence Tools Decision Support Systems in Condition Monitoring and Diagnosis, 1st Edition, CRC Press, 2015.
3. Joseph Babcock & Raghav Bali Generative AI with Python and TensorFlow 2: Create images, text, and music with VAEs, GANs, LSTMs, Transformer models, 1st Edition, Packt Publishing Limited, 2021.
4. Tom Taulli Artificial Intelligence Basics: A Non-Technical Introduction, Apress publisher, 2019.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. <https://builtin.com/artificial-intelligence/ai-tools>
2. <https://www.synthesia.io/post/ai-tools>
3. <https://intellipaat.com/blog/top-artificial-intelligence-tools/>
4. <https://www.simplilearn.com/tutorials/artificial-intelligence-tutorial/top-generative-ai-tools>
5. <https://www.fotor.com/blog/best-free-ai-tools/>
6. <https://www.analyticsinsight.net/top-10-mind-blowing-free-ai-tools-that-anyone-can-use-in-2023/>
7. <https://www.insidr.ai/the-21-best-free-ai-tools-in-2023/>

20AI&ML4352

ADVANCED JAVA PROGRAMMING LABORATORY

| | | | |
|-----------------|----------------------|-------------------|-------|
| Course Category | Program Core | Credits | 1.5 |
| Course Type | Laboratory | L-T-P | 0-0-3 |
| Prerequisites | 20AI&ML3352 | Continuous Eval | 30 |
| | Java Programming Lab | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the basics of HTML and XML.
2. Apply the concepts of Java Servlets for developing Dynamic Web Pages.
3. Apply the concepts of Java Server Pages to build a Web Application.
4. Apply Object-relational Mapping Technology and basic Spring Concepts.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-------------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 1 | 2 | 3 | | | | | | | | | | 1 | 1 | 2 | 1.7.1, 2.7.1 3.8.2, 3.8.3 |
| 2 | 1 | | 2 | | 3 | | | | | | | | 2 | 1 | 3 | 1.7.1, 3.5.6, 3.8.2, 5.4.2 |
| 3 | 1 | | 2 | | 3 | | | | | | | | 2 | 1 | 3 | 1.7.1, 3.5.6, 3.8.2, 5.4.2 |
| 4 | 1 | | 2 | | 3 | | | | | | | | 2 | 2 | 3 | 1.7.1, 3.5.6, 3.8.2, 5.4.2 |

COURSE CONTENT

Task 1: Task 1: Design a static web page with HTML5 basic elements

Task 2: Design a static web page with HTML forms.

Task 3: Create a DTD and XML Schema.

Task 4: Deploy a basic servlet.

Task 5: Deploy a servlet for link statistics of browser.

Task 6: Deploy a servlet for uploading the file.

Task 7: Design a JSP page to keep a page counter of how many times it has been visited.

Task 8: Design a JSP page with the usage of JavaBeans, getProperty and setProperty actions.

Task 9: Design a JSP page using a Tag Handler and TLD

Task 10: Write some simple code to accomplish two things: test the Hibernate setup and also look at a basic example of how to use Hibernate.

Task 11: Developing TimesheetManager using Hibernate

Task 12: Develop a User Interface using Spring.

TEXTBOOKS

1. Jim Keogh, “J2EE: The Complete Reference”, McGraw Hill, 2002. (Unit I)
2. Jayson, Falkner, and Jones Kevin. ”Servlets and Java Server Pages: The J2EE Technology Web Tier.”, Addison-Wesley, 2004. (Unit II, III)
3. Hemrajani, Anil. Agile Java Development with Spring, Hibernate and Eclipse. Sams publishing, 2006. (Unit IV)

REFERENCE BOOKS

1. Hans Bergsten, “JavaServer Pages”, 3rd Edition, O’Reilly Media, Inc., 2003.
2. Christian Bauer, Gavin King, “Hibernate in Action”, Manning Publications, 2005.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Java EE: Servlets and JavaServer Pages (JSP) <https://www.linkedin.com/learning/java-ee-servlets-and-jvaserver-pages-jsp>
2. Building Cloud Services with the Java Spring Framework <https://in.coursera.org/learn/cloud-services-java-spring-framework>

20AI&ML4353

COMPUTER NETWORKS LABORATORY

| | | | |
|-----------------|-----------------------------------|-------------------|-------|
| Course Category | Program Core | Credits | 1.5 |
| Course Type | Laboratory | L-T-P | 0-0-2 |
| Prerequisites | 20AI&DS3305 | Continuous Eval | 30 |
| | Data Structures and Algorithms | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand fundamental concepts of computer networks and reference models.
2. Analyze data link layer mechanisms for error control, flow control and multiple access.
3. Analyze functioning of routing algorithms, congestion control and QoS techniques used at network layer.
4. Analyze the different protocols used at transport layer and Application layer.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | | 1 | | | | | | | | | | | 1 | | | |
| 2 | | | | | 2 | | | | | | | | 1 | | | |
| 3 | | | | | | | | | 3 | | | | 1 | | | |
| 4 | | | | | | | | | 3 | | | | 1 | | | |

COURSE CONTENT

Task 1: Installation of Packet Tracer & environment, Network Representation (PT 1.5.5).

Task 2: Investigate OSI and TCP reference models in action. Part 1 - Examine HTTP Web Traffic (PT 3.5.5), Part 2 - Display Elements of the TCP/IP Protocol Suite.

Task 3: Basic switch and end device configuration, Configure Initial Switch Settings (PT 2.5.5), Basic Switch and End Device Configuration (PT 2.9.1).

Task 4: Physical Layer, Connect a Wired and Wireless LAN (PT 4.6.5), Connect the Physical Layer (PT 4.7.2)

Task 5: Basic Router Configuration, Configure Initial Router Settings (PT 10.1.4), Connect a Router to a LAN (PT 10.3.4), Troubleshoot Default Gateway Issues (10.3.5), Basic Device Configuration (PT 10.4.3).

Task 6: Data Link Layer Protocols, Identify MAC and IP Addresses (PT 9.1.3), Examine the ARP Table (PT 9.2.9).

Task 7: IPv4 Addressing, Subnet an IPv4 Network (PT 11.5.5), Subnetting Scenario (PT 11.7.5)

Task 8: VLSM, VLSM Design and Implementation Practice (PT 11.9.3), Design and Implement a VLSM Addressing Scheme (PT 11.10.1). IPv6 Addressing, Configure IPv6 Addressing (PT 12.6.6), Implement a sub-netted IPv6 Addressing Scheme (PT 12.9.1) ICMP for network testing, Verify IPv4 and IPv6 Addressing (PT 13.2.6), Use Ping and Traceroute to Test Network Connectivity (PT 13.2.7), Use ICMP to Test and Correct Network Connectivity (PT 13.3.1)

Task 11: Transport Layer, TCP and UDP Communications (PT 14.8.1)

Task 12: Device Security, Configure Secure Passwords and SSH (PT 16.4.6), Secure Network Devices (PT 16.5.1), Installing Wireshark and Using Wireshark to View Network Traffic.

Supplementary Coding Tasks

1. Compute Cyclic Redundancy Check (CRC) for a given data frame using the three CRC polynomials – CRC 12, CRC 16 and CRC CCITT.
2. Implement Dijkstra’s algorithm to compute the Shortest path for a given graph.
3. Obtain Routing table at each node using Distance Vector Routing (DVR) algorithm for a given subnet.

TEXTBOOKS

1. Andrew S Tanenbaum, David J Wetherall “Computer Networks”, 5th Edition, Pearson Education

REFERENCE BOOKS

1. Kurose and Ross, “Computer Networks – A Top-down Approach Featuring the Internet”, Pearson Education.
2. Behrouz A.Fourozan, “Data Communications and Networking”. 4th Ed, TATA McGraw Hill.
3. Nader F.Mir, Computer and Communication Networks. PHI Publications

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof Sowmya Kanti Ghosh, IIT Kharagpur, NPTEL Lectures, 18th April 2018, Video Lectures, Available: <https://nptel.ac.in/courses/106/105/106105183/>
2. MIT Open Courseware, MIT, 14th May 2015, Video Lectures, Available: <http://ocw.mit.edu/courses/electricalengineering-and-computer-science/6-033-computer-systemengineering-spring-2009/video-lectures/>

3. Dheeraj, IIT Kharagpur, 14th May 2015, Lecture Notes, Available: <http://www.cse.iitk.ac.in/users/dheeraj/cs425>

20TP4106

ENGLISH FOR PROFESSIONALS

| | | | |
|-----------------|-------------------|-------------------|-------|
| Course Category | Soft Skills - 2 | Credits | 1 |
| Course Type | Learning by Doing | L-T-P | 0-0-2 |
| Prerequisites | – | Continuous Eval | 100 |
| | | Semester End Eval | 00 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Present themselves effectively in the professional world
2. Introduce themselves as well as others appropriately.
3. Use vocabulary to form sentences and narrate stories by using creative thinking skills
4. Involve in practical activity oriented sessions.
5. Learn about various expressions to be used in different situations.
6. Respond positively by developing their analytical thinking skills.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | | | | | | | | | 3 | 3 | | | | | | | |
| 2 | | | | | | | | | | 3 | | | | | | | |
| 3 | | | | | | | | | | 3 | | | | | | | |
| 4 | | | | | | | | | 3 | 3 | | | | | | | |
| 5 | | | | | | | | | 3 | 3 | | | | | | | |
| 6 | | | | | | | | | | 3 | | | | | | | |

COURSE CONTENT

UNIT I

- Beginners, Functional, Situational Conversations
- Practicing on Functional Conversations.

UNIT II

- Errors in usage of Parts of Speech with a thrust on Verbs, Adjectives and Conjunctions, Idioms/Phrases.
- Introducing Basic Grammar
- Practicing on Functional Conversations.

UNIT III

- Introducing Self & Others
- Structures and Forming Sentences
- Telephonic Etiquette, Social Etiquette and Table Manners
- Practicing on Functional Conversations.

UNIT IV

- Direct, Indirect/Reporting Speech
- Public Speaking Basics
- Versant Test Preparation
- Practicing on Situational Conversations.

METHODOLOGY

1. Audio—Visuals / Hand Outs (Compiled/Created by Training Division, T&P Cell, VR Siddhartha Engineering College), Board & Chalk and Interactive Sessions.

20AI&ML4607

INDUSTRY STANDARD CODING PRACTICE-I

| | | | |
|-----------------|---------------------------|-------------------|-------|
| Course Category | Skill Oriented Course - 1 | Credits | 2 |
| Course Type | Laboratory | L-T-P | 1-0-2 |
| Prerequisites | 20AI&ML3305 | Continuous Eval | 30 |
| | Data Structures | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand test and development aspects of programming by solving problems at Industry standards.
2. Apply domain skills and mathematical knowledge to solve any given problem.
3. Apply methods to optimize solutions for any given problem.
4. Apply elementary data structures to solve problems with test driven development.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|----------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 3 | 3 | | 2 | | | | | | | | | | | | 2 | 1.2.1, 1.7.1, 2.5.1, 4.6.3 |
| 2 | 3 | 3 | | 2 | | | | | | | | | 2 | 2 | 3 | 3 | 1.2.1, 2.5.1, 2.5.3, 4.4.1 |
| 3 | 3 | 3 | | 2 | | | | | | | | | 2 | 2 | 3 | 3 | 1.2.1, 2.5.3, 4.4.1 |
| 4 | 3 | 3 | | 2 | | | | | | | | | 2 | 2 | 3 | 3 | 1.2.1, 2.5.3, 4.4.1 |

COURSE CONTENT

UNIT I

Problem solving through Competitive Coding, Problem solving using control structures, Numeric series and patterns, Code Complexity analysis, Linear/ Logarithmic/ Super linear/ Polynomial/ Exponential/ Factorial Algorithms, Problem solving on rotations of data, Problem solving on Order statistic problems, Problem Solving Examples Problem solving on matrix data, Memory manipulation techniques using pointers. Memory Arithmetic, Problem solving implementing pointer to an array, Memory Layout, overcoming the segmentation faults, Run-time memory allocation, Coding comparisons of Linear list data structure and Pointers, examples and Practice problems.

UNIT II

Problem solving on string data, Problem solving on String manipulations, coding problems using string handling functions, Problem solving on Multi-String Problems, Problem Solving for long strings, Examples, Practice problems. Problem solving using modular programming, Inter module communications, scopes of data in the code, Problem solving approaches using recursions, Evaluation of Recursive algorithms, Significance of mathematical Recurrence Relations, Evaluation of recurrence relations, Time Analysis, Examples, Practice problems.

UNIT III

Problem solving on operational and traversal logics on linked lists, Problem solving to compare linked lists, detection of a cycle/ merge point, Merging sorted linked lists, coding problems on circular linked lists/Double linked lists, Examples, Practice problems. Problem Solving Problem solving through Linked list coding, traversals, Problem solving to compare linked lists, detection of a cycle/ merge point, Merging sorted linked lists, Circular linked list formation, Double linked list formation, Examples, Practice problems.

UNIT IV

Problem solving through testing, implementing various testing approaches: Test strategy, Test development, Test execution, Bug fixing, Examples, Practice problems, Problem solving Methods and techniques. Understanding the problem as math abstract, formation of the logic, Identifying the corner cases, Examples, Practice problems, Version control systems, Git repositories and working trees, adding new version of the files to a Git repository, Examples, practice problems.

TEXTBOOKS

1. Halim, Steven and Halim, Felix, Competitive Programming 3, 2013.
2. Ahmed Shamsul Arefin, Art of Programming Contest, ACM Solver, Second Edition, 2012

REFERENCE BOOKS

1. Programming Challenges: The Programming Contest Training Manual By Steven S Skiena, Miguel A. Revilla
2. Guide to Competitive Programming: Learning and Improving Algorithms Through Contests By Antti Laaksonen

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Topcoder tutorials - <https://www.topcoder.com/community/data-science/data-science-tutorials/>
2. Nite Nimajneb's site - <http://comscigate.com/Books/contests/icpc.pdf>
3. Slides from a Stanford Course - <http://web.stanford.edu/class/cs97si/>

4. Halim, Steven and Halim, Felix, Competitive Programming 3, 2013. Ebook available at lulu.com. Site associate with with the book is <http://cpbook.net>

20MC4108B

INDIAN CONSTITUTION

| | | | |
|-----------------|------------------|-------------------|-------|
| Course Category | Mandatory Course | Credits | - |
| Course Type | Theory | L-T-P | 2-0-0 |
| Prerequisites | - | Continuous Eval | 100 |
| | | Semester End Eval | 00 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Know the fundamental law of the land.
2. Understand how fundamental rights are protected.
3. Perceive the structure and formation of the Indian Government System.
4. Explain when and how an emergency can be imposed and what are the consequences.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | | | | | | 3 | 2 | | | | | | | | | 2 | |
| 2 | | | | | | 2 | 3 | | | | | | | | | 2 | |
| 3 | | | | | | 1 | | | | | | | | | | 2 | |
| 4 | | | | | | 2 | 1 | | | | | | | | | 2 | |

COURSE CONTENT

UNIT I

Introduction to Constitution of India: Meaning of the Constitution Law and Constitutionalism, Historical perspective of constitution of India, Salient features of Constitution of India.

UNIT II

Fundamental Rights: Scheme of the fundamental rights, scheme of the fundamental right to equality, scheme of the fundamental right to certain freedoms under Article 19, scope of the right of life and personal liberty under Article 21, writs jurisdiction.

UNIT III

Nature of the Indian Constitution: Federal structure and distribution of legislative and financial powers between the Union and states.

Parliamentary form of Government in India: The Constitution powers

and status of the President of India, Amendment of the Constitutional powers and Procedure, Historical Perspectives of the constitutional amendments in India.

Local Self Government: Constitutional Scheme in India.

UNIT IV

Emergency Provisions: National Emergency, President rule, Financial Emergency.

TEXTBOOKS

1. Dr. J.N. Pandey, Constitutional Law of India published by Central law Agency, Allahabad, Edition 2018

REFERENCE BOOKS

1. V.N Shukla's, Constitution of India Eastern Book Company, Lucknow.
2. M.P. jain, Indian Constitution Law, Wadhwa and Company, Nagpur.
3. D.D. basu, Constitution of India, Wadhwa and Company, Nagpur

E-RESOURCES AND OTHER DIGITAL MATERIALS

SEMESTER V

20AI&ML5301

DATABASE SYSTEMS

| | | | |
|-----------------|---------------------------------|-------------------|-------|
| Course Category | Program Core | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20BS3101A- Discrete Mathematics | Continuous Eval | 30 |
| | 20AI&ML3305 - Data Structures | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the concepts of database systems.
2. Analyse the Entity-Relationship models, in-turn develop the Relational models that leads to database design.
3. Apply various normalization techniques to relational models in order to improve database design quality.
4. Understand database transactions processing, protocols for Concurrency control and Recovery techniques in database.
5. Implement database management techniques using relational SQL database to real world applications.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 1 | 2 | | | | | | | | | | | 1 | 1 | 2 | 1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3 |
| 2 | | 2 | 3 | | | | | | | | | | 1 | 1 | 4 | 2.5.2, 2.5.3, 2.6.3, 2.7.2, 3.5.6, 3.6.2 |
| 3 | | 2 | 3 | | | | | | | | | | 1 | 1 | 3 | 2.5.2, 2.5.3, 2.6.3, 2.7.2, 3.5.6, 3.6.2 |
| 4 | 1 | 2 | | | | | | | | | | | 1 | 1 | 2 | 1.7.1, 2.5.2, 2.6.3, 2.7.2 |
| 5 | | 2 | 3 | | 3 | | | | | | | | 2 | 2 | 5 | 2.5.2, 2.5.3, 2.6.3, 2.6.4, 2.8.4, 5.4.2, 5.5.2 |

COURSE CONTENT

UNIT I

Introduction to Database Systems: Introduction, An example, Characteristics of Database Approach, Advantages of Using the DBMS Approach, A

Brief History of Database Applications.

Database System—Concepts and Architecture: Data Models, Schemas and Instances, Three-schema Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment.

SQL Schema Definition, SQL Data Definition and Data Types , Specifying constraints in SQL, Basic retrieval queries in SQL, Additional features of SQL, More complex SQL Queries, Insert, Delete and Update statements in SQL, Joined Tables in SQL and Outer Joins, Aggregate functions, The GROUP BY and HAVING Clauses, Specifying Constraints as Assertions and Triggers, Views (Virtual Tables) in SQL, Schema Change Statement in SQL.

UNIT II

Data Modeling Using the Entity-Relationship Model- Using High-Level Conceptual Data Models for Database Design; A Sample Database Application; Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types.

Refining the ER Design, ER Diagrams, Naming Conventions and Design Issues, Relationship Types of Degree Higher than two, Relational Database Design using ER-to-Relational Mapping.

UNIT III

Relational Data Model and Relational Database Constraints: Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions and Dealing with Constraint Violations.

Relational Algebra: Unary Relational Operations, SELECT and PROJECT, Relational Algebra Operations from Set Theory Binary Relational Operations: JOIN and DIVISION, Additional Relational Operations, Examples of Queries in Relational Algebra.

Relational Database Design: Functional Dependencies; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form; Properties of Relational Decomposition; Multivalued Dependencies, Fourth Normal Form and Fifth Normal Form.

UNIT IV

Transaction Processing, Concurrency Control, and Recovery: Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions, Characterizing Schedules Based on Recoverability, Characterizing Schedules Based on Serializability, Two-Phase Locking Techniques for

Concurrency Control, Recovery Concepts, NO-UNDO/REDO Recovery Techniques based on Deferred Update, Recovery Techniques Based on Immediate Update, Shadow Paging, The ARIES Recovery Algorithm.

TEXTBOOKS

1. Ramez, E., & Shamkant B. N, Fundamentals of database systems 7th Edition, Pearson Education Ltd., 2016.

REFERENCE BOOKS

1. Raghu Rama Krishnan, Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw Hill Education, 2014
2. Abraham Silberschatz, Henry F.Korth, S.Sudarshan, Database System Concepts, 6th edition, McGraw-Hill Education, 2013.

E-RESOURCES AND OTHER DIGITAL MATERIAL

1. Dr S.Srinath IIT-Madras, Conceptual design process, <https://nptel.ac.in/courses/106/106/106106093/>, Last accessed on: 10/02/2022
2. Prof P.Srinivasa Kumar IIT-Madras, Normalization process, <https://nptel.ac.in/courses/106/106/106106095/Lecture7>, Last accessed on: 10/02/2022
3. Prof D.Janakiram IIT-Madras, Concurrency Control techniques, <https://nptel.ac.in/courses/106/106/106106093/Lecture20,21,22,23>, Last accessed on: 10/02/2022
4. Andy Pavlo, Carnegie Mellon University, Relational model concepts, <https://15445.courses.cs.cmu.edu/fall2017/slides/01-introduction.pdf>

20AI&ML5302

MACHINE LEARNING

| | | | |
|-----------------|---|---|-----------------|
| Course Category | Program Core | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20BS2101B Probability and Statistics for Machine Learning 20BS4101G Introduction to Linear Algebra | Continuous Eval Semester End Eval Total Marks | 30 70 100 |

COURSE OUTCOMES

1. Understand the role of mathematics in the context of Machine Learning.
2. Apply dimensionality reduction techniques for feature exploration.
3. Apply appropriate classification and regression techniques to solve real world problems.
4. Analyze various problems across different domains that can be addressed by applying learned machine learning techniques

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 2 | 2 | | | | | | | | | | | 1 | 1 | 2 | 1.2.1, 1.2.2, 1.6.1, 1.7.1, 2.5.3 |
| 2 | 2 | 2 | | | | | | | | | | | 1 | 1 | 3 | 1.2.1,1.2.2,1.6.1, 1.7.1, 2.6.2, 2.6.4,2.7.2 |
| 3 | 2 | 3 | 2 | 2 | 1 | | | | | | | | 1 | 2 | 3 | 1.2.1, 1.6.1, 1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.7.2,3.6.1, 3.6.2 , 4.4.2, 4.6.1, 5.4.2 |
| 4 | 2 | 2 | 2 | 2 | 1 | | | | | | | | 1 | 2 | 4 | 1.6.1, 2.5.2, 2.6.3, 2.6.4, 2.7.2,3.6.1, 3.6.2 ,4.6.1, 4.6.3, 5.4.2 |

COURSE CONTENT

UNIT I

Introduction to Machine Learning: Motivation and role of machine learning in computer science and decision making, Role of data in learning, Linear

transformations and matrix vector operations in the context of data, Learning Paradigms, History & Motivation of ML in interdisciplinary.

Regression: Formulation of regression problem, Mathematical intuition and algorithmic description of Linear Regression - Least squares estimation, Gradient Descent algorithm, Multiple Linear Regression vs Multivariate Linear Regression. Regularization Techniques: Lasso, Ridge and ElasticNet.

UNIT II

Dimensionality Reduction: Usage of Matrix Decomposition and Eigen vectors in ML, Singular Value Decomposition, PCA, LDA

Supervised Learning: Classifiers - I: Classification problem formulation, Concept of VC Dimensions, Notion of training, validation and testing, Decision Tree Classifiers, Challenges in Decision Tree classifier, Need of generalization.

Ensembles: Learning techniques: Bagging, Boosting and Stacking, Random Forest, Gradient Boosting, Loss Functions, Evaluation Metrics.

UNIT III

Classifiers – II: Eager vs Lazy Learner, K-Nearest Neighbor, Measures to improve KNN performance, Mathematical intuition and algorithmic description of Naïve Bayes, Applications of Naïve Bayes classifier, Geometric intuition behind Bayesian networks, Support Vector Machines: Maximal Margin Classifier, Hyperplane, hard and soft margin classification, Non Linear SVM.

Neural Network Learning: Role of Neural Networks in ML, Multi Layer Perceptrons, Activation Functions.

UNIT IV

Unsupervised Learning: Iterative algorithms - K-Means, Hierarchical Clustering, DBSCAN, Gaussian Mixture Model, role of initialization, notion of convergence.

Applications of Machine Learning: Retail: Recommendation Systems, Healthcare: Disease Diagnosis, Finance: Fraud detection, Agriculture: Plant classification, Facial recognition using Dimensionality Reduction Techniques.

TEXTBOOKS

1. E. Alpaydin, Introduction to Machine Learning, MIT Press, 2020.
2. G. James, D. Witten, T. Hastie, and R. Tibshirani, An Introduction to Statistical Learning, Springer, 2013.
3. T. M. Mitchell, Machine Learning, 1st, McGraw-Hill, 1997.

REFERENCE BOOKS

1. S. Marsland, Machine Learning: An Algorithmic Perspective, CRC Press, 2nd, 2015.
2. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 1st,

2006.

3. K. P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. B. Ravindran, Introduction to Machine Learning, Online Course, NPTEL, 2021.
2. A. Ng, Machine Learning Specialization, Coursera, <https://www.coursera.org/specializations/machine-learning-introduction>
3. J. Brownlee, Machine Learning Mastery, <https://machinelearningmastery.com/start-here/#python>.
4. R. Akerkar, P. S. Sajja, and S. B. Raju, Machine Learning Applications in Agriculture, CRC Press, 2021. [ISBN: 978-0367779747]
5. J. Klaas and Y. Hilpisch, Machine Learning for Finance: Principles and Practice for Financial Insiders, O'Reilly Media, 2020. [ISBN: 978-1492056644]
6. M. S. Ghotra, W. C. K. Goonawardena, and H. Chai, Machine Learning for Retail Analytics: Forecasting Customer Purchases, Fraud Detection, and Predictive Maintenance, Apress, 2016. [ISBN: 978-1484225883]
7. F. Ricci, L. Rokach, and B. Shapira, Eds., Recommender Systems Handbook, Springer, 2015. [ISBN: 978-1461454247]

20HS5103

ENGINEERING ECONOMICS AND MANAGEMENT

| | | | |
|-----------------|--------------------------------|-------------------|-------|
| Course Category | Humanities and Social Sciences | Credits | 2 |
| Course Type | Theory | L-T-P | 2-0-0 |
| Prerequisites | – | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand various forms of organizations and principles of management.
2. Understand the various aspects of business economics.
3. Acquire knowledge on Human resources and Marketing functions.
4. Understand different methods used in calculating depreciation and evaluating alternatives economically.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 2 | | | | | | | 2 | | | | | | 2 | | |
| 2 | 2 | | | | 3 | | | 2 | | | | | | 2 | | |
| 3 | 2 | | | | | | | 2 | | | | | | 2 | | |
| 4 | 2 | | | | 3 | | | 2 | | | | | | 2 | | |

COURSE CONTENT

UNIT I

Forms of Business Organization: Salient Features of Sole Proprietorship, Partnership, Joint Stock Company, Co-operative Society and Public Sector.

Management: Introduction to Management, Functions of Management, Principles of Scientific Management, Modern Principles of Management.

UNIT II

Introduction to Economics: Introduction to Basic Economic Concepts, Utility Analysis: Marginal Utility and Total Utility, Law of Diminishing Marginal Utility, Law of Equi Marginal Utility.

Demand Analysis: Theory of Demand: Demand Function, Factors Influencing Demand, Demand Schedule and Demand Curve, Shift in Demand, Elasticity of Demand: Elastic and Inelastic Demand, Types of Elasticity.

Supply Analysis: Supply Schedule and Supply Curve, Factors Influencing Supply, Supply Function.

UNIT III

Human Resource Management: Meaning and difference between Personnel Management and Human Resource Management, Functions of Human Resource Management.

Marketing Management: Concept of Selling And Marketing – Differences, Functions of Marketing, Product Life Cycle, Concept of Advertising, Sales Promotion, Types of Distribution Channels, Marketing Research, Break-Even Analysis.

UNIT IV

Financial Management: Functions of Financial Management, Time value of money with cash flow diagrams, Concept of Simple and Compound Interest.

Depreciation: Causes of depreciation, Factors influencing depreciation, common methods of Depreciation: Straight Line Method, Declining Balance Method, Sum of Year's Digits Method –Problems.

Economic Alternatives: Methods of Evaluating Alternatives under Present worth method, Future worth method, Annual Equivalent method - Problems.

TEXTBOOKS

1. M. Mahajan Industrial Engineering and Production Management, Dhanpat Rai Publications, 2nd Edition.
2. Martand Telsang, Industrial & Business Management S.Chand publications.

REFERENCE BOOKS

1. R.Paneer selvam , Production and Operations Management, PHI
2. Philip Kotler & Gary Armstrong, Principles of Marketing , Pearson prentice Hall, New Delhi, 2012 Edition.
3. IM Pandey, Financial Management, Vikas Publications,11th Edition.
4. B.B Mahapatro, Human Resource Management, New Age International, 2011.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. <https://www.toppr.com/guides/fundamentals-of-economics-and-management/\supply/supply-function/>
2. <https://keydifferences.com/difference-between-personnel-management-and-human-resource-management.html>
3. <http://productlifecyclestages.com/>
4. <https://speechfoodie.com/cash-flow-diagrams/>

20AI&ML5404A

FEATURE ENGINEERING

| | | | |
|-----------------|--------------------|-------------------|-------|
| Course Category | Program Elective I | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand and articulate the importance of feature engineering in machine learning.
2. Apply techniques to clean datasets, and normalize data for analysis.
3. Apply effective feature construction and feature selection methods.
4. Implement dimensionality reduction techniques

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 1 | 2 | | | | | | | | | | | | | 2 | 1.7.1, 2.6.4 |
| 2 | 1 | 2 | 3 | | | | | | | | | | | 2 | 3 | 1.7.1, 2.5.2, 2.6.4, 3.6.2 |
| 3 | 1 | 2 | | | | | | | | | | | | | 3 | 1.7.1, 2.5.2, 2.6.4 |
| 4 | | 2 | 2 | | | | | | | | | | | 2 | 4 | 2.5.2, 2.5.3, 2.6.3, 2.7.2, 3.5.6, 3.6.2 |

COURSE CONTENT

UNIT I

Introduction to Feature Engineering: Motivating example – AI-Powered Communications, Importance of Feature Engineering, Introduction of Feature Engineering, Evaluation of Machine Learning Algorithms and Feature Engineering Procedures, Feature Understanding, Feature Improvement – Cleaning Datasets, Feature Selection – Removing Bad Attributes, Feature Construction, Feature Transformation, Feature learning

UNIT II

Feature Understanding and Cleaning Datasets: Quantitative Versus Qualitative Data, The Four Levels of Data (Nominal, Ordinal, Interval, Ratio), Feature Improvement - Cleaning Datasets, Standardization and Normalization-

Z-score Standardization, The Min-Max Scaling Method, The Row Normalization Method, Data Augmentation, Pipelines in Machine Learning.

UNIT III

Feature Construction and Selection: Feature Construction- Imputing Categorical Features, Encoding Categorical Variables, Bucketing Continuous Features into Categories, Extending Numerical Features, TextSpecific Feature Construction, Feature Selection- Statistical-Based Feature Selection, Model-Based Feature Selection. Greedy Search Methods- Simple Filters, Recursive Feature Elimination, Stepwise Selection.

UNIT IV

Feature Transformation and Learning: Feature Transformation Dimension Reduction, Principal Component Analysis, Linear Discriminant Analysis, Feature Learning- Parametric Assumptions of Data, Reconstructing the Data, MNIST dataset, Restricted Boltzmann Machines, 147 Learning Text Features – Word Vectorizations, Word Embeddings, Application of Word Embeddings – Information Retrieval.

TEXTBOOKS

1. Ozdemir, Sinan, and Divya Susarla. Feature Engineering Made Easy: Identify unique features from your dataset in order to build powerful machine learning systems. Packt Publishing Ltd, 2018..
2. Zheng, Alice, and Amanda Casari. Feature engineering for machine learning: principles and techniques for data scientists. ” O’Reilly Media, Inc.”, 2018

REFERENCE BOOKS

1. Kuhn, Max, and Kjell Johnson. Feature engineering and selection: A practical approach for predictive models. Chapman and Hall/CRC, 2019.
2. Chicco, Davide, Luca Oneto, and Erica Tavazzi. Eleven quick tips for data cleaning and feature engineering. PLOS Computational Biology 18, no. 12 (2022): e1010718.
3. Liu, Huan, and Hiroshi Motoda, eds. Feature extraction, construction and selection: A data mining perspective. Vol. 453. Springer Science & Business Media, 1998.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Harshil Patel, Feature Engineering Explained, <https://builtin.com/articles/feature-engineering/>, Last accessed on: 24/05/2024
2. Google Cloud Training <https://www.coursera.org/learn/feature-engineering/>, Last accessed on 24/05/2024

3. Soledad Galli, Feature Engineering for Machine Learning, Feature Engineering for Machine Learning, Udemy, Last accessed on: 24/05/2024

20AI&ML5404B

CRYPTOGRAPHY AND NETWORK SECURITY

| | | | |
|-----------------|---------------------------------|-------------------|-------|
| Course Category | Program Elective I | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20AI&ML4304 - Computer Networks | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand fundamental principles of security and symmetric encryption
2. Apply asymmetric encryption techniques and Cryptographic Hash functions
3. Apply Authentication applications and Transport Layer Security mechanisms
4. Understand the protocols for network security and methods to safeguard the network

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|-----------------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 3 | 3 | | | | | | | | | | | | | | 2 | 1.7.1, 2.6.4 |
| 2 | 2 | 3 | 3 | | | | | | | | | | | | 2 | 3 | 1.7.1, 2.5.2, 2.6.4, 3.6.2 |
| 3 | 2 | 2 | | | | | | | | | | | | | | 3 | 1.7.1, 2.5.2, 2.6.4 |
| 4 | 2 | 2 | 3 | | 3 | | | | | | | | | | 2 | 2 | 1.7.1, 2.5.3, 2.6.3, 3.6.2, 5.4.2 |

COURSE CONTENT

UNIT I

Overview: Security attacks, Services, A model for network security; Basics of Cryptography, Cryptanalysis. Symmetric cipher model.

Classical encryption techniques: Substitution Techniques: Caesar Cipher, Mono alphabet Cipher, Playfair Cipher Transposition Techniques: Rail Fence, Row & Column Transposition.

Block Cipher: Stream and Block Cipher, DES, Strength of DES, AES.

Block cipher Operations: Multiple Encryption, ECM, CBC, CFM, OFM, CTR.

UNIT II

Number Theory: Prime Numbers, Fermat's theorem, Euler's Theorem

Cloud Applications: Principles of Public Key Crypto System, RSA algorithm, Diffie-Hellman Key Exchange, Problems, Elliptic Curve Cryptography

Features of Cloud and Grid Platforms: Applications-Message Authentication, Digital signatures, SHA-512 Logic, Round Functions.

UNIT III

Key Management and Distribution: Distribution of Public Keys, X.509 Certificates,

User Authentication: Kerberos: Motivation, Kerberos Version 4, Kerberos Version 5

Transport Level Security: Web Security Threats, Web Traffic Security Approaches.

Transport Layer Security: TLS - TLS Architecture, Record Protocol, Change Cipher Spec Protocol, Alert Protocol, Handshake Protocol, Cryptographic Computations

HTTPS Connection Initiation, Connection Closure.

UNIT IV

Email Security: S/MIME - Operational Description, S/MIME Message Content Types, Approved Cryptographic Algorithms, PGP

IP Security: Overview: Applications, Benefits, IPsec Documents, IPsec Services, Transport and Tunnel Modes, Encapsulating Security Payload - ESP Format, Encryption and Authentication Algorithms, Padding, Anti-Replay Service, Transport and Tunnel Modes

Malicious Software: Types – Viruses, Backdoor, Logic Bomb, Trojan Horses

Email Security: The Need for Firewalls, Characteristics, Types of Firewalls - Packet Filtering Firewall, Stateful Inspection Firewalls, Application-Level, Gateway Circuit-Level Gateway, Firewall Basing- Bastion Host, Host-Based Firewalls, Personal Firewall..

TEXTBOOKS

1. William Stallings, "Cryptography and Network Security: Principles and Practice". 4 th 7 th Editions, Pearson Education, 2017.
2. Rick Lehtinen, G.T. Gangemi, "Computer Security Basics", 2nd Edition, O'Reilly Publishers, 2008

REFERENCE BOOKS

1. Behrouz A. Forouzan and Debdeep Mukhopadhyay, "Cryptography and Network Security", 2nd Edition, 2012
2. J. Katz and Y. Lindell, "Introduction to Modern Cryptography", CRC Press, 2008
3. Bernard Menezes, "Network Security and Cryptography", CENGAGE Learn-

ing, 2010

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. NPTEL Course Cryptography and Network Security, IIT Kharagpur, available @ <https://nptel.ac.in/courses/106105162>, accessed on 3rd January 2023
2. Network and Computer Security - MIT OpenCourseWare, available @ <https://ocw.mit.edu/courses/6-857-network-and-computer-security-spring-2014/pages/lecture-notes-and-readings/>, accessed on 3rd January 2023

20AI&ML5404C

DISTRIBUTED SYSTEMS

| | | | |
|-----------------|---------------------------------|-------------------|-------|
| Course Category | Program Elective I | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20AI&ML4304 - Computer Networks | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the characteristics of distributed systems and the challenges
2. Explain inter process communication, remote invocation and Understand different approaches to support distributed applications
3. Understand different system services and basic distributed algorithms
4. Analyze different protocols for various distributed systems

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 3 | 3 | | | | | | | | | | | | | 2 | 1.7.1 |
| 2 | 3 | 3 | | | | | | | | | | | | | 2 | 1.7.1,2.5.2,2.6.3, 2.6.4, 2.8.3, 2.8.4 |
| 3 | 2 | 2 | 3 | | | | | | | | | | | 2 | 2 | 1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1 |
| 4 | 2 | 2 | 3 | | | | | | | | | | 1 | 2 | 4 | 1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1 |

COURSE CONTENT

UNIT I

Characterization of Distributed Systems: : Introduction, Examples of Distributed Systems, Trends in distributed systems, Focus on Resource Sharing and the Web, Challenges.

System Models: : Introduction, Physical Models, Architectural Models, Fundamental Models.

UNIT II

Inter Process Communication: Introduction, The API for the Internet Protocols, External Data Representation and Marshalling, Multicast communication, Network virtualization: Overlay Networks, Case Study: MPI

Distributed Objects and Components: Introduction, Communication between Distributed Objects, Case Study: CORBA, From objects to components
Remote Invocation: Remote Procedure Call, Events and Notifications, Remote method invocation Case Study: JAVA RMI

UNIT III

Distributed File Systems: Introduction, File Service Architecture, Case Study 1: Sun Network File System, Case Study 2: The Andrew File System, Enhancements and further developments.

Name Services: Introduction, Name Services and the Domain Name System, Directory Services, Case Study of the Global Name Services

Time and Global States: Clocks, Events and process states Clock Synchronization - Logical clocks Global states - Distributed debugging

UNIT IV

Transactions and Concurrency Control: Introduction, Transactions, Nested Transactions, Locks, Optimistic Concurrency Control, Timestamp Ordering, Comparison of Methods for Concurrency Control.

Distributed Transactions: Introduction, Flat and Nested Distributed Transactions, Atomic Commit Protocols, Concurrency Control in Distributed Transactions, Distributed Deadlocks, Transaction Recovery.

TEXTBOOKS

1. George Coulouris, Jean Dollimore, and Tim Kindberg, “Distributed Systems Concepts and Design”, 5th ed., Pearson Education, 2011

REFERENCE BOOKS

1. Distributed Systems, Principles and Paradigms, Andrew S. Tanenbaum, Maarten Van Steen, 2nd Edition, PHI.
2. Distributed Systems, An Algorithm Approach, Sukumar Ghosh, Chapman&Hall/CRC, Taylor & Fransis Group, 2007.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof Rajiv Misra, IIT Patna, NPTEL Last accessed on 25th may 2024 https://onlinecourses.nptel.ac.in/noc21_cs87
2. Distributed Systems, Stanford School of Engineering, Last accessed 22th may 2024 <https://www.scs.stanford.edu/24sp-cs244b>
3. Distributed Systems, Distributed Computing, University Cambridge, Last accessed on 18th may 2024 https://www.youtube.com/watch?v=sGzQT_zrsFI

20AI&ML5404D

MERN TECHNOLOGIES

| | | | |
|-----------------|---|-------------------|-------|
| Course Category | Program Elective I | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20ES1103: Programming for Problem Solving | Continuous Eval | 30 |
| | 20AI&ML3304: Java Programming | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand syntax and semantics of Node.js to build interactive Web application.
2. Develop a dynamic web application using Express.js.
3. Create a web application and connect to database using MongoDB platform.
4. Build a mean stack web application using Angular 2.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 2 | 2 | | | | | | | | | | | | | 1 | 1.7.1,2.5.1,2.5.2 |
| 2 | 2 | 2 | 3 | | 3 | | | | | | | | 2 | 2 | 3 | 1.7.1,2.5.1,2.5.2, 2.6.3, 2.7.1,3.5.1, |
| 3 | 2 | 2 | 3 | | 3 | | | | | | | | 2 | 2 | 3 | 1.7.1,2.5.1, 2.5.2, 2.6.3,2.6.4 3.5.1, |
| 4 | | 2 | 3 | 2 | 2 | | | | | | | | 2 | 2 | 3 | 2.5.1,2.5.2,2.6.3, 2.6.4, 3.5.1,4.6.2 |

COURSE CONTENT

UNIT I

Getting Started with Node.js: Introduction to Node.js, Installing Node.js, io.js and the Node.js foundation, Node.js LTS support, Node.js ES6 support, JavaScript event driven programming, Node.js event driven programming.

Node modules: CommonJS modules, Node.js core modules, Node.js third party modules, Node.js file modules, Node.js Folder modules.

Developing Node.js web applications: Meet the Connect module, connect middleware, Understanding the order of Connect middleware, Mounting Connect middleware.

UNIT II

Building an Express Web Application: Introduction Express, Installing

Express, Creating your first Express application, The application, request and response objects, External middleware.

Implementing the MVC pattern: The application folder structure, vertical folder structure, File-naming conventions, Implementing the horizontal folder structure, Handling request routing, Adding the routing file, Configuring an Express application, Rendering views, serving static files, Configuring sessions

UNIT III

Introduction to MongoDB: Introducing MongoDB, Key Features of MongoDB, MongoDB shell, MongoDB databases, CRUD Operations. **Introduction to Mongoose:** Introducing Mongoose, Understanding Mongoose schemas, Creating the user schema and model, Registering the User model, Creating new users using save(), Finding multiple user documents using find(), Reading a single user document using findOne(), Updating an existing user document, Deleting and existing user document.

UNIT IV

Introduction to Angular JS: Introducing Angular JS, Key concepts of Angular JS, Angular JS modules, Dependency Injection in Angular JS, Angular JS directives, Bootstrapping an Angular JS application, Installing Angular JS, Structuring an Angular JS application,

Angular JS MVC entities: Angular JS views, controllers, and scopes. Angular JS routing, Angular JS services. **Managing Angular JS Authentication:** Rendering the user object, Adding and Using the Authentication service

TEXTBOOKS

1. Amos Q. Haviv , "MEAN Web Development", Second Edition, Packt Publishing, December 2016.

REFERENCE BOOKS

1. Brad Dayley, Brendan Dayley, Caleb Dayley, "Node.js, MongoDB and Angular Web Development," Pearson, 2nd Edition, 2018.
2. Simon Holmes, "Getting MEAN with Mongo, Express, Angular, and Node", Second Edition, Manning Publications, First Edition (31 October 2015).
3. Jeff Dickey, "Write Modern Web Apps with Mean Stack , Peachpit press, 2015
4. Internet and World Wide Web How to program, P.J. Deitel & H.M. Deitel, Pearson
5. Ethan Brown "Web Development with Node; Express (Leveraging the JavaScript Stack), First Edition, O'Reilly Publications.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Courseera: Jogesh K. Muppala, Associate Professor, The Hong Kong University of Science and Technology Full-Stack Web Development ,The Hong Kong University of Science and Technology. <https://www.coursera.org/specializations/full-stack-react#about>
2. Udemy : Brad Traversy, Full Stack Web Developer & Instructor at Traversy Media, MERN Stack Front To Back: Full Stack React, Redux & Node.js <https://www.udemy.com/course/mern-stack-front-to-back/>

20AI&ML5205A

DESIGNING AUTONOMOUS AI

| | | | |
|-----------------|---|-------------------|-------|
| Course Category | Open Elective I | Credits | 3 |
| Course Type | Theory | L-T-P | 2-0-2 |
| Prerequisites | 20AI&ML3303 - Introduction to Artificial Intelligence | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the human-like decision making process.
2. Apply machine teaching for instructing AI brain.
3. Execute AI brain skills to achieve AI brain goals.
4. Inspect AI brain learning through sciences and statistics.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 3 | 2 | | | | | | | | | | | 1 | 1 | 2 | 1.2.1, 1.7.1, 2.5.1, 2.6.4 |
| 2 | 1 | 3 | | | | | | | | | | | 1 | 1 | 3 | 1.2.1, 1.7.1 2.5.2, 2.6.4, 2.8.1 |
| 3 | 1 | 3 | 1 | | | | | | | | | | 1 | 1 | 3 | 1.2.1, 1.7.1 2.5.2, 2.6.4, 2.8.1, 3.6.1 |
| 4 | 1 | 2 | 3 | | | | | | | | | | 1 | 1 | 4 | 1.2.1, 1.7.1 2.5.2, 2.6.4, 2.8.1, 3.5.1, 3.6.1, 3.7.1 |

COURSE CONTENT

UNIT I

Introduction: The changing world and workforce demand, Automated decisions, Control theory, Decision evaluations, Expert systems recalls.

Human-like Decision Making: Augmenting human intelligence, Human decision practices, Superpowers of Autonomous AI and its applications.

UNIT II

Machine Teaching: Building blocks- Strategy vs. Evaluation, Knowledge capturing, Brain built skills, functions, and strategies.

Instructing AI Brain: Action determination, Perceptions, Action triggering, Decision thresholds, Handling delays.

UNIT III

AI Brain Goals: Throughput vs. Efficiency, Goal settings – Identification and Matching, Goal objectives – Maximize and Minimize, Reaching and Avoiding.

AI Brain Skills: Facts and Goals, Expert rules, Paradigm codification, Autonomous AI architecture, and Architect an AI brain.

UNIT IV

AI Brain Pitfalls: Pitfalls to avoid – Confusing the problem solution, losing forest of tress.

AI Brain Learning: Senses of AI brain – Variables, Proxy Variables, and Trends. Simulation – using Sciences, Statistics, Machine learning, and Expert rules

AI Brain Documentation: Designers and Builders, Specifications.

TEXTBOOKS

1. Kence Anderson, Designing Autonomous AI - A Guide for Machine Teaching, O'Reilly Media, Inc., 2022, First edition.
2. Kence Anderson, Designing Autonomous AI, O'Reilly Media, Inc., 2022, First edition.

REFERENCE BOOKS

1. Rothman, Denis, Artificial intelligence by example: develop machine intelligence from scratch using real artificial intelligence use cases. Packt Publishing Ltd, 2018.
2. Lieto, Antonio, Cognitive design for artificial minds. Routledge, 2021.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Product Design in AI, <https://www.udemy.com/course/product-design-in-ai/> Last accessed on 24 April 2024.
2. Designing Autonomous AI, <https://www.coursera.org/learn/designing-autonomous-ai>. Last accessed on 12 March 2024.

20AI&ML5205B

ARTIFICIAL INTELLIGENCE FOR ROBOTICS

| | | | |
|-----------------|-----------------------------|-------------------|-------|
| Course Category | Open Elective I | Credits | 3 |
| Course Type | Theory | L-T-P | 2-0-2 |
| Prerequisites | 20AI&ML3303 | Continuous Eval | 30 |
| | -Introduction to Artificial | Semester End Eval | 70 |
| | Intelligence | Total Marks | 100 |

COURSE OUTCOMES

1. Interpret the basic principles of Robot and its anatomy.
2. Develop a basic robot that can perform simple tasks like toy lifting.
3. Make use of Hardware & Software for Robot speech recognition.
4. Inspect Robot planning for the Artificial Personality development.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 3 | 2 | | | | | | | | | | | 1 | 1 | 2 | 1.2.1, 1.4.1, 2.1.1, 2.4.1 |
| 2 | 1 | 3 | 2 | | | | | | | | | | 1 | 1 | 3 | 1.3.1, 1.3.1 2.4.4, 3.1.1, 3.1.5 |
| 3 | 1 | 3 | 1 | 1 | 1 | | | | | | | | 1 | 1 | 3 | 1.2.1, 2.5.2, 2.6.4, 2.8.1, 3.6.1, 4.1.1, 5.1.1 |
| 4 | 1 | 2 | 2 | | | 1 | | | | | | | 1 | 1 | 4 | 1.2.1, 1.4.1 2.5.2, 2.6.4, 3.2.2, 3.4.1, 6.1.1 |

COURSE CONTENT

UNIT I

Foundation for Advanced Robotics and AI: Basic principle of robotics – AI distinguishing, Advanced robotics techniques, Development environment, and Robot control system - Soft real time control.

Setting Up Robot: Robot anatomy, Software setup – Installing Python and ROS, Raspberry Pi3 setup, Hardware – Track assembling and Mounting, Arm assembly and wiring

UNIT II

Robot Design Process: Image recognition- training and development, Convolutions, Artificial neurons, Convolution neural networks, Usage of neural networks (NN)

Robot Teaching: Task analysis, Teaching the robot arm – Action states, Reinforcement learning, Q-Learning, and Genetic algorithms.

UNIT III

Robot Speech Recognition: Speech to text, Mycroft- Hardware and Software setup.

Avoiding the Stairs: Task analysis- SLAM, Navigation alternatives, NN training for navigation.

UNIT IV

Robot Planning: Decision tress, Entropy, One hot coding, Grid searching, A* algorithm

Artificial Personality: Turing test, Simulation, State machine, Human behavior model, AI Robot integration, Robot emotion engine.

TEXTBOOKS

1. Govers, F. X. (2018). Artificial intelligence for robotics: Build intelligent robots that perform human tasks using AI techniques. Packt Publishing Ltd.
2. Murphy, R. R. (2019). Introduction to AI robotics. MIT press.

REFERENCE BOOKS

1. Murphy, R. R. (Ed.). (2018). Robotics Through Science Fiction: Artificial Intelligence Explained Through Six Classic Robot Short Stories. MIT Press.
2. Yang, S., Lu, H. (Eds.). (2022). Artificial Intelligence and Robotics: 7th International Symposium, ISAIR 2022, Shanghai, China, October 21-23, 2022, Proceedings, Part I. Springer Nature.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Introduction to AI Applications in Robotics, <https://onlinedegrees.sandiego.edu/application-of-ai-in-robotics/> , Last accessed on 17 March 2024.
2. How do AI robots work? , <https://robotnik.eu/how-do-ai-robots-work-artificial-intelligence-and-mobile-robotics/>, Last accessed on 27 March 2024.

20AI&ML5205C

COMPUTATIONAL INTELLIGENCE

| | | | |
|-----------------|---|-------------------|-------|
| Course Category | Open Elective I | Credits | 3 |
| Course Type | Theory and Practice | L-T-P | 2-0-2 |
| Prerequisites | 20AI&ML3303 - Introduction to Artificial Intelligence | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Interpret neural network learning through computational intelligence.
2. Develop fuzzy sets with member functions.
3. Make use of fuzzy sets for the evolutionary computing.
4. Inspect fuzzy neural systems through neuro computing.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 3 | 2 | | | | | | | | | | | 1 | 1 | 2 | 1.2.1, 1.3.1 1.4.1, 2.1.2, 2.4.4 |
| 2 | 1 | 3 | 1 | | | | | | | | | | 1 | 1 | 3 | 1.2.1, 1.4.1 2.4.2, 2.4.4, 3.4.1 |
| 3 | 1 | 3 | 1 | | | | | | | | | | 1 | 1 | 3 | 1.2.1, 1.3.1 2.2.2, 2.4.4, 3.2.3, 3.4.1 |
| 4 | 1 | 2 | 2 | | | | | | | | | | 1 | 1 | 4 | 1.2.1, 1.3.1 2.4.2, 2.2.3, 3.2.1, 3.3.1, 3.4.1 |

COURSE CONTENT

UNIT I

Introduction: Computational intelligence, Computational neurons, Neural network (NN) architecture, Radial basis function.

Neural Network Learning: Universal approximators, Generic NN models, Learning NN, Target class selection, NN generalization.

UNIT II

Fuzzy Sets: Definition, Membership function determination, Fuzzy set characteristics, Fuzzy relations, Triangular norms, Information-based Fuzzy sets.

Matching Fuzzy Sets: Necessity and Compatibility measures, Rough sets, Shadowed sets, Cognition frame, Fuzzy set probability.

UNIT III

Fuzzy Set Computation: Extension principle, Fuzzy numbers, Rule-based computing, Fuzzy controller, Non-monotonic operations.

Evolutionary Computing: Gradient-based Probabilistic optimization, Genetic algorithms, Search space exploration, Computation classes

UNIT IV

Fuzzy Neural Systems: Neurocomputing, Fuzzy set preprocessing, Neural calibration, Knowledge-based learning, Linguistic interpretation, Hybrid fuzzy neural computing.

Fuzzy Neural Networks: Logic-based neurons, Referential neurons, Learning Fuzzy NN, Fuzzy encoding, Fuzzy meta rules, and Genetic optimization.

TEXTBOOKS

1. Pedrycz, Witold, Alberto Sillitti, and Giancarlo Succi. Computational intelligence: an introduction. Springer International Publishing, 2016.
2. Eberhart, Russell C., and Yuhui Shi. Computational intelligence: concepts to implementations. Elsevier, 2011.

REFERENCE BOOKS

1. Rutkowski, Leszek. "Computational." Intelligence Methods and, Techniques; Springer: Berlin/Heidelberg, Germany, 2008).
2. Lieto, Antonio, Cognitive design for artificial minds. Routledge, 2021.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. What is computational Intelligence, <https://www.engati.com/glossary/computational-intelligence>, Last accessed on 24 February 2024.
2. Essential Artificial Intelligence Skills, <https://www.coursera.org/learn/designing-autonomous-ai>, Last accessed on 12 January 2024.

20AI&ML5205D DATA ANALYTICS

| | | | |
|-----------------|--|-------------------|-------|
| Course Category | Open Elective I | Credits | 3 |
| Course Type | Theory | L-T-P | 2-0-2 |
| Prerequisites | 20ES2103C - Programming Essentials in Python | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the concepts of Data Analytics Life cycle and Big Data.
2. Apply advanced analytical theory and methods for real world problems.
3. Apply the concepts of regression and classification for analytical problems.
4. Understand text analysis and Hadoop ecosystem for unstructured data.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---------------------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 2 | 2 | | | | | | | | | | | 1 | 1 | 2 | 1.2.1,1.6.1,1.7.1, 2.5.2,2.6.4,3.5.1 |
| 2 | 1 | 2 | 2 | | | | | | | | | | 1 | 1 | 3 | 1.6.1,1.7.1, 2.5.2, 2.6.4,2.8.1,3.5.1 |
| 3 | 1 | 2 | 2 | | | | | | | | | | 1 | 1 | 3 | 1.6.1,1.7.1, 2.5.2, 2.6.4 3.5.1 |
| 4 | 2 | 2 | 2 | | | | | | | | | | 1 | 1 | 2 | 1.6.1,1.7.1, 2.5.2, 2.6.4,2.7.1,3.5.1 |

COURSE CONTENT

UNIT I

Introduction to Big Data Analytics: Big Data Overview, State of the Practice in Analytics, Key Roles for the New Big Data Ecosystem, Examples of Big Data Analytics.

Data Analytics Lifecycle: Data Analytics Lifecycle Overview, Discovery, Data Preparation, Model Planning, Model Building, Communicate Results, Operationalize.

UNIT II

Advanced Analytical Theory and Methods-Clustering: Overview of Clustering, K-means Use cases, Overview of method, Determining the number of clusters.

Advanced Analytical Theory and Methods-Association Rules: Apriori Algorithm, Evaluation of Candidate Rules, Applications of Association Rules, Transactions in a Grocery Store.

UNIT III

Advanced Analytical Theory and Methods-Regression: Linear Regression and Logistic regression.

Advanced Analytical Theory and Methods-Classification: Introduction, Decision Tree Representation, Attribute Selection measures, Decision Trees Introduction to Bayes Theorem, Naïve Bayes Classifier.

UNIT IV

Advanced Analytical Theory and Methods-Text Analysis: Text Analysis Steps, Text Analysis Example, Collecting Raw Text, Representing Text, Term Frequency—Inverse Document Frequency (TFIDF), Categorizing Documents by Topics, Determining Sentiments.

Advanced Analytics- Technology and Tools: MapReduce and Hadoop: Analytics for Unstructured Data, The Hadoop Ecosystem.

TEXTBOOKS

1. Data Science and Big Data Analytics, EMC2 Education Services, John Wiley, 2015 [Unit I,II,III,IV]

REFERENCE BOOKS

1. Benjamin Bengfort, Jenny Kim, Data Analytics with Hadoop: An Introduction for Data Scientists, OReilly ,1st Edition, 2016

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Nandansudharsanam and Prof . B.Ravindran , IIT Madras, Introduction to Data Analytics <https://nptel.ac.in/courses/110106072> Last accessed on 30 April 2024

20AI&ML5351

DATABASE SYSTEMS LABORATORY

| | | | |
|-----------------|----------------------------------|-------------------|-------|
| Course Category | Program Core | Credits | 1.5 |
| Course Type | Laboratory | L-T-P | 0-0-3 |
| Prerequisites | 20CS3305 - Data Structures | Continuous Eval | 30 |
| | 20BS3101A - Discrete Mathematics | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Demonstrate DDL, DML and DCL statements with integrity constraints
2. Design relational database and manipulate the same using simple and complex queries in SQL
3. Develop Entity Relationship and the corresponding Relational models for the given real-world application
4. Illustrate database objects like Procedure, Functions, Triggers and Package using PL/SQL
5. Apply transactions processing, Concurrency control and Recovery techniques on relational database

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 1 | 2 | 2 | | 2 | | | | | | | | | 1 | 1 | 3 | 1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 3.5.1, 3.6.2, 5.4.2 |
| 2 | 1 | 3 | 3 | | 3 | | | | | | | | | 1 | 1 | 6 | 1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 3.5.1, 3.6.2, 5.4.2, 5.5.2 |
| 3 | 1 | 3 | 3 | | 3 | | | | | | | | | 1 | 1 | 6 | 1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 3.5.1, 3.6.2, 5.4.2, 5.5.2 |
| 4 | 1 | 2 | 2 | | 2 | | | | | | | | | 1 | 1 | 4 | 1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 3.5.1, 3.6.2, 5.4.2 |
| 5 | 1 | 2 | 2 | | 2 | | | | | | | | | 2 | 2 | 3 | 1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 3.5.1, 3.6.2, 5.4.2 |

COURSE CONTENT

- Task 1:** Execute DDL, DML and DCL Commands on the suitable database.
- Task 2:** Implement the following Integrity Constraints on relevant database.
a. Primary Key, b. Foreign Key, c. Unique, d. Not NULL, e. Check
- Task 3:** Execute the aggregate functions like count, sum and avg on the suitable database. Make use of built-in functions according to the need of database chosen. Retrieve data from the database based on date function.
- Task 4:** Apply Set operations (UNION, UNION ALL, INTERSECT and MINUS), Sub-queries, Group by, Order by clause and Pattern Matching operators (LIKE, %) on fine-tuned Database.
- Task 5:** Implementation of different types of Joins, Views and Ranks.
- Task 6:** Draw ER diagram for an application with at least 3 entities and establish relationships between them using a tool. Perform ER to Relational mapping to derive Relational database.
- Task 7:** Write PL/SQL procedure for an application using exception handling for the following; a. Predefined exceptions, b. User defined exceptions.
- Task 8:** Write a PL/SQL block for transaction operations of a typical application using triggers.
- Task 9:** Create concurrent transactions and obtain concurrency control using SSMS.
- Task 10:** Utilizing recovery management, restore the database in case a catastrophic disk loss occurred.

DBMS Laboratory Projects

Design and Implement the given Database Application using the following requirements.

Database Analysis and Design: Build Conceptual schema using tools - Apply Normalization process for relational database design - Relational Model Database.

Implementation: Front End - Java/ Perl/ PHP/ Python/ Ruby/.Net, Back-end - SQL/MySQL/SQLite, Database Connectivity - ODBC/ JDBC/ Servlets.

TEXTBOOKS

1. Ramez, E., & Shamkant B, N. (2016). Fundamentals of database systems (7th ed.). Pearson Education Ltd.

REFERENCE BOOKS

1. Gordon S Linoff Data Analysis Using SQL and Excel, 2nd Edition Wiley 2016
2. Joan Casteel, Oracle 12c:SQL, Cengage Learning ,2017
3. J D Ullman, —Principles of database systems||, Computer Science Press, 2001.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof Arnab Bhattacharya IIT Kanpur, SQL Introduction <https://nptel.ac.in/courses/106104135/10>
2. Prof Arnab Bhattacharya IIT Kanpur SQL: Updates, Joins, Views and Triggers <https://nptel.ac.in/courses/106104135/11>
- 3 Geoff Allix and Graeme Malcolm: Microsoft , Querying with Transact-SQL (edX) <https://www.mooc-list.com/course/querying-transact-sql-edx>

20AI&ML5352

MACHINE LEARNING LABORATORY

| | | | |
|-----------------|--|-------------------|-------|
| Course Category | Program Core | Credits | 1.5 |
| Course Type | Laboratory | L-T-P | 0-0-3 |
| Prerequisites | 20ES2152C - Programming Essentials in Python Laboratory | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Demonstrate the necessary mathematical operations within the framework of Machine Learning.
2. Implement different dimensionality reduction techniques for feature exploration.
3. Analyze supervised and unsupervised machine learning algorithms to solve complex pattern recognition tasks.
4. Select different classification or regression algorithms to solve real world problems.

*Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)*

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 2 | 2 | | | 2 | | | | | | | | 1 | 1 | 3 | 1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3,5.4.2 |
| 2 | 2 | 2 | | 2 | 2 | | | | | | | | 1 | 1 | 3 | 1.2.1, 2.6.2, 2.6.4, 2.7.2, 4.6.4, 5.4.2 |
| 3 | 2 | 3 | 2 | 2 | 2 | 1 | | | | | | | 2 | 2 | 4 | 1.6.1, 2.5.2, 2.6.3, 2.6.4, 2.7.2, 3.6.1, 3.6.2 ,4.4.2, 4.6,1, 5.4.2 |
| 4 | 2 | 3 | 2 | 2 | 2 | 1 | | | | | | | 2 | 2 | 5 | 1.6.1, 2.5.2, 2.6.3, 2.6.4, 2.7.2, 3.6.1, 3.6.2, 4.4.2, 4.6,1, 5.4.2 |

COURSE CONTENT

Task 1

- i. Notebooks that refreshes python programming which are essentials for Machine Learning.
- ii. Programs to demonstrate matrix vector operations and linear transformations on data using numpy library.

Task 2

Programs to perform different data transformations using pandas library.

- i. Series and DataFrames.
- ii. Data Importing and Exporting through CSV and JSON Files.
- iii. Indexing, slicing and filtering with conditional slicing
- iv. Concatenating and Merging
- v. Descriptive statistics
- vi. Missing handling data and other preprocessing techniques

Task 3

Notebooks to visualize 2 –D and 3 –D data by constructing different plots using matplotlib and seaborn libraries.

Task 4

Notebook to demonstrate PCA on gene expression data
(<https://www.kaggle.com/datasets/crawford/gene-expression>)

Task 5

Notebook to demonstrate the notion of ‘training’ and ‘testing’ of different classifiers like Decision Tree, KNN, Naïve Bayes, Random Forest as black boxes on different public datasets using scikit-learn library.

Task 6

Notebooks related to Nearest Neighbors

- i. Visualize the decision boundaries
- ii. Role of hyper parameter ‘K’
- iii. Role of validation data as the choice of hyper parameter

Task 7

Notebooks related to Decision Tree Classifier

- i. Observe the over fitting with deep trees
- ii. How to control over fitting by looking at validation performance during training
- iii. Observe how cross validation techniques affects the performance of the model

Task 8

Program which elucidates the combination of Naïve Bayes and collaborative filtering to develop Recommendation Systems.

Task 9

Experiments related to K – means by varying in ‘K’ initialization, analyze how the algorithm changes by changing objective across iterations. Try multiple

datasets.

Task 10

Experiment that demonstrates how SVM can yield a solution better than simple linear separating solution. And also extend the problem for non linearly separable data.

Task 11

Notebook to demonstrate customer churn prediction using SVM classifier.

Task 12

Case Study: Build an end – to – end ML model for a problem statement in any domain

- i. Problem Identification
- ii. Dataset Gathering.
- iii. Data Preprocessing
- iv. Selection of suitable ML algorithm
- v. Evaluate different metrics
- vi. Finetune the model by adjusting hyperparameters
- vii. Test the model

TEXTBOOKS

- i. Machine Learning Yearning by Andrew Ng (more of a practical guide).
- ii. A. Geron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow," 2nd ed., O'Reilly, 2019.

REFERENCE BOOKS

1. K. P. Murphy, "Machine Learning: A Probabilistic Perspective," MIT Press, 2012.
2. A. A. Patel, "Hands-On Unsupervised Learning Using Python," O'Reilly Media, Inc., March 2019.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. J. Brownlee, "Machine Learning Mastery," Online. Available: <https://machinelearningmastery.com/starthere/python>
2. A. Ng, "Machine Learning Specialization," Coursera, Online. Available: <https://www.coursera.org/specializations/machine-learning-introduction>

20HS5153**ENGLISH COMMUNICATION SKILLS LABORATORY**

| | | | |
|-----------------|---|-------------------|-------|
| Course Category | Humanities and Social Sciences | Credits | 1 |
| Course Type | Laboratory | L-T-P | 0-0-2 |
| Prerequisites | 20HS1105 - Technical English and Communication Skills | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Execute rational pronunciation of speech sounds including accentuation.
2. Apply elements of listening comprehension in professional environments.
3. Develop the abilities of rational argumentation and skills of public speaking.
4. Demonstrate proficiency in the elements of professional communication including the competitive examination.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | | | | | | | | | | 3 | | | | | 3 | |
| 2 | | | | | 2 | | | | | 3 | | | | | 4 | |
| 3 | | | | | 2 | | | | | 3 | | | | | 4 | |
| 4 | | | | | 1 | | | | | 3 | | | | | 4 | |

COURSE CONTENT**UNIT I**

Elements of Spoken Expression and processes of Listening Comprehension: Speech Mechanism, Articulation of vowels and consonants, Patterns of Accentuation.

Types and processes of Listening comprehension.

UNIT II

Patterns of Substantiation and Refutation in Public Speaking: Group Discussion(Open and Monitored), Pyramid Discussion, PNI. Seminar Talk and Power Point Presentation.

UNIT III

Professional Communication: Self Affirmation, Advanced Composition

including Memo and e-mail, Resume Preparation. Corporate ethic of Non-Verbal Communication.

UNIT IV

Life Skills and Vocabulary for Competitive Examinations: Select Life Skills (50), Select Logics, Isms, Phobias and Manias (25 each), Sentence Completion and Double Unit Verbal Analogies (50 items).
Fundamentals of Syllogisms (Descriptive and Pictorial).

TEXTBOOKS

1. Martin Cutts, Oxford Guide to Plain English, 7th Impression, OUP, 2011
2. Exercises in Spoken English, Prepared by Department of Phonetics and Spoken English, CIEFL, OUP, 21st Impression, 2003

REFERENCE BOOKS

1. Stephen R Covey, The 7 Habits of Highly Effective people, II edition, (Pocket Books) Simon & Schuster UK Ltd, 2004
2. Eclectic Learning Materials offered by the Department

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. ODll Language Learner's Software, 27-6-2012 Orell Techno Systems
2. Visionet Spears Digital Language Lab software Advance Pro, 28-01-2015
3. www.natcorp.ox.ac.uk, British National Corpus accessed on 28-11-2017

20TP5106

PERSONALITY DEVELOPMENT

| | | | |
|-----------------|---------------------------|-------------------|-------|
| Course Category | Soft Skills - 3 | Credits | 1 |
| Course Type | Learning by Doing | L-T-P | 0-0-2 |
| Prerequisites | 20TP4106 | Continuous Eval | 100 |
| | English for Professionals | Semester End Eval | 00 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the corporate etiquette.
2. Make presentations effectively with appropriate body language.
3. Be composed with positive attitude.
4. Understand the core competencies to succeed in professional and personal life.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | | | | | | | | 2 | | 3 | | | | | 2 | |
| 2 | | | | | | | | | 2 | 3 | | | | | 3 | |
| 3 | | | | | | | | | | 3 | | | | | 3 | |
| 4 | | | | | | | | | 2 | 3 | | | | | 2 | |

COURSE CONTENT

UNIT I

Analytical Thinking and Communication Skills: Self-Introduction, Shaping Young Minds - A Talk by Azim Premji (Listening Activity), Self-Analysis, Developing Positive Attitude, Perception; Verbal Communication, Non Verbal Communication (Body Language)

UNIT II

Self-Management Skills and Etiquette: Anger Management, Stress Management, Time Management, Six Thinking Hats, Team Building, Leadership Qualities; Social Etiquette, Business Etiquette, Telephone Etiquette, Dining Etiquette

UNIT III

Standard Operation Methods and Verbal Ability: Note Making, Note Taking, Minutes Preparation, Email Letter Writing; Synonyms, Antonyms,

One Word Substitutes-Correction of Sentences-Analogies, Spotting Errors, Sentence Completion, Course of Action -Sentences Assumptions, Sentence Arguments, Reading Comprehension, Practice work

UNIT IV

Career-Oriented Skills: Group Discussion, Mock Group Discussions, Resume Preparation, Interview Skills, Mock Interviews

TEXTBOOKS

- i. Audio—Visuals/ Handouts (Compiled/ Created by Training Division, T&P Cell, VR Siddhartha Engineering College).

REFERENCE BOOKS

- i. Mitra, B. K. (2011). Personality development and soft skills (Vol. 156). Oxford University Press.
- ii. Dhanavel, S. P. (2011). English and Soft Skills. Orient Blackswan Pvt Limited.
- iii. Aggarwal, R. S. (2018). A Modern Approach to Verbal & Non Verbal Reasoning. S. Chand.
- iv. Meenakshi, R. & Sharma, S. (2011). Technical Communication Principles and Practice. Oxford University Press.

E-RESOURCES AND OTHER DIGITAL MATERIALS

- i. Aptitude Questions and Answers. (n.d.). IndiaBIX. <https://www.indiabix.com/>. Last accessed on June 5, 2022.
- ii. Placement Papers of all IT Companies. (n.d.). Freshersworld. <https://placement.freshersworld.com/placement-papers>. Last accessed on June 5, 2022.

20AI&ML5354

ENGINEERING PROJECT FOR COMMUNITY SERVICES EPICS

| | | | |
|-----------------|--------------------------|-------------------|-------|
| Course Category | Project Work /Internship | Credits | 1.5 |
| Course Type | Laboratory | L-T-P | 0-0-3 |
| Prerequisites | – | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Identify a societal problem.
2. Solve the problem.
3. Design the work plan.
4. Design and validation of the prototype/ model.

*Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)*

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | | | | | | 2 | 3 | | | | | | 2 | 2 | | |
| 2 | | | | | | 3 | 1 | | | 2 | | | 2 | 2 | | |
| 3 | | | | | | 3 | | | 2 | | | | 2 | 2 | | |
| 4 | | | | | | | | | 1 | 3 | | | 2 | 2 | | |

The students may register

EPICS: Engineering Project for community services will be carried out during summer vacation for a period of six weeks after IV Semester and the report shall be submitted in V Semester. Students will go to the society (Villages/Hospitals/Towns, etc.,) to identify the problem and survey the literature for a feasible solution. The student(s) is encouraged to solve real life problems leading to innovative model building.. This can be done in a group of students or as an individual.

Internship: The students are expected to do internship of minimum 3 weeks duration in the industry approved by respective Head of the Department. It carries two credits. The candidate shall submit the comprehensive report to the department. The report will be evaluated for 100 marks by the project review committee.

20AI&ML5607

INDUSTRY STANDARD CODING PRACTICE – II

| | | | |
|-----------------|--|-------------------|-------|
| Course Category | Skill Oriented Course - 2 | Credits | 1 |
| Course Type | Laboratory | L-T-P | 1-0-2 |
| Prerequisites | 20AI&ML4607: Industry Standard coding practice-1 | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Able to understand test and development aspects of programming by solving problems at Industry standards.
2. Able to interpret any given problem using required domain skills, mathematics.
3. Able to learn and apply methods to optimize solutions for any given problem.
4. Able to solve problems using elementary data structures with test driven development.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 3 | 2 | 1 | | | | | | | | | | | | | | |
| 2 | | 3 | | | | | | | | | | | 2 | 2 | | | |
| 3 | | 1 | | | | | | | 2 | | | | 3 | 3 | | | |
| 4 | 2 | 3 | | | | | | | | | | | 2 | 2 | | | |

COURSE CONTENT

UNIT I

Problem solving using Stacks, Coding solutions for the implementation of stack using an array, Coding solutions for the implementation of stack using a linked list, Problem solving on expression conversion and evaluations, Examples, Practice Problems.

UNIT II

Search operations implementing linear/binary search, Bubble Sort, Selection Sort, Insertion Sort, Evaluation of sorting Algorithms. Problem solving using Quick Sort, Merge Sort, $O(n \log n)$ algorithms, Examples, Practice problems.

UNIT III

Problem solving approaches using Non-linear data structures, Coding problems

on the height of a binary tree, Size of a binary tree, Tree order traversals, Problem Solving on Binary Trees, Problems solving on key search on binary search trees, Time comparison and analysis on Binary Search Trees, Coding on a binary search tree problems, Search/ probe sequence validation, Examples, Practice problems.

UNIT IV

Industry Standards of leveraging DBMS concepts: SQL Queries, Entity Relationship Models, Question and answers, Query Optimization, Transactions & Concurrency, Normalization, case studies, Question and answers Examples, Practice problems.

TEXTBOOKS

1. Halim, Steven and Halim, Felix, Competitive Programming 3, 2013.
2. Ahmed Shamsul Arefin, Art of Programming Contest, ACM Solver, Second Edition, 2012

REFERENCE BOOKS

1. Programming Challenges: The Programming Contest Training Manual By Steven S Skiena, Miguel A. Revilla
2. Guide to Competitive Programming: Learning and Improving Algorithms Through Contests By Antti Laaksonen

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Topcoder tutorials - <https://www.topcoder.com/community/data-science/data-science-tutorials/>
2. Nite Nimajneb's site - <http://comscigate.com/Books/contests/icpc.pdf>
3. Slides from a Stanford Course - <http://web.stanford.edu/class/cs97si/>
4. Halim, Steven and Halim, Felix, Competitive Programming 3, 2013. Ebook available at lulu.com. Site associate with with the book is <http://cpbook.net>

20MC5108A

BIOLOGY FOR ENGINEERS

| | | | |
|-----------------|---------------------|-------------------|-------|
| Course Category | Humanities Elective | Credits | - |
| Course Type | Theory | L-T-P | 2-0-0 |
| Prerequisites | - | Continuous Eval | 100 |
| | | Semester End Eval | 00 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Describe the fundamental Principles and methods of engineering
2. Identify the functions of different types in bio-molecules
3. Describe mechanisms underlying the working of molecular biological processes including enzyme catalysis, metabolic pathways, gene expression.
4. Use Excel, MATLAB and other computational tools to quantitatively analyze biological processes.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 2 | 3 | | | | | | | | | | | | | | | |
| 2 | | 3 | | | | | | | | | | | | | | | |
| 3 | | 2 | | 4 | | | | | | | | | | | | | |
| 4 | | 1 | | 2 | 3 | | | | | | | | | | | | |

COURSE CONTENT

UNIT I

Introduction and Classification of Living organisms

Introduction: Fundamental differences between science and engineering, draw a comparison between eye and camera, Bird flight and aircraft. Biological observations of 18th Century that lead to major discoveries-examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor.

Classification: Classification of living organisms based on (a) Cellularity - Unicellular or multicellular (b) Ultrastructure- prokaryotes or eukaryotes. (c) Energy and Carbon utilization -Autotrophs, heterotrophs, lithotrophs (d) Ammonia excretion – ammonotelic, uricotelic, ureotelic (e)Habitat- aquatic, terrestrial (e) Molecular taxonomy- three major kingdoms of life.

UNIT II

Biomolecules and Enzymes

Biomolecules: Structures of sugars (Glucose and Fructose), starch and cellulose. Nucleotides and DNA/RNA. Amino acids and lipids. Proteins - structure and functions- as enzymes, transporters, receptors and structural elements.

Enzymes: Enzyme classification. Mechanism of enzyme action, Enzyme kinetics and kinetic parameters.

UNIT III

Genetics and Gene information Transfer

Genetics: Mendel's laws of inheritance, Concept of segregation and independent assortment. Concept of allele, recessiveness and dominance. Gene interaction-Epistasis. Cell cycle and cell division-Meiosis and Mitosis. Transfer of genetic material from parent to offspring during cell division.

Information Transfer: DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

UNIT IV

Metabolism and Microbiology

Metabolism: Exothermic and endothermic reactions versus endergonic and exergonic reactions. Respiration- Breakdown of glucose to $\text{CO}_2 + \text{H}_2\text{O}$ (Glycolysis and Krebs cycle) Photosynthesis- synthesis of glucose from CO_2 and H_2O . Energy yielding and energy consuming reactions.

Microbiology: Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Growth kinetics. Ecological aspects of single celled organisms. Microscopy.

TEXTBOOKS

1. Campbell N. A, Reece J. B, Urry, Lisa, Cain M. L, Wasserman S. A, Minorsky P. V, Jackson R. B, Biology: A global approach, Pearson Education Ltd.
2. Conn E.E, Stumpf P.K, Bruening G; Doi R.H, John Wiley and Sons, Outlines of Biochemistry.
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher, Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Biological & Environmental Engineering, https://bee.cals.cornell.edu/sites/bee.cals.cornell.edu/files/shared/documents/Career_Bee_Final-for-Web.pdf
2. <https://www.teachengineering.org/subjectareas>

SEMESTER VI

20AI&ML6301

NEURAL NETWORKS & DEEP LEARNING

| | | | |
|-----------------|----------------------------------|-------------------|-------|
| Course Category | Program Core | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20AI&ML5302: Machine Learning | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand Biological and Artificial Neurons, Architecture of DNNs
2. Apply training challenges of Deep Neural Networks (DNNs).
3. Apply Recurrent Neural Networks (RNNs) to model the sequential data.
4. Apply the attention mechanism and transfer learning techniques by fine-tuning.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----------------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 1 | 1 | | | 1 | | | | | | | | 1 | 1 | 2 | 1.7.1, 2.5.2, 2.6.3, 5.4.1 |
| 2 | 1 | 1 | | | 2 | | | | | | | | 1 | 1 | 3 | 1.7.1, 2.5.2, 2.6.3, 5.4.1 |
| 3 | 2 | 2 | | | 2 | | | | | | | | 1 | 1 | 3 | 1.7.1, 2.5.2, 2.6.3, 2.7.1, 5.4.1 |
| 4 | 2 | 2 | | | 1 | | | | | | | | 1 | 1 | 3 | 1.7.1, 2.5.2, 2.6.3, 2.7.1, 5.4.1 |

COURSE CONTENT

UNIT I

Biological Neurons vs. Artificial Neurons: Perceptron Model and Learning Algorithms-Single-layer and Multi-layer Perceptrons, Activation Functions: Sigmoid, Tanh, ReLU, Softmax.

Feedforward Neural Networks (FNN): Forward and Backward Propagation, Gradient Descent and Optimization Techniques, Loss Functions: Loss Function Notation, Loss Functions for Regression, Loss Functions for Classification, Loss Functions for Reconstruction Hyperparameters: Learning Rate, Regularization, Momentum.

UNIT II

Deep Neural Networks (DNN): Architecture of DNNs, Training Deep Networks: Challenges and Solutions

Optimization in Deep Learning: Stochastic Gradient Descent (SGD), Adam, RMSprop, Vanishing and Exploding Gradient Problems: Techniques to Mitigate- Batch Normalization, Weight Initialization, Hyper parameter Tuning and Model Selection

UNIT III

Introduction to CNNs: Convolution Operation, Filters/Kernels, Feature Maps, Architectures of CNNs: Pooling Layers, Padding, Stride, Fully Connected Layers, Dropout in CNNs.

Popular CNN Architectures: LeNet, AlexNet, VGG, ResNet, Applications of CNNs: Image Classification, Object Detection, Image Segmentation.

Understanding RNNs: Basic Architecture, Unrolling, Backpropagation Through Time (BPTT), Long Short-Term Memory (LSTM) and Gated Recurrent Units (GRU): Internal Mechanisms, Gates in LSTM and GRU.

UNIT IV

Architecture of GANs: Generator and Discriminator, Applications of GANs: Image Generation, Data Augmentation.

Attention Mechanisms and Transformers: Introduction to Attention in Deep Learning, Self-Attention, Transformer Models (e.g., BERT, GPT)

Transfer Learning and Pre-trained Models: Fine-tuning of Pre-trained Networks (VGG, ResNet, BERT)

TEXTBOOKS

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville , Deep Learning , MIT Press, 2016.

REFERENCE BOOKS

1. Charu C. Aggarwal, Neural Networks and Deep Learning: A Textbook, Springer, 2018
2. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer New York, 2006.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Machine learning education, <https://www.tensorflow.org/resources/learn-ml>, Last accessed on :02/10/2024.
2. Deep Learning.AI, <https://www.deeplearning.ai/resources/> , Last Accessed on: 17/10/2024.

20AI&ML6302

AUTOMATA & COMPILER DESIGN

| | | | |
|-----------------|---|-------------------|-------|
| Course Category | Program Core | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20ES3102: Digital logic and Computer Design | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the basic concepts of formal languages and finite automata Techniques.
2. Apply the parsing techniques for the given programming construct described in Context Free Grammar.
3. Apply the suitable intermediate representation based on the storage administration.
4. Apply the functionalities for generating the machine code involved in different phases of the compilation process.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 2 | 2 | | | | | | | | | | | | | | 2 | 1.2.1, 1.6.1, 1.7.1, 2.5.2 |
| 2 | 2 | 2 | 3 | | | | | | | | | | | | 2 | 3 | 1.2.1, 1.6.1, 1.7.1, 2.5.2, 2.6.4, 3.5.1 |
| 3 | 2 | 3 | 3 | | | | | | | | | | | | 2 | 3 | 1.2.1, 1.6.1, 1.7.1, 2.5.2, 2.7.1, 3.5.1 |
| 4 | 1 | 2 | 3 | | | | | | | | | | | | 3 | 3 | 1.2.1, 1.6.1, 1.7.1, 2.5.2, 2.6.4, 2.7.1, 3.5.1 |

COURSE CONTENT

UNIT I

Structure of Compiler: Lexical Analysis, Syntax analysis, Intermediate Code generation, Code Optimization, Code generation, Bookkeeping, Error handling.

Formal Language and Regular Expressions: Languages, Definition Languages regular expressions, Finite Automata – DFA, NFA. Conversion of

regular expression to NFA, NFA to DFA. Applications of Finite Automata to lexical analysis, lex tools.

UNIT II

Context Free grammars and parsing: Context free grammars, derivations, parse trees, ambiguity, simplification of CFG.

Normal Forms: CNF and GNF. Top Down and Bottom up Parsing: LL(K) grammars and LL(1) parsing, Bottom up parsing, handle pruning, LR Parsing, parsing using ambiguous grammars.

UNIT III

Syntax Directed Translation: S-attributed and L-attributed grammars, abstract syntax trees.

Intermediate Code: types of intermediate code, Translation of simple assignment statements and control flow statements. Type checking, type conversions.

Symbol Table: The contents of a symbol table, Data structures for symbol tables, Representing scope information.

UNIT IV

Storage organization: Storage allocation strategies, scope access to non-local names, language facilities for dynamics storage allocation.

Code optimization: Principal sources of optimization, optimization of basic blocks, flow graphs, peephole optimization.

Code Generation: Issues in the design of a Code generator, The Target language, A simple code generator, Code generation from DAG's.

TEXTBOOKS

1. John E. Hopcroft, Rajeev M & J D Ullman: Introduction to Automata Theory Languages & Computation, Pearson, 3rd Edition, Education, 2007.
2. Alfred V. Aho, Jeffrey D. Ullman, Principles of Compiler Design, Narosa Publishing, 2002.
3. Alfred V. Aho, Monica S Lam, Ravi Sethi, Jeffrey D Ullman, Compilers Principles, Techniques and Tools, Pearson Education India, 2nd Edition, 2014.

REFERENCE BOOKS

1. Tremblay J P, Sorenson G P: The Theory & Practice of Compiler writing, BSP publication, 1st Edition, 2010.
2. Loudon, Compiler Construction: Principle and Practice, Cengage Publications, 1997.
3. Jean-Paul Tremblay, Paul G. Sorenson, The Theory and Practical of Compiler Writing, BS Publications, 2009.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof.Y.N.Srikant, Department of Computer Science and Automation, IISc Bangalore, Compiler Design, <http://nptel.iitm.ac.in/courses/106108052>, Last access on: 09/08/2024.
2. Professor Sanjeev K Agarwal, Dept. of CSE IIT Kanpur, NPTEL lectures, <http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR/compiler-design/ui/TOC.html>, Last accessed on: 10/09/2024.

20AI&ML6303

SOFTWARE ENGINEERING

| | | | |
|-----------------|--------------|-------------------|-------|
| Course Category | Program Core | Credits | 2 |
| Course Type | Theory | L-T-P | 2-0-0 |
| Prerequisites | - | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the different software engineering process models.
2. Apply analysis model for different applications.
3. Apply design model for different application.
4. Apply different testing techniques.

*Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)*

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 2 | 3 | | | | | | | | | | | 2 | 2 | 2 | 1.7.1, 2.5.1, 2.5.2, 2.6.4, 2.7.1 |
| 2 | 2 | 2 | 3 | | | | | | | | | | 1 | 2 | 3 | 1.7.1, 2.5.1, 2.7.1, 3.5.1, 3.5.2, 3.5.6 |
| 3 | 2 | 2 | 3 | | | | | | | | | | 1 | 2 | 3 | 1.7.1, 2.5.1, 2.6.4 3.5.1, 3.8.1 |
| 4 | 2 | 2 | 3 | | | | | | | | | | 2 | 3 | 3 | 1.7.1, 2.5.1, 2.6.4 3.5.1, 3.6.2, 3.8.2 |

COURSE CONTENT

UNIT I

The Nature of Software: The Nature of Software, The changing nature of software. Software engineering: The Software Process, Software Engineering Practice, Software Development Myths.

The Software Process: Software Process Structure. A Generic Process Model, Defining a framework activity, identifying a task set, Process patterns, Process Assessment and Improvement. Process models: Prescriptive Process Models, Specialized Process Models, The Unified Process, Personal and Team Process Models.

Agile Development: Agility and the Cost of Change, Extreme Programming (XP) Other Agile Process Models, A Tool Set for the Agile Process.

UNIT II

Understanding Requirements: Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Analysis Model, Negotiating Requirements, Requirements monitoring, and Validating Requirements.

Requirements Modeling: Scenario Based Methods: Requirements Analysis, Scenario-Based Modeling, UML Models That Supplement the Use Case. Class based methods, Identifying Analysis classes, specifying attributes, Defining operators, Class-Responsibility-Collaborator Modeling, Associates and Dependencies, Analysis Packages.

Behavior, Patterns, And Web apps: Creating a Behavioral Model, identifying events with Use Cases, State Representations, Patterns for Requirements Modeling, Requirements Modeling for Web and Mobile Apps.

UNIT III

Design Concepts: Design within the Context of Software Engineering, the Design Process, Design Concepts, the Design Model.

Architectural Design: Software Architecture, Architectural Genres, Architectural Styles, Architectural Considerations, Architectural Decisions, Architectural Design. Component-Level Design: Designing Class-Based Components, Conducting Component Level Design, and Component level design for Web Apps, Component Level Design for Mobile Apps.

User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Web app and Mobile Interface Design

UNIT IV

Software Testing Strategies: A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Test Strategies for Object-Oriented Software, Test Strategies for Web Apps, Test Strategies for Mobile Apps, Validation testing, System testing, the art of debugging.

Testing Conventional Applications: Software Testing Fundamentals, Internal and External Views of Testing, White Box Testing, Basis Path Testing, Control Structure Testing, Black-Box Testing.

TEXTBOOKS

1. Roger S. Pressman, Bruce R. Maxim, Software Engineering a practitioners approach” 8th Edition, McGraw-Hill Publication 2019.

REFERENCE BOOKS

1. Ian Sommerville, Software Engineering, 9th Edition, Pearson Education. 2011.
2. Software Engineering principles and practice- Waman S Jawadekar, The

Mc Graw Hill Companies.

3. Fundamentals of object-oriented design using UML Meiler page-Jones: Pearson Education.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Software Engineering Course, https://www.tutorialspoint.com/software_engineering/index.htm, Last Accessed on: 12/09/2024.
2. Prof. Rajib Mall, IIT Kharagpur, Software Engineering, <https://archive.nptel.ac.in/courses/106/105/106105182/> Last Accessed On: 12/09/2024.

20AI&ML6404A

BIG DATA ANALYTICS

| | | | |
|-----------------|----------------------------|-------------------|-------|
| Course Category | Program Elective | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 23PC2104A: Data Structures | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand fundamental concepts of Big Data analytics.
2. Understand and implement Hadoop Big Data Framework
3. Apply appropriate Big Data tools to solve actual Big Data problems.
4. Apply Map Reduce Programming in Big Data analysis.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 3 | 2 | 1 | | | | | | | | | | 1 | 1 | 2 | 1.6.1, 1.7.1, 2.5.2, 3.5.1 |
| 2 | 1 | 3 | | | | | | | | | | | 1 | 1 | 2 | 1.2.1, 1.6.1, 1.7.1, 2.5.2 |
| 3 | 2 | 2 | 3 | | 3 | | | | | | | | 1 | 1 | 3 | 1.2.1, 1.6.1, 1.7.1, 2.5.2, 2.7.1, 3.5.1, 5.4.1 |
| 4 | 1 | 3 | 1 | | | | | | | | | | 1 | 1 | 3 | 1.2.1, 1.6.1, 1.7.1, 2.5.2, 2.6.4, 2.7.1, 3.5.1 |

COURSE CONTENT

UNIT I

Introduction to Big Data: Types of Digital Data-Characteristics of Data – Evolution of BigData - Definition of Big Data - Challenges with Big Data - 3Vs of Big Data - Big Dataclassification - Business Intelligence vs. Big Data – Introduction to Big Data platform -Data warehouse and Hadoop environment – Big Data Storage, Big Data Analytics:Classification of analytics – Big Data Analytics Applications, Fundamental concepts of BigData management and analytics – Current challenges and trends in Big Data Acquisition -Analytic scalability, Analysis versus reporting, Popular Big Data Techniques and tools.

UNIT II

Introduction To Big Data Framework : Introduction to Big data framework - Introduction to Hadoop Features – Advantages – Versions - Overview of Hadoop Eco systems - Hadoop distributions - Hadoop vs. SQL –RDBMS vs. Hadoop - Distributed Computing Challenges - Hadoop Components – Architecture – HDFS (Hadoop Distributed File System), HDFS Daemons, Anatomy of File read, Write, Replica management Strategy, working with HDFS Commands - Processing Data with Hadoop - Map Reduce Framework. Hadoop 2 (YARN): Architecture - Managing Resources and Applications with Hadoop YARN - Interacting with Hadoop Eco systems

UNIT III

Hadoop Eco systems: Hive – Introduction to Hive, Hive Query Language, Architecture - data type - File format – HQL – SerDe - User defined functions - Pig: Features – Anatomy - Pig on Hadoop - Pig Philosophy - Pig Latin overview - Data types - Running pig - Execution modes of Pig - HDFS commands - Relational operators - Eval Functions - Complex data type - Piggy Bank - User defined Functions - Parameter substitution - Connecting to Mongo DB - Connecting to Cassandra. Hadoop environment. Frameworks: Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services – HiveQL – Querying Data in Hive

UNIT IV

MapReduce: Introduction, Map Tasks– Grouping by key – Partitioner - Reduce Tasks – Combiners, Details of MapReduce Execution - Coping With Node Failures, Composing MapReduce for Calculations, Algorithms Using MapReduce - Matrix vector multiplication by Map Reduce.

MapReduce Programming: Introduction – Developing a Map Reduce Application - How Map Reduce Works - Anatomy of a Map Reduce Job run – Failures - Job Scheduling - Shuffle and Sort – Task execution - Map Reduce Types and Formats – Features

TEXTBOOKS

1. Seema Acharya, Subhashini Chellappan, Big Data and Analytics, Wiley Publication, 2015.
2. Raj Kamal and Preeti Saxena, Big Data Analytics Introduction to Hadoop, Spark, and Machine- Learning, McGraw Hill Education, 2018.

REFERENCE BOOKS

1. Radha Shankarmani, Vijayalakshmi, Big Data Analytics, Wiley Publications, 1st Edition, 2016.
2. Anand Rajaraman, Jure Leskovec, and Jeffrey D. Ullman, Mining of massive datasets, Copyright, 2014.

3. Hadoop: The Definitive Guide, 3rd Edition, O'Reilly Media.
4. DT Editorial Services, Black Book- Big Data (Covers Hadoop 2, MapReduce, Hive, Yarn, PIG, R, Data visualization), Dream tech Press edition, 2016.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Big Data IIT Kanpur-Nptel <https://www.youtube.com/watch?v=rvJgArru8dI>, Last Accessed on:16/9/2024.
2. Big Data Analytics, <https://www.geeksforgeeks.org/>, Last Accessed on:16/9/2024.

20AI&ML6404B

CYBER SECURITY

| | | | |
|-----------------|--|-------------------|-------|
| Course Category | Program Elective | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20AI&ML5404B: Cryptography & Network Security | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand classification of cyber crimes.
2. Understand the impact of cyber attacks.
3. Apply tools and methods used in cyber crime.
4. Understand organizational implications of cyber security.

*Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)*

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 3 | 2 | | | | | | | | | | | 1 | 1 | 2 | 1.7.1, 2.6.4 |
| 2 | 2 | | | | | | | 2 | | | | | 1 | 2 | 2 | 1.7.1, 8.3.1 |
| 3 | 2 | | | | 3 | | | | | | | | 1 | 1 | 3 | 1.7.1, 5.4.1, 5.5.1 |
| 4 | | | 2 | | | | | 2 | | | | | 1 | 2 | 2 | 3.6.2, 8.3.1 |

COURSE CONTENT

UNIT I

Introduction of Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Cybercriminals, Classifications of Cybercrimes: E-Mail Spoofing, Spamming, Internet Time Theft, Salami Attack/Salami Technique, Data Diddling, Forgery, Web Jacking, Newgroup Spam, Industrial Espionage, Hacking, Online Frauds, Pornographic Offenses, Software Piracy, Computer Sabotage, E-Mail bombing, computer network intrusions, password sniffing, credit card frauds, identity theft.

UNIT II

Cyber offenses: Criminals Plan: Categories of Cybercrime Cyber Attacks: Reconnaissance, Passive Attack, Active Attacks, Scanning/Scrutinizing gathered Information, Attack, Social Engineering: Classification of Social Engineering.

Cyberstalking: Types of Stalkers, Working of Stalking, Real-Life Incident

of Cyber stalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Botnet, Attack Vector, Attacks on mobile/cell phones – Theft, viruses, phishing, vishing, smishing, hacking Bluetooth.

UNIT III

Tools and Methods: Introduction, Proxy Servers and Anonymizers, how phishing works, password cracking, keyloggers and spywares, types of viruses, steganography, DoS and DDoS attacks – classification, types, tools used for launch, DDoS attacks, protection, SQL injection – steps and prevention, Buffer Overflow – types and minimizing attack, Attacks on Wireless Networks.

UNIT IV

Organizational Implications –Introduction –Insider threats, Privacy, Key challenges to organizations, Cost of Cybercrimes and IPR issues

Incident Handling: Definitions, Organizations need Incident Response systems, Examples of incidents, what organizations can do to protect, best practices for organizations.

TEXTBOOKS

1. Nina Godbole, Sunit Belapur, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley India Publications, 2nd Edition, April, 2015.

REFERENCE BOOKS

1. James Graham, R Howard, R Olson, Cyber Security Essentials CRC Press, 2018.
2. Michael E Whitman, Herbert J Mattord, Principles of Information Security, Edition, 4th Edition, Cengage Learning, 2012.
3. William Stallings, Cryptography and Network Security- Principles and Practice, Pearson Education, 7th Edition, 2017.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. MitOpenCourseWare Computer Systems Security https://ocw.mit.edu/courses/6-858-computer-systems-security-fall-2014/video_galleries/video-lectures/ Last accessed on: 09/11/2024.
2. Oxford Home Study Center, Cyber Security short course, <https://www.oxfordhomestudy.com/courses/cyber-security-courses/free-cyber-security-online> Last accessed on: 09/11/2024.

20AI&ML6404C

AUGMENTED REALITY & VIRTUAL REALITY

| | | | |
|-----------------|-------------------------------|-------------------|-------|
| Course Category | Program Elective | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20AI&ML3304: Java Programming | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the concepts of virtual reality and Communication Media
2. Understand about the human perceptual system.
3. Understand about various input and output devices used in the virtual reality
4. Apply the concepts of Representation and Rendering of the Virtual World.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|----------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 1 | 2 | | | | | | | | | | | 1 | | 2 | 1.2.1,1.6.1,2.6.1, 2.7.1 |
| 2 | 1 | 2 | | | | | | | | | | | 1 | | 2 | 1.2.1, 1.6.1, 2.6.1, 2.7.1 |
| 3 | 1 | 2 | | | | | | | | | | | 1 | | 2 | 1.2.1, 1.6.1, 2.6.1, 2.7.1 |
| 4 | 1 | 2 | | | | | | | | | | | 1 | | 3 | 1.2.1, 1.6.1, 2.6.1, 2.7.1 |

COURSE CONTENT

UNIT I

Introduction To Virtual Reality (VR): Defining Virtual Reality, Five key elements of the virtual reality experience, Virtual Reality, Telepresence, Augmented Reality and Cyberspace, History of Virtual Reality.

VR-The Medium: Communicating through a Medium, Communication: Conveyance of Ideas, Common Issues of Human Communication Media.

UNIT II

The Human in the Loop: The Human Perceptual System: Sensation-The Physiological Side of Perception, Visual Perception, Aural Perception,

Haptic Perception, Vestibular Perception, Olfactory Perception, Gustation Perception, Cross-Sensory Effects and Virtual Reality.

Presence And Embodiment: The Concept of Presence, The Determinants and Responses of Presence, Measuring Presence, Embodiment.

UNIT III

Interfacing the Participant(s) with the Virtual World (Input):

Input Technologies, Input Classifications, Position, Tracking Technologies, Using Inputs within a Virtual Reality System, Position Tracking the Body, Physical Input Devices, Body Posture and Gesture Recognition, Speech Recognition (Audio Input). Input Technologies, Input Classifications, Position, Tracking Technologies, Using Inputs within a Virtual Reality System, Position Tracking the Body, Physical Input Devices, Body Posture and Gesture Recognition, Speech Recognition (Audio Input).

Interfacing The Virtual World With The Participant(s)(Output):

Visual Displays, Nonocclusive Head, Based Displays, Smartphone, Virtual Reality Head, Based Displays, Handheld Virtual Reality, Summary of Visual Display Paradigms; Aural Displays, Properties of Aural Displays, Aural Display Paradigms; Haptic Displays, Properties of Haptic Displays, Haptic Display Paradigms, Tactile Haptic Displays, End, Effector Displays.

UNIT IV

Presenting The Virtual World : Representation of the Virtual World-Verisimilitude, Human Perception, choosing a Mapping, Quantitative and Qualitative Representations; Visual Representation in VR, Aural Representation in VR, Haptic Representation in VR; Rendering Systems- Visual Rendering Systems, Sonic Rendering Systems, Haptic Rendering Systems.

The Virtual Reality Experience: Immersion, providing the Context, Physical/Sensory Immersion, Mental Immersion, the virtual World: Substance of the Virtual World, Object Modelling and World Layout.

TEXTBOOKS

1. William R. Sherman and Alan B. Craig, Understanding Virtual Reality Interface, Application, and Design, Morgan Kaufmann Publishers, 2nd Edition, Elsevier, 2019.

REFERENCE BOOKS

1. Rajesh K. Maurya, Computer Graphics with Virtual Reality System, 3rd Edition, Wiley Publication, 2018.
2. Grigore C. Burdea, Philippe Coiffet, Virtual Reality Technology, 2nd Edition, Wiley, 2017.
3. K.S. Hale and K. M. Stanney, Handbook on Virtual Environments, 2nd Edition, CRC Press, 2015.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Steven LaValle, IIT Madras, Virtual Reality, <https://nptel.ac.in/courses/106106138>, Last Accessed on: 17/10/2024.
2. Dr.M.Manivannan, Professor, Department of Applied Mechanics, IIT Madras, <https://elearn.nptel.ac.in/shop/iit-workshops/completed/foundation-course-on-virtual-reality-and-augmented-reality/> Last Accessed on: 17/10/2024.

20AI&ML6404D BACKEND TECHNOLOGIES

| | | | |
|-----------------|-------------------------------|-------------------|-------|
| Course Category | Program Elective | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20AI&ML3304: Java Programming | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand Django framework, MVT architecture .
2. Apply Django framework to develop dynamic web application connecting database
3. Apply Django to Create a web application.
4. Apply PHP to create an interactive web application

*Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)*

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 2 | 2 | | | | | | | | | | | | | 2 | 1.7.1,2.5.1,2.5.2 |
| 2 | 2 | 2 | 3 | | | | | | | | | | 2 | 2 | 3 | 1.7.1,2.5.1,2.5.2, 2.6.3, 2.7.1,3.5.1 |
| 3 | 2 | 2 | 2 | | | | | | | | | | 2 | 2 | 3 | 1.7.1,2.5.1, 2.5.2, 2.6.3, 2.6.4 3.5.1 |
| 4 | 2 | 2 | 3 | 2 | 2 | | | | | | | | 2 | 2 | 3 | 1.7.1,2.5.1,2.5.2, 2.6.3, 2.6.4, 3.5.1, 4.6.2,5.4.2 |

COURSE CONTENT

UNIT I

What is Django: Introduction, Django overview, What is a framework, why do we need a framework, What are some famous web frameworks?, What is a virtual environment?, How to create and use a virtual environment?, How to install Django?, How to create a Django Project?, Overview of your Django project files

Overview of MVT Architecture: What is architecture?, What is MVT?, What are models in Django's MVT?, What are views in Django MVT?, What are Templates in Django's MVT?

The Django Admin Utility: Introduction, Admin page of your Django

project, Creating an app, Editing models.py, settings.py, and admin.py, Adding data to your database, Editing data in your database.

UNIT II

Interacting with the Database using Query Sets: Introduction, ORM overview, Query sets, Adding elements to your database, Manipulating elements of your database, Deleting elements of your database, Understanding Models: Introduction to models, Model fields, Meta options, Model methods, Relationship between models, Connecting models

Django Views and Templates: Introduction, Types of views, Built-in class-based views, Introduction to templates, configuration, template inheritance, Django templating language.

UNIT III

URLs and Regex: Introduction, Functions available in URLconfs, Regex, Writing a regex for different url- functions.

Forms in Django: Introduction, building basic forms, fetching data entered in the forms, Form fields and arguments, Form validation and model forms.

UNIT IV

PHP: Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, Functions, Browser control and detection, string, Form processing, Files.

Advance Features: Cookies and Sessions, Object Oriented Programming with PHP.

PHP and MySQL : Basic commands with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP myadmin and database bugs

TEXTBOOKS

1. Awanish Ranjan, Building Websites with Django, 1st Edition, BPB Publications, India, 2021.
2. Robin Nixon, Learning PHP, MySQL, JavaScript, and CSS, 3rd Edition, O'Reilly Media, Inc. 2012.

REFERENCE BOOKS

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, O'Reilly Media, Inc.
2. William S Vincent, Django for Beginners: Build websites with Python and Django, Independently Published, 2018.
3. Jeff Forcier, Paul Bissex, Wesley Chun, Python Web Development with

Django, 1st Edition, Pearson Education, 2009.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Charles Russell Severance, University of Michigan , Django for Everybody Specialization, Courseera, <https://www.coursera.org/specializations/django#instructors>, Last Accessed on: 15/10/2024.
2. Volkan Atiř, Python Software Developer and Teacher, Django 3.0 MasterClass - Learn How To Create Django Apps, Udemy, <https://www.udemy.com/course/django-30-masterclass-learn-how-to-create-django-apps/#instructor-1>, Last Accessed on: 15/10/2024.

20AI&ML6205A

INTERNET OF THINGS

| | | | |
|-----------------|--------------------------------|-------------------|-------|
| Course Category | Open elective | Credits | 3 |
| Course Type | Theory | L-T-P | 2-0-2 |
| Prerequisites | 20AI&ML4304: Computer networks | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the design concepts and applications of Internet of Things
2. Understand Standards and Key Technologies in IoT.
3. Apply the steps of the design methodology in developing IoT applications using Raspberry Pi
4. Understand the Privacy, security and Vulnerabilities of internet of Things

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 2 | | | | | | | | | | | | 1 | 2 | 2 | 1.6.1,1.7.1 |
| 2 | 2 | | | | | | | | | | | | 1 | 2 | 2 | 1.6.1, 1.7.1 |
| 3 | | 2 | 2 | | | | | | | | | | 2 | | 3 | 2.7.1, 2.7.2, 3.6.2 |
| 4 | 1 | | | | 2 | | | | | | | | | | 2 | 1.6.1, 1.7.1, 5.4.1 |

COURSE CONTENT

UNIT I

Introduction to Internet of things: Introduction, Physical design of IoT, Logical Design of IoT, IoT Enabling technologies, IoT levels & Deployment templates.

Domain Specific IoTs – Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle

UNIT II

IoT and M2M: Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT, Software Defined Networking, Network Function Virtualization.

IoT Platforms Design Methodology: Introduction, IoT Design Methodology, Case Study on IoT System for Home Automation , IoT system for Weather Monitoring.

UNIT III

IoT Physical Devices and Endpoints: Basic building blocks of an IoT Device, Introduction to Raspberry Pi Board, Linux on Raspberry Pi, Raspberry Pi Interfaces (serial, SPI, I2C)

Programming Raspberry PI with Python – Controlling LED with Raspberry Pi, Interfacing an LED and Switch with Raspberry Pi, Interfacing a Light sensor (LDR) with Raspberry Pi.

UNIT IV

IoT Privacy, Security and Vulnerabilities Solutions: Introduction, Vulnerabilities, Security Requirements and Threat Analysis – Privacy, Vulnerabilities of IoT, Security Requirements, Threat Analysis, Use Cases and Misuse Cases, IoT Security Tomography and Layered Attacker model. Security models, profiles and protocols for IoT.

TEXTBOOKS

1. Arshdeep Bahga , Vijay Madisetti, Internet of Things (A Hands-on Approach), 1st Edition, Universities Press Private Limited, 2014.
2. Raj Kamal, Internet of Things, Architecture and Design Principles, 1st Edition, McGraw Hill Education Private Limited, 2017.

REFERENCE BOOKS

1. Matt Richardson & Shawn Wallace, Getting Started with Raspberry Pi, O'Reilly (SPD), 2014.
2. David Hanes, IOT Fundamentals, 1st Edition, CISCO Press, 2018.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Sudip Misra, IIT Kharagpur, Introduction to Internet of things, Available: <https://nptel.ac.in/courses/106/105/106105166/>, Last Accessed on: 24/10/2024.
2. Prof. T V Prabhakar, IISc Bangalore, Design for Internet of things, Available: <https://nptel.ac.in/courses/108/108/108108098/>, Last Accessed on: 24/10/2024.

20AI&ML6205B

DATA WAREHOUSING

| | | | |
|-----------------|------------------------------|-------------------|-------|
| Course Category | Open elective | Credits | 3 |
| Course Type | Theory | L-T-P | 2-0-2 |
| Prerequisites | 20AI&ML3305: Data Structures | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand data warehouse architecture for various Problems
2. Apply the OLAP Technology in various applications
3. Apply the partitioning strategy and the differentiation of various schema for given problem
4. Understand the roles of process manager system manager

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 3 | 1 | 1 | | | | | | | | | | 1 | 1 | 2 | 1.2.1, 1.6.1, 1.7.1, 2.5.2, 3.5.1 |
| 2 | 3 | 2 | 2 | | 2 | | | | | | | | 1 | 1 | 3 | 1.2.1, 1.6.1, 1.7.1, 2.5.2, 2.6.4, 3.5.1, 5.4.1 |
| 3 | 2 | 3 | 3 | | | | | | | | | | 1 | 1 | 3 | 1.2.1, 1.6.1, 1.7.1, 2.5.2, 2.7.1, 3.5.1, |
| 4 | 1 | 1 | 2 | | | | | | | | | | 1 | 1 | 2 | 1.2.1, 1.6.1, 1.7.1, 2.5.2, 2.6.4, 2.7.1,3.5.1 |

COURSE CONTENT

UNIT I

Introduction To Data Warehouse: Data warehouse Introduction - Data warehouse components- operational database Vs data warehouse – Data warehouse Architecture – Three-tier Data Warehouse Architecture - Autonomous Data Warehouse- Autonomous Data Warehouse Vs Snowflake - Modern Data Warehouse

UNIT II

ETL And OLAP Technology: What is ETL – ETL Vs ELT – Types of

Data warehouses - Data warehouse Design and Modeling - Delivery Process - Online Analytical Processing (OLAP) - Characteristics of OLAP - Online Transaction Processing (OLTP) Vs OLAP - OLAP operations- Types of OLAP- ROLAP Vs MOLAP Vs HOLAP.

UNIT III

Meta Data, Data Mart And Partition Strategy: Meta Data, Categories of Metadata, Role of Metadata, Metadata Repository, Challenges for Meta Management, Data Mart, Need of Data Mart, Cost Effective Data Mart, Designing Data Marts- Cost of Data Marts, Partitioning Strategy, Vertical partition, Normalization, Row Splitting, Horizontal Partition

Dimensional Modeling And Schema: Dimensional Modeling, Multi, Dimensional Data Modeling, Data Cube, Star Schema, Snowflake schema, Star Vs Snowflake schema, Fact constellation Schema, Schema Definition, Process Architecture, Types of Data Base Parallelism, Datawarehouse Tools

UNIT IV

System & Process Manager: Data Warehousing System Managers: System Configuration Manager, System Scheduling Manager, System Event Manager, System Database Manager, System Backup Recovery Manager, Data Warehousing Process Managers: Load Manager, Warehouse Manager, Query Manager, Tuning, Testing

TEXTBOOKS

1. George M. Marakas Modern Data Warehousing, Mining, and Visualization: Core Concepts, Prentice Hall, 1st Edition.
2. Pieter Adriaans, DolfZantinge Data Mining, Pearson Education, 978-8131707173, 1st Edition.

REFERENCE BOOKS

1. W. H. Inmon – Building the Data Warehouse, A solid foundation on data warehousing concepts.
2. Han, J., Pei, J., & Kamber, M., Data mining: concepts and techniques, 3rd Edition, Elsevier, 2012.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Sanele M., Data Warehousing, <https://www.udemy.com/course/data-warehousing/>, Last accessed on: 26/10/2024.
2. Prof. Pabitra Mitra Data Mining, IIT Kharagpur, <https://nptel.ac.in/courses/106105174>, Last accessed on: 26/10/2024.

20AI&ML6205C

DATA VISUALIZATION

| | | | |
|-----------------|---------------|-------------------|-------|
| Course Category | Open elective | Credits | 3 |
| Course Type | Theory | L-T-P | 2-0-2 |
| Prerequisites | – | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand visual perception and representation of data
2. Understand about projections of different views of objects.
3. Apply various Interaction and visualization techniques.
4. Analyze various groups for visualization and evaluate visualizations.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 1 | 2 | | | | | | | | | | | 1 | 2 | 2 | 1.2.1, 1.6.1, 1.7.1, 2.5.2 |
| 2 | 1 | 2 | | | | | | | | | | | 1 | 1 | 2 | 1.2.1, 1.6.1, 1.7.1, 2.6.4, 2.7.1 |
| 3 | 1 | 2 | 3 | | | | | | | | | | 1 | 3 | 3 | 1.2.1, 1.6.1, 1.7.1, 2.6.4, 2.7.1, 3.5.1 |
| 4 | 1 | 2 | 3 | | | | | | | | | | 1 | 1 | 4 | 1.2.1, 1.6.1, 1.7.1, 2.6.4, 2.7.1, 3.5.1 |

COURSE CONTENT

UNIT I

Introduction To Data Visualizations: Seven Stages of Visualizing Data, Data Visualization for Exploration, Data Visualization for explanation, Types of Data, Quantitative and Categorical Data, Cross -Sectional and Time Series Data, Data Visualization in Practice, Accounting, Finance, Human Resource Management, Marketing, Operations, Engineering.

Selecting a Chart Type: Selecting the appropriate chart, Creating and Editing charts, Scatter charts and Bubble charts, Line charts, Column charts and Bar charts, Maps, Tables versus charts Other Specialized Charts, Waterfall chart, Stock charts, Funnel charts.

UNIT II

Data Visualization and Design: Preattentive Attributes, Color, Form, Length and Width, Spatial positioning, Movement, Gestalt Principles, Similarity, Proximity, Enclosure, Connection, Data-Ink ratio, Data Visualization Design issues, Common Mistakes in Data Visualization Design.

Purposeful Use of Color: Color and Perception, Color Schemes and Types of Data, Categorical Color Schemes, Sequential Color Schemes, Diverging Color Schemes, Custom Color Using the HSL Color System.

UNIT III

Visualizing Variability: Creating Distributions from Data, Frequency Distributions for Categorical Data, Relative Frequency and Percent Frequency, Visualizing Distributions of Quantitative Data, Statistical Analysis of Distributions of Quantitative Variables, Uncertainty in Sample Statistics, Uncertainty in Predictive Models.

UNIT IV

Exploring Data Visually: Introduction to Exploratory Data Analysis, Analyzing Variables One at a Time, Exploring a Categorical Variable, Exploring a quantitative variable, Relationships between Variables, Cross tabulation Analysis of Missing Data, Types of Missing Data Visualizing Time Series Data, Visualizing Geospatial Data, Choropleth Maps, Cartograms

Data Dashboard's: Data Dashboard Taxonomies, Data updates, User interaction, Organizational function Data Dashboard Design, Understanding the purpose of the data Dashboard, Considering the needs of the Data Dashboard Users, Data Dashboard Engineering.

TEXTBOOKS

1. Camm, Jeffrey D., and James J. Cochran., Data visualization: exploring and explaining. with data., 1st Edition, Cengage Learning India Pvt. Ltd. 2023.

REFERENCE BOOKS

1. Fry, Ben., Visualizing data: Exploring and explaining data with the processing environment., 5th Edition, O'Reilly Media, Inc. 2022.
2. Wilke, Claus O., Fundamentals of data visualization: a primer on making informative and compelling figures, 2nd Edition, O'Reilly Media, 2022.
3. Munzner, Tamara. Visualization analysis and design, 1st Edition, CRC press, 2014.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Data visualization: Definition, Benefits and examples <https://www.coursera.org/articles/data-visualization> Last Accessed on:

03/09/2024.

2. Course on Data Visualization, <https://www.kaggle.com/learn/data-visualization> Last Accessed on: 03/09/2024.
3. Learn Data Visualization Techniques with Python, Udemy , <https://www.udemy.com/course/data-visualization-techniques-with-python/> Last Accessed on: 03/09/2024.
4. Data Visualization Techniques, Udemy, <https://www.udemy.com/course/data-visualization-techniques/>, Last Accessed on 03/09/2024.

20AI&ML6205D

INTERNET TECHNOLOGIES

| | | | |
|-----------------|---------------|-------------------|-------|
| Course Category | Open elective | Credits | 3 |
| Course Type | Theory | L-T-P | 2-0-2 |
| Prerequisites | – | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the web layout design and web page formatting.
2. Understand the basic HTML concepts such as tags, forms, and tables.
3. Apply client-side scripting and form validations.
4. Apply data base connection to web applications.

*Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 – Medium, 3 – High)*

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|-----------------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 1 | 2 | | | 1 | | | | | | | | | 1 | 1 | 2 | 1.7.1, 2.5.2, 2.6.3, 5.4.1 |
| 2 | 2 | 1 | | | 1 | | | | | | | | | 1 | 1 | 2 | 1.7.1, 2.5.2, 2.6.3, 5.4.1 |
| 3 | 1 | 2 | | | 2 | | | | | | | | | 1 | 1 | 3 | 1.7.1, 2.5.2, 2.6.3, 2.7.1, 5.4.1 |
| 4 | 2 | 2 | | | 1 | | | | | | | | | 1 | 1 | 3 | 1.7.1, 2.5.2, 2.6.3, 2.7.1, 5.4.1 |

COURSE CONTENT

UNIT I

Introduction: Concept of WWW, Internet and WWW, HTTP Protocol: Request and Response, Web browser and Web servers, Features of Web 2.0.

Web Design: Concepts of effective web design, Web design issues including Browser, Bandwidth and Cache, Display resolution, Look and Feel of the Website, Page Layout and linking, User centric design, Sitemap, Planning and publishing website, Designing effective navigation.

UNIT II

Introduction to HTML:

Structure of an HTML document, Essential tags: headings, paragraphs, links, images, and lists, Semantic elements.

Forms and Input Handling: Creating forms with various input types and attributes, Form validation Designing tables, merging cells, and advanced formatting.

Introduction to CSS: Basic syntax, selectors, and applying styles to HTML, Understanding the box model: margin, border, padding, and content, Advanced Styling Techniques. **CSS Layouts:** Positioning (static, relative, absolute, fixed), Flexbox layout and grid system for responsive design, Structuring CSS with modular and reusable code **UNIT III**

Core JavaScript Concepts: Variables, data types, and basic operators, Conditional statements, loops, and functions.

DOM Manipulation: Selecting and modifying HTML elements using JavaScript, Event handling and creating interactive web pages.

Form Validation: Client-side form validation techniques using JavaScript

UNIT IV

Introduction to PHP: PHP syntax, embedding PHP in HTML, and basic PHP scripting, Variables, data types, and control structures (if-else, loops).

Functions and Arrays in PHP: Defining and calling functions, using built-in functions, Working with associative arrays and array functions.

Form Handling and Data Processing: Handling form submissions using GET and POST methods, Validating and sanitizing user input.

Database Connectivity: Connecting to a MySQL database using PHP, Performing CRUD operations for dynamic web applications.

TEXTBOOKS

1. DT Editorial Services, HTML 5 Black Book, Covers CSS 3, JavaScript, XML, XHTML, AJAX, PHP and jQuery 2nd Edition, Dreamtech Press, 2016.
2. Nixon, R, Learning PHP, MySQL, JavaScript, and CSS: A step-by-step guide to creating dynamic websites. O'Reilly Media, Inc., 2012.

REFERENCE BOOKS

1. David Flanagan, JavaScript: The Definitive Guide, O'Reilly Media, 7th Edition,, 2020.
2. Brett McLaughlin, PHP & MySQL: The Missing Manual, O'Reilly Media, 2nd Edition, 2018.
3. Eric A. Meyer, CSS: The Definitive Guide, O'Reilly Media, 4th Edition, 2017.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. HTML Tutorial, <https://www.w3schools.com/html/default.asp>.,

Last accessed on: 15/10/2024.

2. CSS-Tricks, <https://css-tricks.com/>, Last accessed on: 17/10/2024.
3. JSFiddle, <https://jsfiddle.net/>, Last accessed on: 20/10/2024.

20AI&ML6351**NEURAL NETWORKS & DEEP LEARNING LABORATORY**

| | | | |
|-----------------|------------------|-------------------|-------|
| Course Category | Program Core | Credits | 1.5 |
| Course Type | Laboratory | L-T-P | 0-0-3 |
| Prerequisites | 20AI&ML5352: | Continuous Eval | 30 |
| | Machine Learning | Semester End Eval | 70 |
| | Laboratory | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the importance of various activation functions in neural network architectures.
2. Apply Back Propagation and Gradient Descent to optimize feed forward and deep neural networks.
3. Apply CNNs & RNNs to perform image processing tasks and to model the sequential data.
4. Apply GANs for image generation and data augmentation.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----------------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 1 | 1 | | | | | | | | | | | 1 | 1 | 2 | 1.2.1, 1.7.1, 2.8.1 |
| 2 | 1 | 2 | 1 | | 2 | | | | | | | | 1 | 1 | 3 | 1.2.1, 1.7.1, 2.8.1, 3.6.2, 5.4.1 |
| 3 | 2 | 2 | 2 | | 2 | | | | | | | | 1 | 1 | 3 | 1.2.1, 1.7.1, 2.5.2, 3.6.2, 5.5.2 |
| 4 | 2 | 2 | 1 | | 1 | | | | | | | | 1 | 1 | 3 | 1.2.1, 1.7.1, 2.5.2, 3.6.2, 5.5.2 |

COURSE CONTENT

1. Implement a single-layer perceptron to classify a linearly separable dataset, such as an AND or OR logic gate.
2. Train a multi-layer perceptron with Sigmoid, Tanh, ReLU, and Softmax activation functions on a multi-class dataset, like the Iris dataset, and compare their performance.
3. Apply forward and backward propagation on a feed forward neural network to observe weight updates and loss reduction using a small regression dataset.
4. Analyze different loss functions (e.g., Mean Squared Error, Cross-Entropy Loss) by training neural networks on regression and classification datasets.

5. Build a deep neural network and evaluate training difficulties like vanishing gradients using a complex dataset, such as CIFAR-10.
6. Compare optimization techniques like SGD, Adam, and RMSprop in terms of training speed and model accuracy on a deep learning model.
7. Implement Batch Normalization and weight initialization techniques to stabilize gradient flow in a neural network during training.
8. Visualize feature maps generated by convolutional layers using filters on an image dataset, such as MNIST.
9. Train and evaluate popular CNN architectures (LeNet, AlexNet, VGG, ResNet) on an image classification dataset like CIFAR-10.
10. Implement RNN and LSTM models to analyze their performance on sequence data, highlighting LSTM's ability to handle long-term dependencies.
11. Build a Generative Adversarial Network (GAN) to generate synthetic images using a random noise vector and a real dataset like MNIST.
12. Fine-tune pre-trained models like VGG, ResNet, or BERT on a new dataset to demonstrate improved performance in specific tasks.

TEXTBOOKS

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville , Deep Learning, MIT Press, 2016.

REFERENCE BOOKS

1. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, 2017.
2. Rajalingappaa Shanmugamani, Deep Learning for Computer Vision, Packt Publishing, 2018.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Neural Networks and Deep Learning, <http://neuralnetworksanddeeplearning.com/>, Last accessed on :02/10/2024.
2. Deep Learning Specialization, <https://www.coursera.org/specializations/deep-learning>, Last Accessed on: 17/10/2024.
3. Machine Learning Mastery, <https://machinelearningmastery.com/>, Last Accessed on: 20/10/2024.

20AI&ML6352

AUTOMATA & COMPILER DESIGN LABORATORY

| | | | |
|-----------------|--|-------------------|-------|
| Course Category | Program Core | Credits | 1.5 |
| Course Type | Laboratory | L-T-P | 0-0-3 |
| Prerequisites | 20AI&ML4305: Digital logic and computer Organization | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the basic concepts of formal languages and finite automata Techniques.
2. Apply the parsing techniques for the given programming construct described in Context Free Grammar.
3. Apply the suitable intermediate representation based on the storage administration
4. Apply the functionalities for generating the machine code involved in different phases of the compilation process

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 2 | 2 | | | | | | | | | | | | | 2 | 1.2.1, 1.6.1, 1.7.1, 2.5.2 |
| 2 | 2 | 2 | 3 | | | | | | | | | | | 2 | 3 | 1.2.1, 1.6.1, 1.7.1, 2.5.2, 2.6.4, 3.5.1 |
| 3 | 2 | 3 | 3 | | | | | | | | | | | 2 | 3 | 1.2.1, 1.6.1, 1.7.1, 2.5.2, 2.6.4, 3.5.1 |
| 4 | 2 | 2 | 3 | | | | | | | | | | | 3 | 3 | 1.2.1, 1.6.1, 1.7.1, 2.5.2, 2.6.4, 3.5.1 |

COURSE CONTENT

1. Write a C Program to Scan and Count the number of characters, words, and lines in a file.
2. Write a Program for Token separation with a given expression.
3. Write a LEX Program to scan reserved word & Identifiers of C Language.
4. Write a LEX program to find out total number of vowels, and consonants from the given input sting.
5. Write a C Program to implement NFAs that recognize identifiers, constants, and operators of the mini language.

6. Write a C Program to implement DFAs that recognize identifiers, constants, and operators of the mini language.
7. Design a lexical analyzer for the given language. The lexical analyzer should ignore redundant spaces, tabs and new lines, comments etc.
8. Implement the lexical analyzer using JLex, flex or other lexical analyzer generating tools.
9. Design Predictive Parser for the given language.
10. Write a C program to generate three address code.
11. Implement SLR(1) Parsing algorithm.
12. Design LALR bottom up parser for the given language.

TEXTBOOKS

1. John E. Hopcroft, Rajeev M & J D Ullman: Introduction to Automata Theory Languages & Computation, 3rd Edition, Pearson Education, 2007.
2. Alfred V. Aho, Jeffrey D. Ullman, Principles of Compiler Design, Narosa Publishing, 2002
3. Alfred V. Aho, Monica S Lam, Ravi Sethi, Jeffrey D Ullman, Compilers Principles, Techniques and Tools, 2nd Edition, Pearson Education India, 2014.

REFERENCE BOOKS

1. Tremblay J P, Sorenson G P: The Theory & Practice of Compiler writing, 1st Edition, BSP publication, 2010.
2. Loudon, Compiler Construction: Principle and Practice, Cengage Publications, 1997.
3. Jean-Paul Tremblay, Paul G. Sorenson, The Theory and Practical of Compiler Writing, BS Publications, 2009.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Y. N. Srikant, Department of Computer Science and Automation, IISc Bangalore, Compiler Design, <http://nptel.iitm.ac.in/courses/106108052> Last access on: 09/08/2024.
2. Professor Sanjeev K Agarwal, Dept. of CSE IIT Kanpur, NPTEL lectures, <http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR/compiler-design/ui/TOC.html> Last accessed on: 10/09/2024.

20AI&ML6353

SOFTWARE ENGINEERING LABORATORY

| | | | |
|-----------------|--|-------------------|-------|
| Course Category | Program Core | Credits | 1.5 |
| Course Type | Laboratory | L-T-P | 0-0-3 |
| Prerequisites | 20AI&ML4305: Digital logic and computer Organization | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Analyze different software engineering process models.
2. Analyze the principles of requirement engineering.
3. Apply UML design concepts for a given case study.
4. Apply different testing techniques.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 2 | 2 | | | | | | | | | | | | | | 4 | 1.7.1, 2.5.1, 2.5.2, 2.6.4, 2.7.1 |
| 2 | 2 | 2 | 3 | | | | | | | | | | | 2 | | 4 | 1.7.1, 2.5.1, 2.7.1, 3.5.1, 3.5.2, 3.5.6 |
| 3 | 2 | 3 | 3 | | 2 | | | | | | | | | 2 | | 3 | 1.7.1, 2.5.1, 2.6.4, 3.5.1, 3.8.1, 5.4.1 |
| 4 | 2 | 2 | 3 | | 2 | | | | | | | | | 3 | | 3 | 1.7.1, 2.5.1, 2.6.4, 3.5.1, 3.6.2, 3.8.2, 5.4.1 |

COURSE CONTENT

Task 1: Overview of SDLC: A Study

Task 2: Studying various phases of waterfall model

Task 3: Estimation of Project Metrics using COCOMO model

Task 4: Identifying the Software Requirement from problem statements

Task 5: Project Planning

Task 6: Capturing use case and modeling use case diagram for the given problem

Task 7: System modeling

Task 8: OOA: Identifying Domain Classes from the problem statement and State Transition Diagram

Task 9: Interaction diagrams: Sequence and collaboration diagrams and Flow of events and activity diagram

Task 10: Software Design: software architecture and object oriented design

Task 11: Component and Deployment diagrams

Task 12: Software Testing

Lab Projects: Design all UML diagrams for an online course registration application.

TEXTBOOKS

1. Roger S. Pressman, Bruce R. Maxim, Software Engineering a practitioners approach, 8th Edition, McGraw-Hill Publication 2019.

REFERENCE BOOKS

1. Ian Somerville, Software Engineering, 9th Edition, Pearson Education, 2011.
2. Software Engineering principles and practice- Waman S Jawadekar, The McGraw-Hill Companies.
3. Fundamentals of object-oriented design using UML Meiler page-Jones: Pearson Education.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Software Engineering Course, https://www.tutorialspoint.com/software_engineering/index.htm, Last Accessed on:12/9/2024.
2. Prof. Rajib Mall, IIT Kharagpur, Software Engineering, <https://archive.nptel.ac.in/courses/106/105/106105182/> Last Accessed on: 12/9/2024.
3. UML Diagrams, <https://www.youtube.com/watch?v=WnMQ8HlmeXc/Last> Accessed on: 12/9/2024.

SEMESTER VII

20AI&ML7301

NATURAL LANGUAGE PROCESSING

| | | | |
|-----------------|--|-------------------|-------|
| Course Category | Program Core | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20AI&ML5302: Machine Learning | Continuous Eval | 30 |
| | 20ES2103C: Programming Essentials in Python | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the fundamentals of natural language processing.
2. Understand the word level analysis methods.
3. Analyze the syntactic, semantic and pragmatic analysis concepts.
4. Apply various NLP applications and tools in real time environment.

*Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 – Medium, 3 – High)*

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 2 | 2 | 3 | | 3 | | | | | | | | 1 | 1 | 2 | 1.2.1, 2.1.1, 2.2.3, 2.4.3, 3.1.1, 5.4.1 |
| 2 | 2 | 2 | 3 | | 3 | | | | | | | | 1 | 1 | 2 | 1.2.1, 2.1.3, 2.4.1, 3.2.1, 5.4.1 |
| 3 | 2 | 2 | 3 | | 3 | | | | | | | | 1 | 1 | 4 | 1.2.1, 2.1.3, 2.4.1, 3.1.1, 3.2.1, 5.4.1, 5.4.2 |
| 4 | 2 | 3 | 3 | | 3 | | | | | | | | 1 | 1 | 3 | 1.2.1, 2.1.3, 2.4.1, 3.2.1, 5.4.1, 5.4.2 |

COURSE CONTENT

UNIT I

Introduction: Origins and challenges of NLP, Language Modeling: Grammar-based LM, Statistical LM, Regular Expressions, Finite-State Automata, English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

UNIT II

Word Level Analysis: Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff, Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging, Hidden Markov and Maximum Entropy models.

UNIT III

Syntactic Analysis: Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar, Dependency Grammar, Syntactic Parsing, Ambiguity Dynamic Programming parsing, Shallow parsing, Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs, Feature structures, Unification of feature structures.

Semantics And Pragmatics: Requirements for representation, First, Order Logic, Description Logics, Syntax-Driven Semantic analysis, Semantic attachments, Word Senses, Relations between Senses, Thematic Roles, selectional restrictions.

UNIT IV

NLP Applications: Machine Translation, Rule-based, Statistical, and Neural approaches to translation, Google Translate and modern systems, challenges in translation (ambiguity, context, idioms).

Sentiment Analysis: Understanding sentiment in text, Applications in social media, product reviews, and customer feedback. NLP Tools: NLP libraries, NLTK, spaCy, Stanford NLP Penn Treebank, WordNet, PropBank, FrameNet

TEXTBOOKS

1. Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, 1st Edition, O'Reilly Media, 2009.

REFERENCE BOOKS

1. Breck Baldwin, Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
2. Richard M Reese, Natural Language Processing with Java, O'Reilly Media, 2015.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Lukasz Kaiser, Natural Language Processing Specialization <https://www.coursera.org/specializations/natural-language-processing>, Last Accessed on: 16/09/2024.
2. Martin Jocqueviel, Modern Natural Language Processing in Python, <https://www.udemy.com/course/modern-nlp/?couponCode=ST11MT91624B>, Last Accessed on: 16/09/2024.

20AI&ML7402A COMPUTER VISION

| | | | |
|-----------------|----------------------------------|-------------------|-------|
| Course Category | Program Elective III | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20AI&ML5302: Machine Learning | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the major concepts and techniques in computer vision and image processing.
2. Apply computer vision and image processing knowledge to solve practical problems.
3. Apply segmentation techniques to perform Pattern analysis on images.
4. Analyze real time applications using computer vision techniques.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|----------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 1 | 2 | | | | | | | | | | | 1 | 1 | 2 | 1.2.1, 1.7.1, 2.8.1 |
| 2 | 1 | 2 | | | 2 | | | | | | | | 1 | 2 | 3 | 1.2.1, 1.7.1, 2.8.1, 5.4.1 |
| 3 | 1 | 2 | | | 2 | | | | | | | | 1 | 2 | 3 | 1.2.1, 1.7.1, 2.5.2, 5.4.1 |
| 4 | 1 | 2 | | | 2 | | | | | | | | 1 | 2 | 4 | 1.2.1, 1.7.1, 2.5.2, 5.4.1 |

COURSE CONTENT

UNIT I

Image Processing Foundations: Image processing techniques, classical filtering operations, thresholding techniques, edge detection techniques, corner and interest point detection, mathematical morphology, texture.

UNIT II

Image Formation and Processing: Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine and Projective. Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

UNIT III

Feature Extraction: Edges, Canny, LOG, DOG; Line detectors (Hough Transform), Corners, Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.

UNIT IV

Clustering: K-Means, K-Medoids, Mixture of Gaussian's, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

Applications: Surveillance, foreground, background separation, particle filters, Chamfer matching, tracking, and occlusion, combining views from multiple cameras. In-vehicle vision system: locating roadway, road markings, identifying road signs, locating pedestrians.

TEXTBOOKS

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003.
3. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.

REFERENCE BOOKS

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, 2nd Edition, Cambridge University Press, March 2004.
2. K. Fukunaga; Introduction to Statistical Pattern Recognition, 2nd Edition, Academic Press, Morgan Kaufmann, 1990.
3. R. Szeliski, — Computer Vision: Algorithms and Applications, Springer 2011.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. P.K. Biswas, Digital Image Processing Available: <http://www.nptel.ac.in/courses/117105079/>, Last accessed on: 10/10/2024.
2. Aggelos K. Katsaggelos, Northwestern University, Fundamentals of Digital Image and Video Processing, Available at: <https://www.coursera.org/course/digital>, Last accessed on: 01/11/2024.

20AI&ML7402B**GENERATIVE AI MODELS AND PROMPT ENGINEERING**

| | | | |
|-----------------|----------------------------------|-------------------|-------|
| Course Category | Program Elective III | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20AI&ML5302: Machine Learning | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the foundational concepts and techniques in generative modelling.
2. Understands LLM basic concepts and its types.
3. Analyse the generative models to real-world problems like image, text, and data generation.
4. Apply the Prompt Engineering concepts for a specific application.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 2 | 2 | | | | | | | | | | | 1 | 1 | 2 | 1.2.1,1.7.1,2.5.2, 2.6.3,2.8.1, 2.8.4 |
| 2 | 2 | 1 | | | 2 | | | | | | | | 1 | 1 | 2 | 1.2.1,1.7.1, 2.5.2, 2.6.3, 2.8.1, 2.8.4, 5.4.1 |
| 3 | 3 | 2 | 2 | | 2 | | | | | | | | 1 | 1 | 4 | 1.2.2,2.8.2, 3.5.1, 3.8.2, 5.4.1 |
| 4 | 1 | 3 | 2 | | 2 | | | | | | | | 1 | 1 | 3 | 1.2.2,2.8.2, 3.5.1, 3.8.2, 5.4.1 |

COURSE CONTENT**UNIT I**

Introduction to Generative Models: Overview of Generative Models, Definition and types of generative models- Statistical models and neural network based models, Comparison with discriminative models, Prompting and prompt engineering, Generative AI project lifecycle.

UNIT II

Large Language Models (LLMs): Introduction to LLMs, Evolution of

LLMs, Training and fine-tuning LLMs, Applications of LLMs: Text generation and NLP tasks, Ethical and social implications of LLMs. Multi Model LLMs: Open Source LLMs, Domain Specific LLMs, LLM agents, Smaller LLMs and Non-Transformer LLMs.

UNIT III

Transformer-based Generative Models: Introduction to Transformers: Self attention mechanism Transformer architecture (Encoder-Decoder, GPT, BERT)

Generative Pre-Trained Transformers(GPT): GPT, GPT-2, GPT-3, and beyond Training techniques and challenges.

Applications of Transformer-based Models: Text generation and completion Language Translation Code generation.

UNIT IV

Prompt Engineering and Fine-Tuning: Role and Importance in Generative AI, Basics of Prompt Construction.

Crafting Effective Prompts: Types of Prompts: Open-ended, Specific Techniques: Keyword Selection, Context Setting.

Advanced Techniques: Zero-shot, One-shot, Few-shot Learning, Controlling Output: Temperature, Max Tokens, Iterative Refinement Customizing Prompts for Tasks: Text Generation, Code Generation, Image Generation, Domain-Specific Prompting, Designing and Testing Prompts, Evaluating and Improving Prompt Performance.

Ethical Considerations: Bias, Misuse, and Responsible Prompting.

TEXTBOOKS

1. David Foster, Generative Deep Learning, O'Reilly Media, Inc., 2nd Edition, 2023.(Unit 1)
2. Sanket Subhash Khandare, Mastering Large Language Models: Advanced techniques, BPB Publication, 1st Edition, 2024.(Unit 2)
3. Valentina Alto, Modern Generative AI with ChatGPT and OpenAI Models, Packt Publication, 1st Edition, 2023.(Unit 3)
4. Denis Rothman, Transformers for Natural Language Processing, Packt Publication, 1st Edition, 2021. (Unit 3)
5. Michelle Erickson, Mastering Language Models: A Comprehensive Guide for Beginners, Kindle Edition, 1st Edition, 2023. (Unit 4)

REFERENCE BOOKS

1. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, 1st Edition, MIT Press, 2012.
2. Josh Kalin Generative Adversarial Networks Cookbook, Packt Publishing, 1st Edition, 2018.
3. Ian Goodfellow, YoshuaBengio, and Aaron Courville, Deep Learning, 1st

Edition, MIT Press, 2016.

4. Lewis Tunstall, Leandro von Werra, and Thomas Wolf, Natural Language Processing with Transformers: Building Language Applications with Hugging Face, O'Reilly Media, 1st Edition, 2022.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Ramaseshan Ramachandran, Introduction to Language Models, <https://elearn.nptel.ac.in/shop/iit-workshops/completed/introduction-to-language-models/?v=c86ee0d9d7ed/>, Last accessed on: 21/11/2024.
2. Chris Fregly, Generative AI with Large Language Models <https://www.deeplearning.ai/courses/generative-ai-with-llms/>, Last accessed on: 21/11/2024.

20AI&ML7402C

ROBOTICS PROGRAMMING

| | | | |
|-----------------|----------------------------------|-------------------|-------|
| Course Category | Program Elective III | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20AI&ML5302: Machine Learning | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the genealogy of artificial beings, robot operation systems, and different mathematical building blocks.
2. Understand different robot making processes, basics on social robots and human-robot interaction.
3. Apply machine learning algorithms for decision making and approaches for risk assessment and mitigation.
4. Analyze algorithms related to robot control, navigation and planning, robot localization, its mapping and Multi robot systems.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 2 | 1 | | | | | | | | | | | | 1 | 2 | 1.2.1, 1.7.1, 2.5.2, 2.8.1 |
| 2 | 2 | 2 | 1 | | 1 | | | 1 | | | | | | 1 | 2 | 1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 2.8.1, 3.5.1, 3.6.2, 3.8.1, 5.4.1, 8.3.1 |
| 3 | 2 | 2 | 2 | 2 | 1 | | | 1 | | | | | | 1 | 2 | 1.7.1, 2.5.2, 2.5.3, 2.6.3, 2.8.1, 3.5.1, 3.6.1, 3.6.2, 3.8.2, 4.4.1, 5.4.1, 8.3.1 |
| 4 | 2 | 2 | 2 | 2 | 1 | | | | | | | | | 1 | 2 | 1.7.1, 2.5.2, 2.5.3, 2.6.3, 2.8.1, 3.5.1, 3.6.1, 3.6.2, 3.8.2, 4.4.1, 5.4.1 |

COURSE CONTENT

UNIT I

Genealogy of Artificial Beings: Early Automata, Industrial revolutions, Modern robotics, social robotics, Robotics futures and Trans-robotics.

The Robot Operating System: Introduction, Key Features from the Core, Additional Useful Features, Linux for Robotics.

Mathematical Building Blocks:

Introduction, Basic Geometry and Linear Algebra, Geometric Transformations, Basic Probability, Derivatives, Basic Statistics.

UNIT II

Robots Making: Introduction, Sensing the world with sensors, Common Sensors in Robotics, Moving about with Actuators, Computer Vision in Robotics.

Social Robots: Introduction, Cobots, Social Robots and Human–Robot Interaction, Conduct Research, Research Variables, Sampling, Reliability and Validity, Ethics: Ethical Principles in Research, Data, Analysis and Interpretation, Common Mistakes and Pitfalls

UNIT III

Managing the World Complexity: Introduction, Definitions, Linear Regression, Training Generalizable Models, Deep Neural Networks, Gradient Back propagation, Convolutional Neural Network, Recurrent Neural Networks and their applications, Deep Reinforcement Learning and its applications.

Safety of Robotic Systems: Introduction, Terms and Definitions, Industrial Risk Assessment and Mitigation

UNIT IV

Control, Navigation and Path Planning: Introduction, Mobile Robots, Controlling robots, Path Planning, Obstacle Avoidance.

Localization and Mapping: Introduction, Robot Localization Problem, Robot Mapping Problem, Simultaneous Localization and Mapping.

Multi-robot Systems: Introduction, Types of multi-robot systems, Swarm Programming, Deployment of Real-world swarm systems

TEXTBOOKS

1. Herath D., & St-Onge, D., Foundations of Robotics: A Multidisciplinary Approach with Python and ROS, Springer Nature Singapore, 2022.

REFERENCE BOOKS

1. Selig, J. M., Geometric fundamentals of robotics (Vol. 128). New York: Springer, 2005.

2. Xie, M., Fundamentals of robotics: linking perception to action (Vol. 54). World Scientific, 2003.
3. Yoshikawa, T., Foundations of robotics: analysis and control, MIT press, 1990.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Khatib. O. (n.d.). CS223A - Introduction to Robotics. Stanford University, <https://see.stanford.edu/course/cs223a>, Last Accessed on: 02/11/2024.
2. Pratihar, D. K., Robotics. Swayam, onlinecourses.nptel.ac.in/noc19_me74/preview, Last Accessed on: 02/11/2024.
3. Khedekar. P, Best Starter Course: Robotics & ROS Introduction. Udemy, <https://www.udemy.com/course/robotic-system-ros-foundations/>, Last Accessed on: 02/11/2024.

20AI&ML7402E UI&UX Design

| | | | |
|-----------------|----------------------|-------------------|-------|
| Course Category | Program Elective-III | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand Human factors and Psychology in design process of Interactive systems.
2. Understand interaction and experience design in the different contexts.
3. Apply techniques to design interactive systems and prototypes.
4. Apply the user experience from websites, mobile and smart devices to design interactive systems.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|-----------------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 2 | 2 | | | | | | | | | | | | | 2 | 2 | 1.6.1, 1.7.1, 2.5.2, 2.6.1, 2.6.2 |
| 2 | | 3 | | | | | | | | | | | | | 2 | 2 | 2.5.1, 2.5.2, 2.6.1, 2.6.2, 2.7.1 |
| 3 | | 3 | 3 | | | | | | | | | | | | 2 | 3 | 2.7.1, 2.7.2, 3.6.1, 3.7.1 |
| 4 | | 3 | 3 | | | | | | | | | | | | 2 | 3 | 2.6.1, 2.7.2, 3.6.2, 3.7.1, 3.8.1 |

COURSE CONTENT

UNIT I

The Importance of the User Interface:

Defining the User Interface, The Importance of Good Design, A Brief History of the Human-Computer Interface, Introduction of the Graphical User Interface

Characteristics of Graphical and Web User Interfaces: Interaction Styles, Command Line, Menu Selection, Form Fill-in, Direct Manipulation, Anthropomorphic; The Graphical User Interface, The Web User Interface, The Merging of Graphical Business Systems and the Web, Principles of User Interface Design.

UNIT II

The User Interface Design Process: Obstacles and Pitfalls in the Development Path, Usability, Important Human Characteristics in Design, Human Considerations in the Design of Business Systems.

Understand the Business Function: Determining Basic Business Functions, Design Standards or Style Guides.

Understand the Principles of Good Interface and Screen Design: Human Considerations in Interface and Screen Design.

UNIT III

Techniques for designing interactive systems: Understanding requirements, Participative design, Interviews, Questionnaires, Probes, Card sorting techniques, Working with groups, Onsite working

Envisionment: Basic techniques, Prototypes, Envisionment in practice. Design: Introduction, Conceptual design, Metaphors in design, Physical design.

UNIT IV

Agents and Avatars: Agents, Adaptive systems, An architecture for agents, Applications of agent-based interaction, Avatars and conversational agents

Mobile and Wearable devices: Understanding in mobile computing, Designing for mobiles, Evaluation for mobile computing, Smart materials, Material design.

TEXTBOOKS

1. Wilbert O Galitz, The Essential Guide to User Interface Design, 2 ed, Wiley Dreamatech [UNIT I,II]
2. David Benyon “Designing Interactive Systems: A Comprehensive Guide to HCI, UX and Interaction Design” 3rd ed. Addison Wesley, 2013, [UNIT III, IV]

REFERENCE BOOKS

1. Alan Dix, Janet Finckay, Gregor, Abowd and Russell Beaulieu, Human Computer interaction. Pearson Education.
2. Prece, Rogers, Sharps Interaction Design. Wiley Dreamatech Soren Lauesen, User Interface Design. Pearson Education..

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Dr.Samit Bhattacharya, CSEm IIT Guwahati, “Human Computer Interaction” NPTEL videos, <http://nptel.ac.in/syllabus/106103115/>, Last Accessed On: 03/06/2024.
2. Pradeep P Yammivayar , CSE, IIT Guwahati, NPTEL Videos <http://nptel.ac.in/syllabus/106103115/>

[//www.nptelvideos.com/video.php?id=1461&c=15](http://www.nptelvideos.com/video.php?id=1461&c=15), Last Accessed On:
03/06/2024.

20AI&ML7403A

INFORMATION RETRIEVAL SYSTEMS

| | | | |
|-----------------|---|-------------------|-------|
| Course Category | Program Elective-IV | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20AI&ML5301: Database Management Systems | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the fundamental concepts and principles of information retrieval.
2. Understand knowledge of text processing techniques and indexing methods
3. Apply query processing and ranking algorithms to retrieve relevant information.
4. Analyze advanced topics in information retrieval, such as web search, social media search, and multimedia retrieval.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|----------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 2 | 1 | | | | | | | | | | | 1 | 1 | 2 | 1.6.1, 1.2.1, 2.5.1 |
| 2 | 2 | 2 | 3 | | | | | | | | | | 1 | 1 | 2 | 1.6.1, 1.2.1, 2.5.1, 3.5.1 |
| 3 | 2 | 2 | 3 | | | | | | | | | | 1 | 2 | 3 | 1.6.1, 1.2.1, 2.5.1, 3.5.1 |
| 4 | 2 | 2 | 3 | | | | | | | | | | 1 | 2 | 4 | 1.6.1, 1.2.1, 2.5.1, 3.5.1 |

COURSE CONTENT

UNIT I

Introduction to Information Retrieval

Definition and scope of information retrieval, Historical overview of information retrieval, Components of an information retrieval system, indexing, query processing and ranking, Challenges and issues in information retrieval, Applications of information retrieval, web search, document retrieval, social media search

UNIT II**Text Processing and Indexing**

Preprocessing, tokenization, stemming, stop word removal, lemmatization, Term weighting schemes, TF-IDF, BM25, Okapi BM25, Indexing techniques, inverted indexes, signature files, suffix trees, Index compression methods, dictionary compression, posting list compression, Index maintenance and update

UNIT III**Query Processing and Ranking**

Representation and matching, Boolean model, vector space model, and probabilistic models, Ranking algorithms, cosine similarity, TF-IDF, BM25, Page Rank, Evaluation metrics, precision, recall, F-measure, NDCG, User interface and relevance feedback, query refinement, result diversification

UNIT IV**Advanced Topics in Information Retrieval**

Search, crawling, indexing, ranking, link analysis, Social media search, sentiment analysis, topic modeling, community detection, Multimedia retrieval, image, video, audio retrieval, Information retrieval in the cloud, distributed indexing, distributed query processing, Emerging trends and research directions, e.g., deep learning for information retrieval, neural IR.

TEXTBOOKS

1. Manning, C. D., Raghavan, P., & Schütze, H., Introduction to information retrieval. Cambridge University Press, 2008.
2. Hearst, M, Modern information retrieval. Addison-Wesley Professional, 2004.

Reference Books

1. Baeza-Yates, R., & Ribeiro-Neto, B, Information retrieval: Algorithms and practice. Addison-Wesley Longman, 1999.
2. Baeza-Yates,R., & Ribeiro-Neto, B., Text retrieval: Applications to search engine, 1999.
3. Lawrence, M. K, Web search engines: How they work, O'Reilly Media, 2005.
4. Witten, I. H., Frank, E., & Hall, M. A., Data mining: Practical machine learning tools and techniques. Morgan, Kaufmann, 2011.
5. Lew, M. S., Introduction to multimedia information retrieval. McGraw-Hill, 2001.
6. Manning, C. D., Schütze, H., & Raghavan, P, Deep learning for informa-

tion retrieval. Morgan Kaufmann, 2022.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Mika, P, Semantic search: A survey of the state of the art. In International Conference on Semantic Web and Web Services (pp. 213-224). Springer, Last Accessed On: 03/06/2024.
2. Berkeley School of Information, Information Retrieval. [Online course]. Available at: <https://dictionary.cambridge.org/dictionary/english/in-the-course-of>, Last Accessed On: 03/06/2024. .
3. Alur, R,. Information Retrieval: s [Online course]. NPTEL. [fromhttps://nptel.ac.in/](https://nptel.ac.in/), Last Accessed On: 03/06/2024.

20AI&ML7403B CYBER FORENSICS

| | | | |
|-----------------|---------------------------------|-------------------|-------|
| Course Category | Program Elective -IV | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20AI&ML6404B: Cyber Security | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand cyber forensic processes in compliance with legal and ethical standards.
2. Apply various forensic tools and techniques for investigating cybercrimes.
3. Analyze the processes involved in forensic analysis of mobile devices and environments.
4. Understand effective evidence management strategies.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----------------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 2 | 2 | | | | | | | | | | | 1 | | 2 | 1.7.1, 2.6.2 |
| 2 | 2 | 2 | | | 2 | | | | | | | | 1 | 2 | 3 | 1.7.1, 2.6.2, 2.6.3, 2.6.4, 5.4.1 |
| 3 | 2 | 2 | | | | | | | | | | | | 2 | 4 | 1.7.1, 2.6.2, 2.6.3, 2.6.4, 2.8.4 |
| 4 | 2 | 2 | | | | | | | | | | | 1 | | 2 | 1.7.1, 2.6.2, 2.6.3, 2.6.4 |

COURSE CONTENT

UNIT I

Fundamentals of Cyber Forensics: Introduction to Cybercrime and Digital Forensics -Definition of Cybercrime and Cyber Forensics, Evolutionary Cycle of Digital Forensics, Principles of Digital Forensics, Investigate process methodologies- Existing models, Scientific Working Group on Digital Evidence, Process methodology Workflow.

UNIT II

Data Acquisition and Forensic Tools: Acquire an Image with dd Tool- Standard Unix dd and GNU dd, Acquire an Image with Forensic Format-

ewfacquire Tool, Preserve Digital Evidence with Cryptography- Basic Cryptographic Hashing, Sign an Image with PGP or S/MIME, Manage Drive Failures and Errors- Forensic Tool Error Handling, Data Recovery Tools, SMART and Kernel Errors.

UNIT III

Specific Forensic Techniques: Mobile Forensics, Persistent Threats and Challenges, Mobile Device Governance, Device Management Methodologies, Mobile Device Process Methodology, Combatting Anti Forensic, Traditional Techniques, Detection Methods, Strategic Countermeasures.

UNIT IV

Digital Evidence Management: Types of Digital Evidence, Evidence Gathering Considerations, Cause and Effect, Data Security Requirements, Preservation Strategies, Enterprise Log Management, Digital Forensics Readiness, Cost versus Benefit.

TEXTBOOKS

1. Bill Nelson, Amelia Phillips, and Christopher Steuart, Guide to Computer Forensics and Investigations, 6th Edition, Cengage Learning, 2019.
2. Bruce Nikkel, Practical Forensic Imaging: Securing Digital Evidence with Linux Tools, 1st Edition, No Starch Press, 2016.

REFERENCE BOOKS

1. Leighton Johnson, Computer Incident Response and Forensics Team Management: Conducting Successful Incident Response, 1st Edition, Syngres, 2013
2. Andrew Case, Jamie Levy, and Aaron Walters, The Art of Memory Forensics, 1st Edition, Wiley, 2014.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Sans, DFIR (Digital Forensics and Incident Response) certification, <http://www.sans.org/digital-forensics-incident-response/>, Last accessed on: 23/08/2024.

20AI&ML7403C

CLOUD COMPUTING

| | | | |
|-----------------|-----------------------------------|-------------------|-------|
| Course Category | Program Elective-IV | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20AI&ML4304: Computer Networks | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand cloud computing concepts, types of services and deployment models.
2. Understand the architecture and infrastructure of cloud computing.
3. Analyze the different Cloud Platforms and Cloud Applications.
4. Analyze the core issues of cloud computing such as security, privacy and interoperability.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 3 | 2 | | | | | | | | | | | | | 2 | 1.7.1, 2.5.1 |
| 2 | 3 | 2 | | | | | | | | | | | 2 | | 2 | 1.7.1, 2.6.3, 2.6.4, 2.8.3, 2.8.4 |
| 3 | 1 | 3 | | | 3 | | | | | | | | 1 | 2 | 4 | 1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 5.4.1 |
| 4 | 3 | 2 | | | | | | | | | | | 1 | 2 | 4 | 1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4 |

COURSE CONTENT

UNIT I

Introduction to Cloud Computing: Cloud Computing in a Nutshell, Roots of Cloud Computing, Layers and Types of Clouds, Desired Features of a Cloud, Cloud Infrastructure Management, Infrastructure as a Service Providers, Platform as a Service Providers, Challenges and Risks.

Migrating into a Cloud: Introduction, Broad Approaches to Migrating into the Cloud, The Seven Step Model of Migration into a cloud

UNIT II

Virtualization: Introduction, Characteristics of Virtualized Environments,

Taxonomy of Virtualization Techniques - Execution Virtualization, Other types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples -Xen, VMware, Microsoft Hyper-V. **Virtual Machine Provisioning and Migration Services:** Introduction, Virtual Machine Provisioning and Manageability, Virtual Machine Migration Services, VM Provisioning and Migration in Action, Provisioning in the cloud context

UNIT III

Cloud Platforms in Industry: Amazon web services, Compute services, Storage services, Communication services and Additional Services. Google AppEngine, Architecture and core concepts, Application life cycle, Cost model, Observations. Microsoft Azure, Azure Core Concepts, SQL Azure, Windows Azure Platform Appliance Cloud Applications: Scientific Applications. **Programming and Runtime Support:** Programming Support of Google App Engine, Programming on Amazon AWS and Microsoft Azure.

UNIT IV

Data Security in the Cloud: Introduction, Current State, Homo Sapiens and Digital Information, Cloud Computing and Data Security Risk, Cloud Computing and Identity, The Cloud, Digital Identity, and Data Security.

Legal Issues in Cloud Computing : Introduction, Data Privacy and Security Issues, Cloud Contracting models, Jurisdictional Issues Raised by Virtualization and Data Location

TEXTBOOKS

1. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski Cloud Computing: Principles And Paradigms, Wiley, 2013.(Unit-1,2,4)
2. Selvi, S., Buyya, R., & Vecchiola, C, Mastering Cloud Computing: Foundations and Applications Programming. Netherlands: Elsevier Science, 2013.(Unit 2,3)

REFERENCE BOOKS

1. Kai Hwang, Geoffrey C Fox, Jack J Dongarra, Distributed and Cloud Computing - From Parallel Processing to the Internet of Things, Morgan Kaufman Publishing, 2012.
2. Barrie Sosinsky, Cloud Computing Bible, Wiley Publishers, 2012.
3. Thomas Erl, Cloud Computing: Concepts, Technology & Architecture, 1st Edition, Pearson, 2014.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Cloud computing By Prof. Soumya Kanti Ghosh, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc21_cs14/preview, Last accessed

- on: 10/09/2024.
2. Cloud Computing Applications Part 1:Cloud Systems and Infrastructure-University of Illinois at Urbana, <https://in.coursera.org/learn/cloud-applications-part1?specialization=cloud-computing#about>, Last accessed on: 12/09/2024.
 3. Architecting Software For The Cloud Dept. of Computer Science and Engineering at IIT Ropar and IIT Kanpur,<https://www.youtube.com/user/arch4cloud/playlists>, Last accessed on: 11/09/2024.

20AI&ML7403D

FRAMEWORK AND MICROSERVICES

| | | | |
|-----------------|-----------------------|-------------------|-------|
| Course Category | Program Elective-IV | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20AI&ML6404D | Continuous Eval | 30 |
| | Back End Technologies | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand Microsoft .NET Framework Architecture and Fundamentals of C#.
2. Apply OOP principles and ASP.NET to create dynamic web applications.
3. Apply ASP.NET Core Razor pages to create a web application.
4. Apply .NET Core to create micro services.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 2 | 2 | 3 | | | | | | | | | | | | | 2 | 1.7.1, 2.5.1, 2.5.2, 3.5.1 |
| 2 | 2 | 2 | 3 | | | | | | | | | | | 2 | 2 | 3 | 1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.7.1, 3.5.1 |
| 3 | 2 | 2 | 2 | | | | | | | | | | | 2 | 2 | 3 | 1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.6.4, 3.5.1 |
| 4 | 2 | 2 | 3 | | | | | | | | | | | 2 | 2 | 3 | 1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.6.4, 3.5.1 |

COURSE CONTENT

UNIT I

C# Language Basics: Introducing the C# language, brief history of C#, A First C# Program, Syntax, Type basics, Numeric Types, Boolean type and operators, Strings and Characters, Arrays, Variables and Parameters, Expressions and Operators, Null operators, Statements, Namespaces. Creating Types in C#: Classes, Inheritance, The object type, Structs, Access modifiers, Interfaces, Enums, Nested types, Generics.

UNIT II

Packaging and distributing .NET Types: The road to .NET 8, Understanding .NET Components, .NET Framework Architecture, CTS, The

Common Language Runtime, The Common Language Specification, The Common Type System, Object orientation, Type Safety, Memory management, Publishing your code for deployment, Native ahead-of-time compilation, Decompiling .NET assemblies, Packaging your libraries for NuGET distribution.

Working with common .NET Types: Working with numbers, working with text, Pattern matching with regular expressions, storing multiple objects in collections, working with spans, indexes and ranges.

UNIT III

Introduction to ASP.NET: ASP.NET Basics, ASP.NET Page Structure, Page Life Cycle. Controls: HTML Server Controls, Web Server Controls, Web User Controls, Validation Controls, Custom Web Controls.

Building Websites using ASP.NET Core: New features in ASP.NET Core, Understanding web development, Understanding HTTP, Using Google Chrome to make HTTP requests.

Understanding ASP.NET Core: Classic ASP.NET versus modern ASP.NET Core, Creating an empty ASP-.NET Core project, Testing and securing the website, Controlling the hosting environment, Separating configuration for services and pipeline, Enabling a website to serve static content

UNIT IV

Working with Data Using Entity Framework Core: Understanding modern databases, Understanding Entity Framework Core, Creating a console app for working with EF Core, Using a sample relational database, Using Microsoft SQL Server for Windows, Setting up EF Core, Defining EF Core Models, Querying EF Core models, Loading patterns with EF Core, Manipulating data with EF Core.

Designing a Web API: Difficulty with Traditional services. Building a Web API services with ASP.NET Core, Designing a RESTful Interface, REST at a glance, REST in ASP.NET Core.

Docker and Containerization for Microservices: Introduction to Docker, Overview of containerization and its benefits, Docker architecture and components, Basic Docker commands and usage, Writing Dockerfiles for .NET applications, Building and running Docker images.

TEXTBOOKS

1. Mark J.Price, C# 12 and .NET 8 – Modern Cross-Platform Development Fundamentals: Start building websites and services with ASP.NET Core 8, Blazor, and EF Core 8, 8th Edition, Packt Publishing Ltd, 14 Nov 2023.
2. Mark J.Price, C# 10 and .NET 8 – Modern Cross-Platform Development, 6th Edition, O'Reilly Publications, Nov 2021.
3. Dino Esposito, Programming ASP.NET Core, Microsoft, PHI Publications, 2019.

4. Web link: Introduction to Docker - .NET — Microsoft Learn

REFERENCE BOOKS

1. Kemal Birer, ASP.NET Core for Jobseekers, BPB publications 2021.
2. Andreas Helland, ASP.NET Core 5 for Beginners, Packt, 2021.
3. Kogent Learning Solutions, ASP.NET4.5 PROGRAMMING, Black Book, Dreamtech Press, 2016.
4. Adam Freeman, Pro ASP.NET MVC 5, 5th Edition, APress, 2020

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Scott Hanselman, Maira Wenzel, Modern Web Development with .NET 6 Ep1: Create a web UI with ASP.NET Core, <https://docs.microsoft.com/en-us/shows/learn-live/modern-web-development-net6-ep01-create-web-ui-aspnet-core>, Last Accessed on: 11/10/2024.
2. Rehan Saeed, Upgrading ASP.NET Core to .NET 6 & C# 10,
3. Slides from a Stanford Course, <http://web.stanford.edu/class/cs97si/>, Last Accessed on: 11/10/2024.
4. Cam Sopar, Getting Started with Entity Framework Core, <https://docs.microsoft.com/en-us/shows/entity-framework-core-101/getting-started-with-entity-framework-core>, Last Accessed on: 11/10/2024.
5. Kaushik Roy Chowdhury, ASP.NET 6.0 - Build Hands-On Web Projects, <https://www.udemy.com/course/aspnetcore-31-build-hands-on-web-projects/>, Last Accessed on: 11/10/2024.

20AI&ML7404A

REINFORCEMENT LEARNING

| | | | |
|-----------------|----------------------------------|-------------------|-------|
| Course Category | Program Elective-V | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20AI&ML5402: Machine Learning | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the elements of Reinforcement Learning.
2. Apply Markov Reward Processes (MRP) to solve problem models.
3. Apply Dynamic Programming techniques.
4. Analyze Temporal Difference (TD) methods for prediction and control in RL.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 3 | | 2 | | | | | | | | | | 1 | 1 | 2 | 1.2.1, 3.5.1 |
| 2 | 3 | | 2 | | | 2 | | | | | | | 1 | 1 | 3 | 1.2.1, 3.5.3, 6.4.1 |
| 3 | 2 | | 2 | | | 3 | | | | | | | 1 | 1 | 3 | 1.2.1, 3.5.3, 6.4.1 |
| 4 | 3 | | 2 | | | 2 | | | | | | | 1 | 1 | 4 | 1.7.1, 3.5.3, 6.4.1 |

COURSE CONTENT

UNIT I

Introduction: Difference between RL, Supervised, and Unsupervised Learning, Elements of RL: Agent, Environment, Rewards, Actions, States, and Transitions, Markov Property, Markov Chains, Markov Reward Process (MRP).

Evaluative Feedback: Multi-Arm Bandit Problem, Exploration vs. Exploitation, Action-value methods, Incremental Implementation, Optimistic Initial Values, Upper Confidence Bound (UCB) Action Selection, Gradient Bandits.

UNIT II

Markov Decision Process (MDP): Introduction to MDPs, State and Action Value Functions, Bellman Expectation Equations, Bellman Optimality Equations, Proof of Bellman Equations for MDPs, Optimality of Value Functions and Policies.

UNIT III

Dynamic Programming (DP): Overview of DP for MDPs , Principle of Optimality, Policy Evaluation, Policy Improvement, Policy Iteration, Value Iteration, Asynchronous DP, Generalized Policy Iteration

UNIT IV

Monte Carlo (MC) Methods for Prediction and Control: Overview of Monte Carlo Methods for Model-Free RL Monte Carlo Prediction, Monte Carlo Estimation of Action Values , Monte Carlo Control, On-Policy and Off-Policy Learning, Importance Sampling

TEXTBOOKS

1. Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction, MIT Press, 2020, 2nd Edition,.

REFERENCE BOOKS

1. Csaba Szepesvári, Algorithms for Reinforcement Learning, Morgan & Claypool, 2010, 1st Edition.
2. Warren B. Powell, Reinforcement Learning and Stochastic Optimization: A Unified Framework for Sequential Decisions, Wiley, 2022, 1st Edition.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. NPTEL course by Prof. Balaraman Ravindran, IIT Madras <https://nptel.ac.in/courses/106106182>, Last accessed on: 24/10/2024.
2. Lectures by David Silver, UCL, https://www.youtube.com/playlist?list=PL5eJgcfsD-r_GqpbUbKNUqVJvCf1bIPD2, Last accessed on: 24/10/2024.

20AI&ML7404B

BLOCKCHAIN TECHNOLOGY

| | | | |
|-----------------|--|-------------------|-------|
| Course Category | Program Elective V | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20AI&ML5404B: Cryptography and Network Security | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the basics of blockchain.
2. Analyze the blockchain architecture with Consensus agreement methods.
3. Understand blockchain components with the development tools.
4. Apply cryptocurrency for blockchain applications. blockchain.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 3 | | | | | | | | | | | | 1 | 1 | 2 | 1.7.1 |
| 2 | 3 | 2 | | | | | | | | | | | 1 | 1 | 4 | 1.7.1,2.5.1 |
| 3 | 2 | | | 2 | 2 | | | | | | | | 1 | 1 | 2 | 1.7.1, 4.5.1,5.4.1 |
| 4 | 2 | | | 3 | 2 | | | | | | | | 1 | 1 | 3 | 1.7.1, 4.5.1, 5.4.1 |

COURSE CONTENT

UNIT I

Basics of Blockchain: Introduction, History, Definition of Blockchain, Fundamentals of Blockchain, Characteristics, Public, Private, and Hybrid Blockchains, Distributed Ledger Technologies, Architecture of Blockchain.

UNIT II

Consensus: Introduction, Consensus Approach, Consensus Algorithms, Byzantine Agreement Methods, Consensus in Trust-Building Exercise. Mining: Introduction, Mining Nodes, Mining the block, Validating a New Block, Blockchain Forks, Mining Hardware and Software

UNIT III

Blockchain Components: Introduction, Ethereum, History, Ethereum Virtual Machine, Working of Ethereum, Ethereum Clients, Key Pairs, Addresses, Wallets, Transactions, Development Tools.

UNIT IV

Blockchain Applications: Smart Contracts, Supply Chain Management, Finance Blockchain Allied Technologies: Cloud Computing, Artificial Intelligence, IoT, Machine Learning, Robotic Process Automation.

TEXTBOOKS

1. A. Sourabh, A. Sexena, Blockchain Technology: Concepts and Applications, Wiley, 2019.
2. Melanie Swan, Blockchain, O'Reilly, 2nd Edition., 2018.

REFERENCE BOOKS

1. Andreas M. Antonopoulos, Mastering Bitcoin, O'Reilly, 2nd Edition., 2017.
2. Manav Gupta, "Blockchain for Dummies", John Wiley & Sons, 2nd Edition, 2018.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Sandeep Sukla, IIT Kanpur, <https://www.digimat.in/nptel/courses/video/106104220/L01.html>, Last Accessed on: 24/10/2024.
2. Prof. Sandeep Chakraborty, IIT Kharagpur <https://archive.nptel.ac.in/courses/106/105/106105184/>, Last Accessed on: 24/10/2024.

20AI&ML7404C

SOFTWARE PROJECT MANAGEMENT

| | | | |
|-----------------|--------------------------------------|-------------------|-------|
| Course Category | Program Elective-V | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | 20AI&ML6303: Software Engineering | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the basic concepts of software project management.
2. Apply Project Approach and Estimation for a real-world problem.
3. Apply appropriate risk management strategies to address each identified risk, including mitigation, transfer, avoidance, or acceptance.
4. Apply motivational theories and techniques to enhance team engagement and performance.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | |
| 1 | 1 | 2 | | 1 | | | | | | | | | | 1 | 1 | 2 | 1.6.1, 1.7.1, 2.5.1, 4.5.1 |
| 2 | 2 | 3 | | | | | | | | | | | | 1 | 1 | 3 | 1.6.1, 1.7.1, 2.6.4, 2.6.5, 2.8.1 |
| 3 | 2 | 3 | | | | | | | | | | | | 1 | 1 | 3 | 1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.8.2 |
| 4 | 3 | 3 | 2 | | | | | 1 | | | | | | 1 | 1 | 3 | 1.6.1, 1.7.1, 2.5.2, 2.5.3, 2.6.4, 2.7.1, 3.5.5, 8.3.1 |

COURSE CONTENT

UNIT I

Introduction to Software Project Management: Introduction, Software Projects versus Other Types of Project, Contract Management and Technical Project Management, Activities Covered by Software Project Management, Plans, Methods and Methodologies, Some Ways of Categorizing Software Projects, Project Charter, Stakeholders, Setting Objectives, The Business Case, Project Success and Failure, Management Control, Project Management Life Cycle, Traditional versus Modern Project Management Practices.

UNIT II

Selection of an Appropriate Project Approach: Introduction, Choosing Methodologies and Technologies, Software Processes and Process Models, Choice of Process Models, Structure versus Speed of Delivery, The Water-fall Model, The Spiral Model, Software Prototyping, Other Ways of Categorizing Prototypes, Incremental Delivery, Atern/Dynamic Systems Development Method, Rapid Application Development, Agile Methods, Extreme Programming (XP), Scrum, Lean Software Development, Managing Iterative Processes, Selecting the Most Appropriate Process Model.

Software Effort Estimation: Introduction, Problems with Over- and Under-Estimates, The Basis for Software Estimating, Software Effort Estimation Techniques, Bottom- up Estimating, The Top-down Approach and Parametric Models, Expert Judgement, Estimating by Analogy, Albrecht Function Point Analysis, Function Points Mark II, COSMIC Full Function Points.

UNIT III

Activity Planning: Introduction, Objectives of Activity Planning, When to Plan, Project Schedules, Projects and Activities, Sequencing and Scheduling Activities, Network Planning Models, Formulating a Network Model, Adding the Time Dimension, The Forward Pass, Backward Pass, Identifying the Critical Path, Activity Float, Shortening the Project Duration, Identifying Critical Activities, Activity-on-Arrow-Networks.

Risk Management: Introduction, Risk, Categories of Risk, Risk Management Approaches, A Framework for Dealing with Risk, Risk Identification, Risk Assessment, Risk Planning, Risk Management, Evaluating Risks to the Schedule, Boehm's Top 10 Risks and Counter Measures, Applying the PERT Technique, Monte Carlo Simulation, Critical Chain Concepts.

UNIT IV

Resource Allocation: Introduction, Nature of Resources, Identifying Resource Requirements, Scheduling Resources, Creating Critical Paths, Counting the Cost, Being Specific, Publishing the Resource Schedule, Cost Schedules, Scheduling Sequence.

Managing People in Software Environments: 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, Stress Management, Health and Safety, Some Ethical and Professional Concerns.

TEXTBOOKS

1. Software Project Management, Bob Hughes, Mike Cotterell, Rajib Mall,

TMH, 6th Edition , 2018.

REFERENCE BOOKS

1. Project Management and Tools & Technologies – An overview, Shailesh Mehta, SPD, 2017.
2. Murali Chemuturi, Thomas M. Cagley, —Mastering Software Project Management: Best Practices, Tools and techniques, J. Ross Publishing, 2010.
3. Antonio Borghesi, Barbara Gaudenzi, —Risk Management: How to Assess, Transfer and Communicate Critical Risks: Perspectives in Business Culture, Illustrated Edition, Springer, 2013.
4. Project Management and Tools & Technologies – An overview, Shailesh Mehta, SPD, 2017.
5. Murali Chemuturi, Thomas M. Cagley, —Mastering Software Project Management: Best Practices, Tools and techniques, J. Ross Publishing, 2010.
6. Antonio Borghesi, Barbara Gaudenzi, —Risk Management: How to Assess, Transfer and Communicate Critical Risks: Perspectives in Business Culture, Illustrated Edition, Springer, 2013.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. By Prof. Rajib Mall & Prof. Durga Prasad Mohapatra, IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc19_cs70/preview, Last Accessed on: 13/09/2024.
2. Mike Clayton, Monte Carlo Simulation, <https://www.youtube.com/watch?v=PMISi2ZyuR8>, Last Accessed on: 13/09/2024.

20AI&ML7404D DEVOPS

| | | | |
|-----------------|--------------------|-------------------|-------|
| Course Category | Program Elective-V | Credits | 3 |
| Course Type | Theory | L-T-P | 3-0-0 |
| Prerequisites | | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the basics of Devops and its history.
2. Understand the concepts of container and its life cycle, docker file, and multi-containers orchestration.
3. Apply Kubernetes components and resources to efficiently deploy, manage, and scale containerized applications.
4. Apply robust monitoring and logging solutions for containerized applications and manage Kubernetes resources.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 1 | 2 | 3 | | | | | | | | | | 1 | 2 | 2 | 1.6.1, 2.7.1, 3.5.3 |
| 2 | | 1 | 3 | | 2 | | | | | | | | 1 | 2 | 2 | 2.5.2, 3.8.2, 5.5.2 |
| 3 | | 1 | 2 | | 3 | | | | | | | | 1 | 3 | 3 | 2.5.2, 3.6.2, 5.6.2 |
| 4 | | 1 | 2 | | 3 | | | | | | | | 1 | 3 | 3 | 2.5.2, 3.8.3, 5.4.2 |

COURSE CONTENT

UNIT I

Devops and History: The Devops Equation, Devops as Folk Model, The Old View and the New View, Devops Compact, Developer as Operator, Advent of Software Engineering, Advent of Proprietary Software and Standardization, Age of the Network, Beginnings of a Global Community, Age of Applications and the Web, Growth of Software Development Methodologies, Open Source Software, Proprietary Services, Agile Infrastructure, Beginning of Devopsdays, Current State of Devops.

Devops Misconceptions and Anti-Patterns: Common Devops Misconceptions, Devops Anti-Patterns, Four Pillars of Effective Devops.

UNIT II

Container and Container Life Cycle: Resource Isolation, Linux Container Concept, Containerized Delivery, Installing Docker for Ubuntu, CentOS, macOS, Container life cycle – Docker Basics, Layer, Image, Container, and Volume, Distributing Images, Connect Containers.

Dockerfile and Multi-Containers Orchestration: Writing your first Dockerfile, Dockerfile Syntax, Organizing a Dockerfile, Piling up Containers, Docker Compose Overview, Composing Containers.

UNIT III

Kubernetes Components: Master components, API Server (kube apiserver), Controller Manager (kube-controller manager), etcd, Scheduler (kube scheduler), Node components Kubelet, Proxy (kube-proxy), Docker, Interaction between Kubernetes master and nodes.

Kubernetes Resources: Preparing the Environment, Kubectl, Kubernetes Objects – Namespace, Name, Label and Selector, Annotation, Pods, ReplicaSet (RS) and ReplicationController (RC), Deployments, Services, Volumes, Secrets, ConfigMap, Using ConfigMap via Volume, Using ConfigMap via Environment Variables.

UNIT IV

Kubernetes Volume and Resource Management: Container Volume Lifecycle, Sharing Volume between Containers within a Pod, Stateless and Stateful Applications, Kubernetes Persistent Volume and dynamic provisioning, Replicating Pods with a Persistent Volume using StatefulSet, Persistent Volume examples, Resource Quality of Service, Configuring the BestEffort Pod, Configuring as the Guaranteed Pod, Configuring as Burstable Pod, Monitoring Resource Usage.

Monitoring and Logging: Inspecting a Container, Monitoring in Kubernetes – Application, Host, External Resources, Container, Kubernetes, Getting Monitoring Essentials for Kubernetes, Hands-on Monitoring – Meeting Prometheus, Deploying Prometheus, Working with PromQL, Discovering targets in Kubernetes, Gathering data from Kubernetes, Seeing metrics with Grafana, Logging Events - Patterns of Aggregating Logs, Collecting Logs with a Logging Agent per Node, Running a Sidecar Container to Forward Logs, Ingesting Kubernetes Events, Logging with Fluentd and Elasticsearch.

TEXTBOOKS

1. Davis, Jennifer, and Ryn Daniels, Effective DevOps: building a culture of collaboration, affinity, and tooling at scale, O'Reilly Media, Inc., 1st Edition, 2016. [Unit I]
2. Saito, Hideto, Hui-Chuan Chloe Lee, and Cheng-Yang Wu, DevOps with Kubernetes: accelerating software delivery with container orchestrators, Packt Publishing Ltd, 2019. [Unit II, III, IV]

REFERENCE BOOKS

1. Hering, Mirco, DevOps for the modern enterprise: Winning practices to transform legacy IT organizations, IT Revolution, 2018.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Introduction to DevOps, <https://www.coursera.org/learn/intro-to-devops>, Last Accessed on: 11/11/2024.
2. Devops Fundamentals - CI/CD with AWS +Docker+Ansible+Jenkins, <https://www.udemy.com/course/devops-fundamentals-aws>, Last Accessed on: 11/11/2024.

HONORS

20AI&MLH4801**MATHEMATICAL MODELS FOR MACHINE LEARNING**

| | | | |
|-----------------|-------------------------------------|-------------------|-------|
| Course Category | Honors | Credits | 4 |
| Course Type | Theory | L-T-P | 3-1-0 |
| Prerequisites | Mathematics For Machine Learning | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Describe the concepts of Analytic Geometry required for ML.
2. Interpret various ML Optimization approaches mathematically.
3. Implement data dimensionality reduction strategies for ML data preparation.
4. Use concepts calculus to understand the various ML approaches.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 3 | 2 | 2 | | 2 | | | | 1 | | 1 | 1 | 1 | 1 | 2 | 1.7.1, 2.5.1, 2.6.4, 2.3.2, 5.3.1, 5.3.2, 11.4.1, 12.6.2 |
| 2 | 2 | 1 | 1 | | | 2 | | | 1 | | | | 2 | 2 | 3 | 2.5.2, 2.6.1, 2.6.3, 3.6.1, 3.6.2, 3.7.6.4.1 |
| 3 | 2 | 2 | | | 1 | | | | 2 | | 1 | | 2 | | 3 | 1.2.1, 1.7.1, 2.5.1, 2.4.1, 2.4.4, 5.3.1 |
| 4 | 2 | 2 | 1 | | | 1 | | | | | | 2 | 3 | 2 | 3 | 1.2.1, 2.6.3, 2.7.1, 3.6.1, 3.6.2, 12.6.2 |

COURSE CONTENT**UNIT I**

Analytic Geometry: Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Inner product of Functions, Orthogonal projections, Rotations.

Matrix Decompositions: Determinant and Trace, Eigenvalues and Eigenvectors, Cholesky Decomposition, Eigen Decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation, Matrix Phylogeny.

UNIT II

Optimization: using Gradient Descent, Constrained Optimization and Lagrange Multipliers, Convex Optimization, Constrained Optimization, Second-Order Optimization- Newton's method, Quasi-Newton methods, Bayesian Optimization- Sequential Model-Based Optimization (SMBO), Meta heuristic Optimization- Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO).

Data Models: Data, Models, and Learning, Empirical Risk Minimization, Parameter estimation, Probabilistic modeling and Inference, Directed graphical models, Model selection.

UNIT III

Linear Regression: Problem formulation, Bayesian Linear Regression, Maximum likelihood as Orthogonal Projection.

Dimensionality Reduction: Maximum variance perspective, Projection perspective, Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), t-Distributed Stochastic Neighbor Embedding (t-SNE), Uniform Manifold Approximation and Projection (UMAP), Isomap (Isometric Mapping), Locally Linear Embedding (LLE), Independent Component Analysis (ICA).

UNIT IV

Density estimation with Gaussian Mixture models: Gaussian mixture model, Parameter learning via Maximum likelihood, EM algorithm, Latent-Variable perspective.

Classification with Support Vector Machines: Separating hyper planes, Primal Support Vector Machines, Dual Support Vector Machine, Kernels, Numerical solution

TEXTBOOKS

1. Deisenroth, Marc Peter, A. Aldo Faisal, and Cheng Soon Ong. Mathematics for machine learning. Cambridge University Press, 2020.

REFERENCE BOOKS

1. Brownlee, Jason. Optimization for machine learning. Machine Learning Mastery, 2021.
2. Jerry Shurman Multivariable Calculus. Reed College

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. <https://ocw.mit.edu/courses/18-657-mathematics-of-machine-learning-fall-2015/>, Last Accessed on: 11/11/2024.
2. <https://www.analyticsvidhya.com/blog/2021/06/how-to-learn-mathematics-for-machine-learning-what-concepts-do-you-need-t>

- [o-master-in-data-science/](#), Last Accessed on: 11/11/2024.
3. <https://www.deeplearning.ai/courses/mathematics-for-machine-learning-and-data-science-specialization/>, Last Accessed on: 11/11/2024.

20AI&MLH5801

EDGE COMPUTING AND AI FOR IOT

| | | | |
|-----------------|--------|-------------------|-------|
| Course Category | Honors | Credits | 4 |
| Course Type | Theory | L-T-P | 3-1-0 |
| Prerequisites | | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the basic concepts of Edge Computing and its relevance to IoT and Explore future research trends in AI, IoT, and Edge Computing.
2. Apply AI techniques to optimize IoT systems in resource-constrained environments.
3. Analyze IoT-based systems that integrate with AI at the edge for real-time analytics and automation.
4. Apply industry-standard tools to implement AI models on edge devices.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|---------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 2 | | | | | | | | | | | | | 2 | 2 | 1.6.1, 1.7.1 |
| 2 | 2 | 2 | | | | | | | | | | | 1 | | 3 | 1.6.1, 1.7.1, 2.7.1 |
| 3 | 2 | | 2 | | | | | | | | | | | 2 | 4 | 1.6.1, 1.7.1, 3.6.1 |
| 4 | 2 | | | | 3 | | | | | | | | | 2 | 3 | 1.6.1, 1.7.1, 5.4.1 |

COURSE CONTENT

UNIT I

Overview of Edge Computing: Definitions, Concepts, and Comparison with Cloud Computing Architectures of Edge Computing: Multi-tier, Fog, and Edge Challenges and Opportunities in Edge Computing for IoT.

Use Cases: Smart Cities, Industrial IoT, and Connected Vehicles.

UNIT II

AI Models and Algorithms at the Edge: Introduction to AI and ML Models for Edge Environments Lightweight AI Models for Edge (e.g., TensorFlow Lite, TinyML) Federated Learning: Distributed AI for Edge and IoT Resource-Constrained Machine Learning and Optimization Strategies for AI at the Edge.

UNIT III

Role of AI in IoT Applications: Predictive Maintenance, Healthcare, and Smart Homes Real-time Data Analytics and Event Detection using AI.

Case Studies: AI-Powered Smart Devices and Wearable IoT Sensors Security and Privacy Challenges in AI-enabled IoT Systems.

UNIT IV

Tools, Frameworks, and Future Trends in Edge-AI IoT: AWS IoT Greengrass, Azure IoT Edge, and Google Edge TPU Edge-AI Development Frameworks: TensorFlow Lite, OpenVINO, and Edge Impulse.

Future Trends: Autonomous Edge Systems, Swarm Intelligence, and Green AI

TEXTBOOKS

1. Shi, Weisong, and Jie Cao. "Edge Computing: A Primer." Springer, 2020 (Chapters 1-3)
2. Raj, Pethuru, and Ganesh Chandra Deka. "AI and Machine Learning for Edge Computing: A Roadmap for IoT." Springer, 2020 (Chapters 2, 3, and 4)
3. Turjman, Fadi. "Artificial Intelligence in IoT." Springer, 2019 (Chapters 3, 4, and 5)
4. Raj, Pethuru, and Ganesh Chandra Deka. "AI and Machine Learning for Edge Computing: A Roadmap for IoT." Springer, 2020 (Chapters 6 and 7)

REFERENCE BOOKS

1. Michael Roshak "Artificial Intelligence for IoT" Packet publishers, 2021.
2. Souvik Pal, Debashis De ,Rajkumar Buyya "Artificial Intelligence-based Internet of Things Systems" springer,2022.
3. Amitoj Singh, Vinay Kukreja, Taghi Javdani Gandomani "Machine Learning for Edge Computing" CRC Press,2022.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. https://onlinecourses.nptel.ac.in/noc23_cs65/preview, Last accessed on: 30-10-2024.
2. Edge Computing By Prof. Rajiv Misra IIT Patna, https://onlinecourses.nptel.ac.in/noc24_cs66/preview,Last accessed on 30-10-2024.

20AI&MLH6801

HIGH-PERFORMANCE COMPUTING

| | | | |
|-----------------|--------------------------------------|-------------------|-------|
| Course Category | Honors | Credits | 4 |
| Course Type | Theory | L-T-P | 3-1-0 |
| Prerequisites | 20AI&ML3303: Artificial Intelligence | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Explain the High-performance computing concepts with performance metrics.
2. Demonstrate the parallel and distributed programming models.
3. Implement optimization techniques on various architectures.
4. Apply HPC frameworks in AI applications.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----------------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | |
| 1 | 1 | 1 | | | 2 | | | | | | | | 1 | 1 | 2 | 1.7.1, 2.5.2, 2.6.3, 5.4.1 |
| 2 | 1 | 2 | | | 1 | | | | | | | | 1 | 1 | 3 | 1.7.1, 2.5.2, 2.6.3, 5.4.1 |
| 3 | 2 | 2 | | | 1 | | | | | | | | 1 | 1 | 3 | 1.7.1, 2.5.2, 2.6.3, 2.7.1, 5.4.1 |
| 4 | 2 | 1 | | | 1 | | | | | | | | 1 | 1 | 3 | 1.7.1, 2.5.2, 2.6.3, 2.7.1, 5.4.1 |

COURSE CONTENT

UNIT I

Overview of High-Performance Computing (HPC): Definition and importance in scientific computing and AI, Historical development and current trends in HPC Architectures and Systems. Overview of HPC architectures: clusters, grids, and supercomputers. Understanding parallelism: shared vs. distributed memory systems.

Performance Metrics: Measuring performance: FLOPS, latency, bandwidth, Benchmarking techniques and tools (e.g., Linpack, STREAM).

Basic Concepts in Parallel Computing: Introduction to parallel algorithms, Types of parallelism: data parallelism, task parallelism.

UNIT II

Parallel Programming Models and Tools: Shared memory vs. distributed memory programming models, Shared-memory computers: Cache coherence, UMA, ccNUMA, Overview of MPI (Message Passing Interface) and OpenMP, Parallel Programming Languages for parallel programming, High-level languages and frameworks for parallel programming (e.g., Python with multiprocessing).

Distributed-Memory Programming with MPI: Message passing fundamentals, Point-to-point communication: send/receive, Collective communication: broadcast, scatter, gather, and reduce, MPI synchronization and data management, Load Balancing and Scalability, Load balancing techniques, Domain decomposition, Scalability issues in parallel systems.

UNIT III

Optimization Techniques for HPC: Performance Optimization Strategies: Memory optimization: cache usage, data locality, Computation optimization: algorithmic improvements, loop unrolling. Concurrency and Synchronization: Understanding threads, locks, and barriers, Avoiding race conditions and deadlocks.

Advanced Optimization Techniques: Vectorization and instruction-level parallelism, Use of GPUs and accelerators (e.g., CUDA, OpenCL), Optimization, Locality optimizations on ccNUMA architectures.

UNIT IV

Applications of HPC in Artificial Intelligence: AI and Machine Learning Algorithms on HPC: Running large-scale machine learning models, Parallelizing training and inference processes.

Deep Learning Frameworks: Introduction to HPC-enabled deep learning frameworks (e.g., TensorFlow, PyTorch), Techniques for distributed training of neural networks, Case Studies in AI Applications: Real-world examples of HPC in AI: genomics, climate modelling, and large-scale simulations

TEXTBOOKS

1. Hager, Georg, and Gerhard Wellein. Introduction to High Performance Computing for Scientists and Engineers. CRC Press, 1st edition, 2010.

REFERENCE BOOKS

1. Kreutzer, Moritz, and Georg Hager. High Performance Computing: Modern Systems and Practices. Morgan Kaufmann, 1st edition, 2018.
2. Raj, Pethuru, and Sourav Bhattacharya. High-Performance Big-Data Analytics: Computing Systems and Approaches. Springer, 1st edition, 2019.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. High-Performance Computing with Containers, https://learn.nvidia.com/courses/course-detail?course_id=course-v1:DLI+L-AC-25+V1, Last accessed on :12-10-2024
2. Intro to High-Performance Computing, <https://omscs.gatech.edu/course-6220-intro-high-performance-computing>, Last Accessed on: 17-10-2024.
3. High Performance Computing for Scientists and Engineers, https://onlinecourses.nptel.ac.in/noc20_me61/preview, Last Accessed on: 17-10-2024.

20AI&MLH7801

QUANTUM COMPUTING

| | | | |
|-----------------|--------|-------------------|-------|
| Course Category | Honors | Credits | 4 |
| Course Type | Theory | L-T-P | 3-1-0 |
| Prerequisites | | Continuous Eval | 30 |
| | | Semester End Eval | 70 |
| | | Total Marks | 100 |

COURSE OUTCOMES

1. Understand the principles of quantum computing.
2. Design and analyze quantum circuits and algorithms.
3. Implement quantum circuits and algorithms using Qiskit.
4. Analyze the fundamentals of quantum communication and cryptography.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

| CO | PO | | | | | | | | | | | | PSO | | BTL | POI | | |
|----|----|---|---|---|---|---|---|---|---|----|----|----|-----|---|-----|-----|---|-----------------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | | | | |
| 1 | 2 | | 1 | 1 | | 1 | | | | | | | | | | | 2 | 1.1.2, 1.2.3, 3.6.1, 4.5.1, 6.4.1 |
| 2 | 2 | | 2 | 2 | 3 | 2 | | | | | | | | | | | 3 | 1.1.2, 3.6.1, 4.5.1, 5.3.1, 6.4.1 |
| 3 | 3 | | 2 | 2 | 1 | 2 | | | | | | | | | | | 3 | 1.1.2, 3.6.1, 4.5.1, 5.3.1, 6.4.1 |
| 4 | 3 | | 2 | 2 | 2 | 2 | | | | | | | | | | | 4 | 1.1.2, 3.6.1, 4.5.1, 5.3.1, 6.4.1 |

COURSE CONTENT

UNIT I

Introduction to Quantum Computing: Fundamentals of Quantum Computing: Differences between classical and quantum computing. Qubits and Quantum States: Dirac notation, Bloch sphere representation. Quantum Gates: Single-qubit gates, two-qubit gates (CNOT, SWAP, etc.). Quantum Circuits: Circuit representation, Bell states. No-Cloning Theorem: Implications and applications.

UNIT II

Query Complexity: Deutsch's algorithm, Deutsch-Josza algorithm. Period Finding and Shor's Algorithm: Applications in integer factorization. Quantum

Fourier Transform: Applications in phase estimation. Grover's Algorithm: Quantum search algorithm, applications in unstructured search problems.

UNIT III

Quantum Communication and Cryptography: : Quantum Communication: Quantum teleportation, superdense coding, Quantum Cryptography: BB84 protocol, E91 protocol, Noisy Intermediate-Scale Quantum (NISQ) Computing: Challenges and opportunities.

UNIT IV

Quantum Programming and Implementation: Introduction to Qiskit: Setting up the environment , Circuit Implementation: Basic circuits, multi-qubit operations, Quantum Measurement Outcomes and probabilities , Simulators and Quantum Hardware: IBM Quantum Experience, Quantum Error Correction: Basic principles and techniques.

TEXTBOOKS

1. Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 2010, 10th Anniversary Edition.
2. Noson S. Yanofsky and Mirco A. Mannucci, Quantum Computing for Computer Scientists, Cambridge University Press, 2008, First Edition.

REFERENCE BOOKS

1. Eleanor G. Rieffel and Wolfgang H. Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.
2. Hassi Norlén, Quantum Computing in Practice with Qiskit® and IBM Quantum Experience®, Packt Publishing, 2020.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. NPTEL course on Quantum Computing by Prof. Bikas Chakrabarti, IIT Kharagpur: NPTEL Link
2. Quantum Computation Lectures by IBM Research: IBM Quantum
3. Qiskit Tutorials: Qiskit Documentation.