MOOGAMBIGAI CHARITABLE AND EDUCATIONAL TRUST

# Rajarajeswari College of Engineering

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)
#14, Ramohalli Cross, Kumbalagodu, Mysore Road, Bengaluru–560074


# Artificial Intelligence & Machine Learning

V & VI Semester Scheme and Syllabus

(2024 Scheme)

# VISION

To empower young minds through technology, research and innovation, to produce technically competent and socially responsible professionals in higher education.

# MISSION

1. To deliver excellence in education through innovative teaching, impactful research, and continuous skill development, preparing students to meet global challenges with technical expertise and ethical responsibility.
2. To foster a transformative learning environment that integrates technology, research and practical experience, empowering students to become skilled professionals and socially conscious leaders.
3. To cultivate a culture of lifelong learning and professional excellence by encouraging creativity, research, and community engagement, equipping students with the skills to thrive in a dynamic world.
4. To provide a holistic educational experience that combines advanced technology, hands-on research, and community-focused learning, shaping students into competent, ethical professionals who contribute positively to society.

# QUALITY POLICY

Rajarajeswari College of Engineering is committed to imparting quality technical education that nurtures competent, ethical professionals with global relevance. We ensure academic excellence through a dynamic, outcome-based curriculum, experienced faculty, and cutting-edge infrastructure. Continuous improvement is driven by innovation, research and strong industry collaboration. We foster holistic development and a progressive environment that supports lifelong learning, teamwork, and professional growth.

# CORE VALUES

Academic Excellence, Integrity, Innovation, Global Competence, Continuous Improvement.

# Artificial Intelligence & Machine Learning

## DEPARTMENT VISION

To bring out the competent and socially responsible engineers in the field of AI&ML Education, Research and Innovation.

## DEPARTMENT MISSION

1. To Inculcate, the integration process of concepts in AI&ML domain.
2. To equip AI&ML graduates with skills to meet Industry and Societal challenges by skill enhanced training.
3. To promote Research and ethical culture through interaction for broader application in AIML domain.

# PROGRAM OUTCOMES (POs)

**PO1: Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

**PO2: Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

**PO3: Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems /components / processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

**PO4: Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modeling, analysis & interpretation of data to provide valid conclusions. (WK8).

**PO5: Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modeling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

**PO6: The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, WK7).

**PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

**PO8: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

**PO9: Communication:** Communicate effectively and inclusively within the community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

**PO10: Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

**PO11: Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

# PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

**PEO1:** Develop competent profession in the field of Artificial Intelligence and Machine Learning towards advanced skills in solving contemporary problems.

**PEO2:** Pursue their professional on technical and progress towards Research and Entrepreneurship.

**PEO3:** Progress as skilled in team and adapting leadership qualities and ethical values as per the society.

# PROGRAM SPECIFIC OUTCOMES (PSOs)

**PSO1:** Design and develop AI&ML Solution, through modern engineering tools and Programming Language, Technical skills in presenting modern insights.

**PSO2:** Ability to adapt continues changing AI&ML domain for innovative challenges.

# INDEX

## V& VI Semester Common Courses

## V Semester

| S.No | Course Category and Course Code | | Course Title | TD / PSB | Teaching Hours / Week | | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Lecture | Tutorial | Practical | Self-Learning | CIE Marks | SEE Duration in Hrs. | SEE Marks | Total Marks | |
| | | | | | L | T | P | S | | | | | |
| 1. | HSMC | B24CS501 | Software Engineering and Project Management | AI | 3 | 0 | 0 | 3 | 50 | 3 | 50 | 100 | 3 |
| 2. | IPCC | B24CS502 | Computer Networks | AI | 3 | 0 | 2 | 3 | 50 | 3 | 50 | 100 | 4 |
| 3. | PCC | B24AI503 | Machine Learning | AI | 2 | 2 | 0 | 2 | 50 | 3 | 50 | 100 | 3 |
| 4. | PCC | B24AI504 | Data Warehousing and Data Mining | AI | 3 | 0 | 0 | 3 | 50 | 3 | 50 | 100 | 3 |
| 5. | PCCL | B24AI505L | Machine Learning Laboratory | AI | 0 | 0 | 2 | 0 | 50 | 3 | 50 | 100 | 1 |
| 6. | PEC | B24YY56X | Professional Elective Course- I | CS & Allied | 3 | 0 | 0 | 3 | 50 | 3 | 50 | 100 | 3 |
| 7. | BSC | B24BEK507 | Biology for Engineers | AI / Che | 2 | 0 | 0 | 2 | 50 | 2 | 50 | 100 | 2 |
| 8. | AEC | B24YY58X | Ability Enhancement Course Lab - V | CS & Allied | 0 | 0 | 2 | 0 | 50 | 3 | 50 | 100 | 1 |
| 9. | NCMC | B24NCK59X | NSS / NCC / PE / Yoga / Music | HSS | 2 | 0 | 0 | 0 | 100 | - | - | 100 | PP |
| 10. | NCMC | B24ESK510 | Environmental Science and E-Waste Management | AI / CV | 2 | 0 | 0 | 0 | 100 | - | - | 100 | PP |
| 11. | SDC | B24AIP511 | Mini-Project | AI | 0 | 0 | 4 | 0 | 50 | 3 | 50 | 100 | 2 |
| | | | | | | | | TOTAL | 650 | | 450 | 1100 | 22 |

BSC: Basic Science Course, HSMC: Humanity Social sciences including Management courses, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, PCCL: Professional Core Course laboratory, NCMC: Non-Credit Mandatory Course, AEC: Ability Enhancement Course, PEC: Professional Elective Course, SDC- Skill Development Course, L: Lecture, T: Tutorial, P: Practical S: Self-Learning, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation. K: Indicates common course to all the streams of engineering, PP/NP: Pass/ Not Pass, YY: Programme Code (EC, CS, IS etc.,), X: 1/2/3/4.

| **Professional Elective Courses (PEC) - I** | | | |
|---|---|---|---|
| B24AI561 | Probability and Statistics for ML | B24AI562 | Optimization Techniques for ML |
| B24AI563 | Data Engineering for AI | B24IC564 | Big Data Analytics |

| **Ability Enhancement Course / Skill Enhancement Course (AEC/SEC) – V** | | | |
|---|---|---|---|
| B24CS581 | Angular JS Lab | B24AI582 | Innovation, Startup, and Incubation Lab |
| B24AI583 | Julia Programming Lab | B24IC584 | Big Data Analytics with Python Lab |

| **Non-Credit Mandatory Courses (NCMC)** | | | |
|---|---|---|---|
| B24NCK591 | National Service Scheme | B24NCK592 | National Cadet Corps |
| B24NCK593 | Physical Education | B24NCK594 | Yoga |
| B24NCK595 | Music | | |

**National Service Scheme/National Cadet Corps/ Physical Education/Yoga/Music:** All the students have to register the same course namely National Service Scheme (NSS), National Cadet Corps (NCC), Physical Education (PE), Yoga (YOG) and Music (MUS) during the first week of III/IV/V/VI semesters. However, the option is given to students to change the activity. He/she may opt for the change of the course in ensuing semester. If the student is opting new course in V semester first time, he/she may take the basic modules from the syllabus to complete and if they repeat the same course in ensuing semester, subsequent modules can be offered.

**These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.**

**Professional Elective Courses (PEC):** A PEC is intended to enhance the depth and breadth of educational experience in the engineering and technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of student's strength for offering a professional elective is 10. However, this condition shall not be applicable to cases where the admission to the programme is less than 10 students.

**HoD** **Dean-Academics** **Principal**

**MOOGAMBIGAI CHARITABLE AND EDUCATIONAL TRUST**

# Rajarajeswari College of Engineering

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)

**DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**

Scheme of Teaching and Examinations -2024 Scheme

Outcome based Education (OBE) and Choice Based Credit System (CBCS) Effective from the Academic Year 2026-27

## VI Semester

| S.No | Course Category and Course Code | | Course Title | TD / PSB | Teaching Hours / Week | | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Lecture | Tutorial | Practical | Self-Learning | CIE Marks | SEE Duration Hrs | SEE Marks | Total Marks | |
| | | | | | L | T | P | S | | | | | |
| 1. | PCC | B24AI601 | Deep Learning | AI | 2 | 2 | 0 | 2 | 50 | 3 | 50 | 100 | 3 |
| 2. | IPCC | B24AI602 | Natural Language Processing | AI | 3 | 0 | 2 | 3 | 50 | 3 | 50 | 100 | 4 |
| 3. | PEC | B24YY63X | Professional Elective Course- II | CS & Allied | 3 | 0 | 0 | 3 | 50 | 3 | 50 | 100 | 3 |
| 4. | OEC | B24YY64X | Open Elective Course - I | Any Dept | 3 | 0 | 0 | 3 | 50 | 3 | 50 | 100 | 3 |
| 5. | PCCL | B24AI605L | Deep Learning Laboratory | AI | 0 | 0 | 2 | 0 | 50 | 3 | 50 | 100 | 1 |
| 6. | AEC | B24RMK606 | Research Methodology and IPR | AI / IC | 1 | 0 | 0 | 1 | 50 | 1 | 50 | 100 | 1 |
| 7. | SDC | B24PRJ607 | Capstone Project work: Phase I | AI | 0 | 0 | 4 | 0 | 100 | - | - | 100 | 2 |
| 8. | AEC | B24YY68X | Ability Enhancement Course Lab – VI | CS & Allied | 0 | 0 | 2 | 0 | 50 | 3 | 50 | 100 | 1 |
| 9. | NCMC | B24NCK69X | NSS / NCC / PE / Yoga / Music | HSS | 2 | 0 | 0 | 0 | 100 | - | - | 100 | PP |
| 10. | HSMC | B24IKK610 | Indian Knowledge System | AI | 2 | 0 | 0 | 0 | 100 | - | - | 100 | PP |
| | | | | | | | | TOTAL | 600 | | 400 | 1000 | 18 |

HSMC: Humanity Social sciences including Management courses, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, PCCL: Professional Core Course laboratory, NCMC: Non-Credit Mandatory Course, AEC: Ability Enhancement Course, PEC: Professional Elective Course, OEC: Open Elective Course, SDC-Skill Development Course, L: Lecture, T: Tutorial, P: Practical S: Self-Learning, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation. K: Indicates common course to all the streams of engineering, PP/NP: Pass/ Not Pass, YY: Programme Code (EC, CS, IS etc.,), X: 1/2/3/4

| | | | |
|---|---|---|---|
| **Professional Elective Courses (PEC) - II** | | | |
| B24AI631 | AI in Cloud and Distributed Systems | B24AI632 | Vision AI |
| B24AI633 | Exploratory Data Analysis | B24AI634 | Robotic Process Automation Design and Development |
| **Open Elective Course (OEC)- I** | | | |
| B24CS641 | Introduction to Data Structures | B24IC642 | Introduction to Cyber Security |
| B24CS643 | Fundamentals of Operating Systems | B24AI644 | AI for Everyone |
| **Ability Enhancement Course (AEC) – VI** | | | |
| B24AI681 | Explainable AI | B24CS682 | MAD using Flutter |
| B24CS683 | Cloud Computing and Services | B24AI684 | Agentic AI |
| **Non-Credit Mandatory Courses (NCMC)** | | | |
| B24NCK691 | National Service Scheme | B24NCK692 | National Cadet Corps |
| B24NCK693 | Physical Education | B24NCK694 | Yoga |
| B24NCK695 | Music | | |

**Capstone Project Work**: **Phase – I:** The objective of the Project work is (i) To encourage independent learning and the innovative attitude of the students. (ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills. (iii) To impart flexibility and adaptability. (iv) To inspire team working. (v) To expand intellectual capacity, credibility, judgment and intuition. (vi) To adhere to punctuality, setting and meeting deadlines. (vii) To install responsibilities to oneself and others. (viii)To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

**CIE Procedure for Project Work:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned department and two senior faculty members of the department, one of whom shall be the Guide. The CIE marks awarded for the project work shall be based on the evaluation of the **Project Work Report, Project Reviews and Viva-Voce.** The marks awarded for the project report shall be the same for all the batch mates.

**SEE procedure for Project Work**: SEE for project work will be conducted by the two examiners appointed by the Institution. The SEE marks awarded for the project work shall be based on the evaluation of **Project Demonstration, Project Presentation and Viva-Voce** in the ratio 20:60:20.

**Open Elective Courses**: Students belonging to a particular stream of Engineering are not entitled to the open electives offered by their parent department. However, they can opt for an elective offered by other departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Mentor. The minimum number of students' for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

**HoD** **Dean-Academics** **Principal**

| **Semester-V** | | | | | |
|---|---|---|---|---|---|
| **Software Engineering and Project Management**<br>**Category: HSMC**<br>**(Common to CSE, CSD, CSE(IC), AIML, ISE)** | | | | | |
| Course Code | : | **B24CS501** | CIE | : | 50 Marks |
| Teaching Hours L : T : P : S | : | 3:0:0:3 | SEE | : | 50 Marks |
| Total Hours | : | 45 | Total | : | 100 Marks |
| Credits | : | 3 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To outline software engineering principles and activities involved in building large software programs. Identify ethical and professional issues and explain why they are of concern to Software Engineers. |
| 2. | To describe the process of requirement gathering, requirement classification, requirement specification and requirements validation. |
| 3. | To recognize the importance of Project Management with its methods and methodologies. |
| 4. | To identify software quality parameters and quantify software using measurements and metrics. |
| 5. | To list software quality standards and outline the practices involved. |

| **Module – 1** | **No.of Hrs** |
|---|---|
| **Software and Software Engineering:** The nature of Software, The unique nature of WebApps,Software Engineering, The software Process, Software Engineering Practice, Software Myths.<br>**Process Models:** A generic process model, Process assessment and improvement, Prescriptive process models: Waterfall model, Incremental process models, Evolutionary process models,Concurrent models, Specialized process models. Unified Process , Personal and Team process models | 9 |
| **Module – 2** | **No.of Hrs** |
| **Understanding Requirements:** Requirements Engineering, Establishing the ground work, Eliciting Requirements, Developing use cases, Building the requirements model, Negotiating Requirements,Validating Requirements.<br>**Requirements Modeling Scenarios, Information and Analysis classes**: Requirement Analysis, Scenario based modeling, UML models that supplement the Use Case, Data modeling Concepts, Class-Based Modeling.<br>**Requirement Modeling Strategies:** Flow oriented Modeling , Behavioral Modeling. | 9 |
| **Module – 3** | **No.of Hrs** |
| **Agile Development:** What is Agility?, Agility and the cost of change. What is an agile Process?, Extreme Programming (XP), Other Agile Process Models, A tool set for Agile process .<br>**Principles that guide practice**: Software Engineering Knowledge, Core principles, Principles that guide each framework activity. | 9 |
| **Module – 4** | **No.of Hrs** |
| **Introduction to Project Management:** Introduction, Project and Importance of Project Management, Contract Management, Activities Covered by Software Project Management, Plans, Methods and Methodologies, Some ways of categorizing Software Projects, Stakeholders, Setting Objectives,Business Case, Project Success and Failure, Management and Management Control, Project Management life cycle, Traditional versus Modern Project Management Practices.<br>**Project Evaluation:** Evaluation of Individual projects, Cost–benefit Evaluation Techniques, Risk Evaluation. | 9 |
| **Module – 5** | **No.of Hrs** |
| **Software Quality:** Introduction, The place of software quality in project planning, Importance of software quality, Defining software quality, Software quality models, product versus process quality management. Software Project Estimation: Observations on Estimation, Decomposition Techniques, Empirical Estimation Models. | 9 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| **CO1** | Differentiate process models to judge which process model has to be adopted for the given scenarios. |
| **CO2** | Derive both functional and nonfunctional requirements from the case study. |
| **CO3** | Analyze the importance of various software testing methods and agile methodology. |
| **CO4** | Illustrate the role of project planning and quality management in software development. |
| **CO5** | Identify appropriate techniques to enhance software quality. |

| **Text Books** | |
|---|---|
| 1. | Roger S. Pressman: Software Engineering-A Practitioners approach, 7th Edition, Tata McGraw Hill. |
| 2. | Bob Hughes, Mike Cotterell, Rajib Mall: Software Project Management, 6th Edition, McGraw Hill Education, 2018. |
| **Reference Text Books** | |
| 1. | Pankaj Jalote: An Integrated Approach to Software Engineering, Wiley India. |
| 2. | "Software Engineering: Principles and Practice", Hans van Vliet, Wiley India, 3rd Edition, 2010. |

| **Web links and Video lectures (e-Resources)** |
|---|
| 1. https://onlinecourses.nptel.ac.in/noc20_cs68/preview |
| 2. https://onlinecourses.nptel.ac.in/noc24_mg01/preview |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Theory** | **Internal Assessment-1** | **50** | **30 (Average of Best two Assessments)** | **50** |
| | **Internal Assessment-2** | **50** | | |
| | **Internal Assessment-3** | **50** | | |
| **AAT** | **Two Assessments as per regulations** | **20** | **20** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Grand Total** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

**CO-PO Mapping**

| CO / PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | - | - | - | - | - | - | - | 1 |
| **CO2** | 2 | 3 | 3 | 2 | - | - | - | - | 1 | - | 1 |
| **CO3** | 2 | 3 | 2 | 2 | 2 | - | - | - | - | - | 1 |
| **CO4** | 2 | 2 | 3 | - | 1 | 1 | - | 2 | 1 | 3 | 1 |
| **CO5** | 2 | 2 | 3 | 2 | 2 | 1 | 1 | - | - | - | 2 |

Level 3 - High, Level 2 - Moderate, Level 1 - Low

| **Semester -V** | | | | | |
|---|---|---|---|---|---|
| **Computer Networks**<br>**Category: IPCC**<br>**(Common to CSE, CSD, CSE(IC), AIML, ISE)** | | | | | |
| Course Code | : | **B24CS502** | CIE | : | 50 Marks |
| Teaching Hours L:T:P:S | : | 3:0:2:3 | SEE | : | 50 Marks |
| Total Hours | : | 45+30 | Total | : | 100 Marks |
| Credits | : | 4 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To **understand fundamental concepts of computer networks**, including network applications, hardware, software, and reference models such as OSI and TCP/IP. |
| 2. | To **explain the functions and technologies of the Physical Layer**, including transmission media, wireless communication, PSTN, and mobile communication systems. |
| 3. | **Analyze Data Link Layer mechanisms**, covering error detection and correction, flow control, sliding window protocols, Ethernet, and wireless LAN technologies. |
| 4. | To **describe Network and Transport Layer operations**, including routing algorithms, congestion control, IPv4/IPv6, Quality of Service (QoS), and transport protocols like TCP and UDP. |
| 5. | To **demonstrate knowledge of Application Layer protocols**, such as DNS, HTTP, FTP, SMTP, SNMP, and Telnet, and understand how network services support real-world applications. |

| **Module – 1** | **No. of Hours** |
|---|---|
| **Introduction:** Network applications, network hardware, network software, reference models: OSI, TCP/IP, Internet, frame relay. THE PHYSICAL LAYER:, guided transmission media, wireless transmission, the public switched telephone networks, mobile telephone system. | 9 |
| **Module – 2** | **No. of Hours** |
| **Data Link Layer:** Design issues, error detection and correction, elementary data link protocols, sliding window protocols, example data link protocols - HDLC, the data link layer in the internet. THE MEDIUM ACCESS SUBLAYER:, multiple access protocols, Ethernet, Data Link Layer switching, Wireless LAN, Broadband Wireless, Bluetooth. | 9 |
| **Module – 3** | **No. of Hours** |
| **Network Layer:** Network layer design issues, routing algorithms, Congestion control algorithms, Internetworking, the network layer in the internet (IPv4 and IPv6), Quality of Service. | 9 |
| **Module – 4** | **No. of Hours** |
| **Transport Layer:** Transport service, elements of transport protocol, Simple Transport Protocol, Internet transport layer protocols: UDP and TCP. | 9 |
| **Module – 5** | **No. of Hours** |
| **Application Layer:** Domain name system, electronic mail, World Wide Web: architectural overview, dynamic web document and http. APPLICATION LAYER PROTOCOLS: Simple Network Management Protocol, File Transfer Protocol, Simple Mail Transfer Protocol, Telnet. | 9 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Explain the fundamentals of computer networks, network models (OSI, TCP/IP), and different types of network applications. |
| CO2 | Analyze the functions of the Physical Layer, including transmission media, wireless communication, PSTN and mobile communication systems. |
| CO3 | Apply Data Link Layer concepts such as error detection and correction, flow control, sliding window protocols, and multiple access techniques. |
| CO4 | Evaluate Network Layer and Transport Layer protocols, including routing algorithms, congestion control, IPv4/IPv6, TCP, and UDP. |
| CO5 | Demonstrate the working of Application Layer services and protocols such as DNS, HTTP, FTP, SMTP, SNMP, and Telnet in real-world networking scenarios. |

## LABORATORY

| Sl. No | List Of Experiments |
|---|---|
| 1. | Write a program to implement CRC (Cyclic Redundancy Check) for error detection. |
| 2. | Write a program to implement Hamming Code for error detection and correction. |
| 3. | Write a program to simulate Flow Control using Stop-and-Wait Protocol. |
| 4. | Write a program to simulate Sliding Window Protocol. |
| 5. | Write a program to implement Leaky Bucket Algorithm for traffic shaping |
| 6. | Write a program to implement Token Bucket Algorithm. |
| 7. | Write a program to Create a TCP server and client to exchange messages. |
| 8. | Write a program to Implement connectionless communication between client and server. |
| 9. | Write a program to Implement error detection using CRC. |
| 10. | Write a program to Detect and correct single-bit errors |
| 11. | Write a program to Basic error detection technique. |
| 12. | Write a program to Control data transmission rate. |

| **Text Books** | |
|---|---|
| 1. | 1. A. S. Tanenbaum (2003), Computer Networks, 4th edition, Pearson Education/ PHI, New Delhi, |

| **Reference Text Books** | |
|---|---|
| 1. | Behrouz A. Forouzan (2006), Data communication and Networking, 4th Edition, Mc Graw-Hill, India |
| 2. | Kurose, Ross (2010), Computer Networking: A top down approach, Pearson Education, India |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Theory** | **Internal Assessment-1** | **50** | **30** (Average of Best Two Assessments) | **50/2 = 25** |
| | **Internal Assessment-2** | **50** | | |
| | **Internal Assessment-3** | **50** | | |
| **AAT** | Any One Assessments as per regulations | **20** | **20** | |
| **Laboratory** | **Lab conduction & Record** | Evaluating each expt. for 10 marks. | **05** | **25** |
| | **Internal Test** | **50** | **20** | |
| **Total Marks** | | | | **50** |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total marks** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice. Students should answer five full questions, selecting one full question from each module.
5. Students have to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
6. The maximum marks from the practical component to be included in the SEE question paper is **16 marks.**
7. Question papers to be set as per the Blooms Taxonomy levels.
8. The laboratory component of the **integrated course** shall be CIE only. However, in SEE, the questions from the practical component shall be included.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | - | - | - | - | - | - | - | - |
| CO2 | 3 | 2 | 2 | 1 | | - | - | - | - | - | - |
| CO3 | 2 | 3 | 2 | 1 | 1 | - | - | - | - | - | - |
| CO4 | 2 | 3 | 2 | 2 | | - | - | - | - | - | - |
| CO5 | 2 | 2 | 3 | 1 | 2 | - | - | - | - | - | - |

Level 3 - High, Level 2 - Moderate, Level 1 - Low

| **Semester -V** | | | | | |
|---|---|---|---|---|---|
| **Machine Learning**<br>**Category:PCC** | | | | | |
| Course Code | : | **B24AI503** | CIE | : | 50 Marks |
| Teaching Hours L:T:P:S | : | 2:2:0:2 | SEE | : | 50 Marks |
| Total Hours | : | 55 | Total | : | 100 Marks |
| Credits | : | 3 | SEE Duration | : | 3 Hrs |

| **Course Learning Objectivesis** | |
|---|---|
| 1. | To understand the core concepts, principles, and foundations of machine learning. |
| 2. | Todevelop an understanding of supervised learning algorithms for prediction and classification tasks. |
| 3. | To acquire knowledge of unsupervised learning techniques for data exploration and pattern discovery. |
| 4. | To build skills in model evaluation, validation, and performance optimization. |
| 5. | To apply machine learning techniques effectively to solve real-world problems. |

| **Module – 1** | **No. of Hours** |
|---|---|
| **Introduction:** Need for Machine Learning, Machine Learning Explained, Machine Learning in Relation to Other Fields, Types of Machine Learning, Challenges of Machine Learning, Machine Learning Process, Machine Learning Applications.<br>**Understanding Data-1:** Introduction, Big Data Analysis Framework, Descriptive Statistics, Univariate Data Analysis and Visualization. | 11 |
| **Module – 2** | **No. of Hours** |
| **Understanding Data-2**: Bivariate Data and Multivariate Data, Multivariate Statistics, Essential Mathematics for Multivariate Data, Feature Engineering and Dimensionality Reduction Techniques.<br>**Testing Machine Learning Algorithms:**Overfitting, Training, Testing, and Validation Sets, The Confusion Matrix, Accuracy Metrics, The Receiver Operator Characteristic (ROC) Curve, Unbalanced Datasets, Measurement Precision. | 11 |
| **Module – 3** | **No. of Hours** |
| **Similarity-based Learning:** Nearest-Neighbour Learning, Weighted K-Nearest-Neighbour Algorithm, Nearest Centroid Classifier, Locally Weighted Regression (LWR).<br>**Regression Analysis:** Introduction to Regression, Introduction to Linear Regression, Multiple Linear Regression, Polynomial Regression, and Logistic Regression. | 11 |
| **Module – 4** | **No. of Hours** |
| **Decision Tree Learning:** Introduction to Decision Tree Learning Model, Decision Tree Induction Algorithms, Validating and pruning of Decision trees.<br>**Bayesian Learning:** Introduction to Probability-based Learning, Fundamentals of Bayes Theorem, Classification Using Bayes Model, Naïve Bayes Algorithm for Continuous Attributes. | 11 |
| **Module – 5** | **No. of Hours** |
| **Artificial Neural Networks:** Introduction, Biological Neurons, Artificial Neurons, Perceptron and Learning Theory, Types of Artificial Neural Networks, Popular Applications of Artificial Neural Networks, Advantages and Disadvantages of ANN, Challenges of ANN.<br>**Clustering Algorithms:** Introduction to Clustering Approaches, Proximity Measures, Hierarchical Clustering Algorithms, Partitional Clustering Algorithm, Density-based Methods, Grid-based Approach. | 11 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Explain ML basics and perform basic data analysis. |
| CO2 | Apply preprocessing, feature engineering, and model evaluation. |
| CO3 | Build kNN and regression models. |
| CO4 | Develop decision tree and Bayesian models. |
| CO5 | Implement ANN and clustering techniques. |

| **Text Books** | |
|---|---|
| 1. | S Sridhar, M Vijayalakshmi, “Machine Learning”, OXFORD University Press 2021, 1st Edition. |
| 2. | Stephen Marsland, “Machine Learning - An Algorithmic Perspective”, 2nd Edition, CRC Pres |

| **Reference Text Books** | |
|---|---|
| 1. | T. M. Mitchell, "Machine Learning", McGraw Hill, 1997. |
| 2. | Murty, M. N., and V. S. Ananthanarayana. Machine Learning: Theory and Practice, Universities Press, 2024. |
| 3. | Burkov, Andriy. The hundred-page machine learning book. Vol. 1. Quebec City, QC, Canada: AndriyBurkov, 2019 |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Theory** | **Internal Assessment-1** | **50** | **30 (Average of Best two Assessments)** | **50** |
| | **Internal Assessment-2** | **50** | | |
| | **Internal Assessment-3** | **50** | | |
| **AAT** | **Two Assessments as per regulations** | **20** | **20** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Grand Total** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | - | 2 | 2 | - | - | - | - | - | 2 |
| CO2 | 2 | 3 | 1 | 3 | 3 | - | - | - | - | - | 2 |
| CO3 | 2 | 3 | 2 | 2 | 3 | - | - | - | - | - | 2 |
| CO4 | 2 | 3 | 2 | 2 | 2 | - | 1 | 1 | - | - | 2 |
| CO5 | 2 | 2 | 2 | 2 | 3 | - | 1 | 1 | - | - | 2 |

Level 3 - High, Level 2 - Moderate, Level 1 - Low

| **Semester-V** | | | | | |
|---|---|---|---|---|---|
| **Data Warehousing and Data Mining**<br>**Category: PCC** | | | | | |
| Course Code | : | **B24AI504** | CIE | : | 50 Marks |
| Teaching Hours L:T:P:S | : | 3:0:0:3 | SEE | : | 50 Marks |
| Total Hours | : | 45 | Total | : | 100 Marks |
| Credits | : | 3 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To understand data warehouse concepts, architecture, and OLAP systems. |
| 2. | To learn data preprocessing techniques for cleaning and transformation. |
| 3. | To acquire knowledge of data mining concepts and pattern discovery. |
| 4. | To study classification, association, and clustering techniques. |
| 5. | To apply data warehousing and mining techniques to real-world problems. |

| **Module – 1** | **No. of Hours** |
|---|---|
| **Introduction:**Data warehousing v/s operational databases, OLTP v/s OLAP, Need for data warehouse in AI-driven analytics. **Data Warehouse Architecture:**Three-tier architecture, Data warehouse components, Metadata repository, Data marts.**Data Warehouse Modeling:**Fact tables and dimension tables, Star schema, Snowflake schema, Galaxy schema.**ETL Process:**Data extraction, Data transformation, Data loading, Data cleaning, and integration.**OLAP Operations:**Roll-up, Drill-down, Slice, Dice, Pivot. | 9 |
| **Module – 2** | **No. of Hours** |
| **Data Preprocessing:**Data cleaning, handling missing values, Data integration, and Data reduction.**Data Transformation:**Normalization, Aggregation, Discretization, Feature construction. **Data Exploration & Visualization:**Statistical description of data, Correlation analysis, Data distribution. **Attribute Selection:** Feature selection methods, Dimensionality reduction, PCA overview. | 9 |
| **Module – 3** | **No. of Hours** |
| **Frequent Pattern Mining:**Market basket analysis, Frequent itemset. **AprioriAlgorithm:**Candidate generation, Support and confidence-Growth Algorithm. **InterestingnessMeasures:**Lift, Conviction, Correlation. **Applications:**Recommendation systems, Web usage mining. | 9 |
| **Module – 4** | **No. of Hours** |
| **Classification:**Decision trees, Naïve Bayes, k-NN, Rule-based classification.**Model Evaluation:**Confusion matrix, Cross-validation, ROC analysis.**Clustering:**k-means clustering, Hierarchical clustering, Density-based clustering (DBSCAN), Grid-based method, Cluster High-dimensional data, outer analysis, Applications in AI & ML. | 9 |
| **Module – 5** | **No. of Hours** |
| **Outlier Detection:**Statistical methods, Distance-based methods. **Sequential Pattern Mining:**Sequence discovery, Time-series pattern mining. **Text & Web Mining:**Document representation, Web structure mining, Web content mining. Spatial & Temporal Data Mining. **Data Mining Tools & Case Studies:**WEKA / RapidMiner / Python (Scikit-learn), Applications in healthcare, finance, e-commerce. | 9 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Understand data warehouse architecture and OLAP operations. |
| CO2 | Apply data preprocessing and feature selection techniques. |
| CO3 | Implement association rule mining algorithms. |
| CO4 | Develop classification and clustering models for data analysis. |
| CO5 | Analyze advanced data mining methods for real-world datasets. |

| **Text Books** | |
|---|---|
| 1. | Jiawei Han, MichelineKamber, and Jian Pei, Data Mining: Concepts and Techniques, 3rdEdition, Elsevier, 2012. |
| 2. | Alex Berson and Stephen J. Smith, Data Warehousing, Data Mining and OLAP, McGraw-Hill Education, 2004. |

| **Reference Text Books** | |
|---|---|
| 1. | Pang-Ning Tan, Michael Steinbach, and Vipin Kumar, Introduction to Data Mining, Pearson Education, 2019. |
| 2. | Ralph Kimball and Margy Ross, The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling, 3rdEdition, Wiley, 2013. |
| 3. | Margaret H. Dunham, Data Mining: Introductory and Advanced Topics, Pearson Education, 2006. |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Theory** | **Internal Assessment-1** | **50** | **30 (Average of Best two Assessments)** | **50** |
| | **Internal Assessment-2** | **50** | | |
| | **Internal Assessment-3** | **50** | | |
| **AAT** | **Two Assessments as per regulations** | **20** | **20** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Grand Total** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |
| CO2 | 2 | 3 | 1 | 2 | 3 | - | - | - | - | - | 2 |
| CO3 | 2 | 3 | 2 | 2 | 3 | - | - | - | - | - | 2 |
| CO4 | 2 | 3 | 2 | 3 | 3 | - | 1 | - | - | - | 2 |
| CO5 | 2 | 3 | 2 | 3 | 3 | 1 | 2 | 1 | 1 | - | 3 |

Level 3 - High, Level 2 - Moderate, Level 1 - Low

| **Semester-V** | | | | | |
|---|---|---|---|---|---|
| **Machine Learning Laboratory**<br>**Category: PCCL** | | | | | |
| Course Code | : | **B24AI505L** | CIE | : | 50 Marks |
| Teaching Hours L: T: P:S | : | 0:0:2:0 | SEE | : | 50 Marks |
| Total Hours | : | 30 | Total | : | 100 Marks |
| Credits | : | 1 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To develop hands-on skills in implementing machine learning algorithms using programming tools. |
| 2. | To apply data preprocessing and analysis techniques for machine learning tasks. |
| 3. | To build and evaluate supervised and unsupervised learning models. |
| 4. | To use performance metrics and validation techniques to assess models. |
| 5. | To apply machine learning methods to real-world problems and datasets. |

| **Sl. No.** | **Title of the program/list of the experiment** |
|---|---|
| 1. | Write a program to perform data preprocessing on a given dataset, including handling missing values, normalization, and encoding categorical data. |
| 2. | Develop a program to perform exploratory data analysis using descriptive statistics and visualization techniques such as histograms, box plots, and scatter plots. |
| 3. | Implement Simple Linear Regression and Multiple Linear Regression on a dataset and evaluate model performance. |
| 4. | Implement Logistic Regression for binary classification and evaluate using the confusion matrix, accuracy, precision, and recall. |
| 5. | Implement the k-Nearest Neighbors (k-NN) algorithm for classification and analyze the effect of different values of k. |
| 6. | Implement the Decision Tree algorithm for classification and visualize the tree structure. |
| 7. | Implement a Naïve Bayes classifier for classification problems and compare its results with those of other classifiers. |
| 8. | Implement the k-Means clustering algorithm and visualize clusters for a given dataset. |
| 9. | Implement Hierarchical clustering and plot a dendrogram for cluster analysis. |
| 10. | Implement an Artificial Neural Network (ANN) using a suitable library and evaluate performance on a dataset. |
| 11 | Develop a Machine Learning **Mini Project**, such as:<br>• Prediction system (house price, rainfall, stock, etc.)<br>• Classification system (spam detection, disease prediction, etc.)<br>• Clustering-based analysis<br>• Recommendation system.<br>• Any related topics. |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Perform data preprocessing and exploratory data analysis using Python tools. |
| CO2 | Implement regression and classification algorithms for supervised learning tasks. |
| CO3 | Evaluate machine learning models using appropriate performance metrics. |
| CO4 | Apply clustering techniques for unsupervised learning problems. |
| CO5 | Develop and analyze neural network models for prediction tasks. |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Laboratory** | **Lab Conduction & Record** | **Evaluating each expt. for 10 marks** | **20** | **50** |
| | **Laboratory Test -1** | **50** | **15** | |
| | **Laboratory Test -2** | **50** | **15** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total Marks** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
4. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
5. Change of experiment is allowed only once and 15% of Marks allotted to the Conduction procedure part are to be made zero. The minimum duration of SEE is 03 hours.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 1 | 2 | 3 | - | - | - | 1 | - | 2 |
| CO2 | 3 | 3 | 2 | 3 | 3 | - | - | - | 1 | - | 2 |
| CO3 | 3 | 3 | 2 | 3 | 3 | - | - | - | 1 | - | 2 |
| CO4 | 3 | 3 | 2 | 3 | 3 | - | - | - | 1 | 1 | 3 |
| CO5 | 3 | 3 | 2 | 2 | 3 | - | 1 | 3 | 3 | 2 | 3 |

Level 3 – High, Level 2 – Moderate, Level 1 –Low

| **Semester -V** | | | | | |
|---|---|---|---|---|---|
| **Probability and Statistics for ML**<br>**Category: PEC-I** | | | | | |
| Course Code | : | **B24AI561** | CIE | : | 50 Marks |
| Teaching Hours L:T:P:S | : | 3:0:0:3 | SEE | : | 50 Marks |
| Total Hours | : | 45 | Total | : | 100 Marks |
| Credits | : | 3 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To understand probability theory and random variables for modeling uncertainty. |
| 2. | To apply probability distributions and statistical methods to analyze datasets. |
| 3. | To perform descriptive statistics and exploratory data analysis. |
| 4. | To use sampling, estimation, and inference for data-driven decision making. |
| 5. | To apply hypothesis testing and probabilistic reasoning in model evaluation. |

| **Module – 1** | **No. of Hours** |
|---|---|
| **Foundations of Probability:** Uncertainty modeling in artificial intelligence and machine learning using probability theory, sample space, events, and axioms of probability. Addition and multiplication laws of probability, conditional probability, independence of events, Bayes' theorem, and the theorem of total probability. Applications include spam filtering, medical diagnosis, and recommendation systems. | 9 |
| **Module – 2** | **No. of Hours** |
| **Random Variables and Probability Distributions:** Discrete and continuous random variables, probability mass function, probability density function, and cumulative distribution function. Joint, marginal, and conditional distributions, expectation, variance, covariance, and moments. Important distributions such as Bernoulli, Binomial, Poisson, Uniform, Gaussian, and Exponential. Central Limit Theorem and its significance in machine learning. | 9 |
| **Module – 3** | **No. of Hours** |
| **Descriptive Statistics and Data Analysis:** Types of data, measures of central tendency and dispersion, skewness, kurtosis, covariance, and correlation. Statistical interpretation of simple linear regression. Data visualization techniques, including histograms, box plots, and scatter plots for exploratory data analysis. | 9 |
| **Module – 4** | **No. of Hours** |
| **Sampling, Estimation, and Statistical Inference:** Concepts of population and sample, sampling techniques such as random, stratified, and systematic sampling. Sampling distributions, point and interval estimation, confidence intervals for mean and proportion, maximum likelihood estimation, bias, variance, and standard error. | 9 |
| **Module – 5** | **No. of Hours** |
| **Hypothesis Testing and Applications in ML:** Null and alternative hypotheses, Type I and Type II errors, p-values, and significance levels. Hypothesis tests, including the z-test, t-test, chi-square test, and introduction to ANOVA. Applications in machine learning include model comparison, A/B testing, Naïve Bayes intuition, and the probabilistic interpretation of predictions. | 9 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Apply probability concepts and axioms to uncertain events in ML. |
| CO2 | Analyze random variables and probability distributions relevant to AI/ML datasets. |
| CO3 | Compute statistical summaries, correlation, and regression for data analysis. |
| CO4 | Perform sampling, estimation, and hypothesis testing on real datasets. |
| CO5 | Use probabilistic/statistical reasoning in machine learning model evaluation and decision-making. |

| **Text Books** | |
|---|---|
| 1. | Sheldon M. Ross, *Introduction to Probability and Statistics for Engineers and Scientists*, 12$^{th}$Edition, Academic Press, 2019. |
| 2. | Jay L. Devore, *Probability and Statistics for Engineering and the Sciences*, 9$^{th}$Edition, Cengage Learning, 2016. |

| **Reference Text Books** | |
|---|---|
| 1. | Morris H. DeGroot and Mark J. Schervish, *Probability and Statistics*, 4th Edition, Pearson Education, 2012. |
| 2. | Larry Wasserman, *All of Statistics: A Concise Course in Statistical Inference*, Springer, 2004. |
| 3. | Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006. |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Theory** | **Internal Assessment-1** | **50** | **30 (Average of Best two Assessments)** | **50** |
| | **Internal Assessment-2** | **50** | | |
| | **Internal Assessment-3** | **50** | | |
| **AAT** | **Two Assessments as per regulations** | **20** | **20** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total Marks** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | - | - | - | - | - | 1 |
| CO2 | 3 | 3 | 1 | 2 | 1 | - | - | - | - | - | 1 |
| CO3 | 2 | 3 | 2 | 3 | 2 | - | - | - | 1 | - | 1 |
| CO4 | 2 | 3 | 1 | 3 | 2 | - | - | - | 1 | - | 1 |
| CO5 | 2 | 3 | 2 | 3 | 2 | - | 1 | 1 | 1 | - | 2 |

Level 3 - High, Level 2 - Moderate, Level 1 - Low

| **Semester-V** | | | | | |
|---|---|---|---|---|---|
| **Optimization Techniques for ML**<br>**Category: PEC-I** | | | | | |
| Course Code | : | **B24AI562** | CIE | : | 50 Marks |
| Teaching Hours L:T: P:S | : | 3:0:0:3 | SEE | : | 50 Marks |
| Total Hours | : | 45 | Total | : | 100 Marks |
| Credits | : | 3 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To introduce mathematical and optimization principles for machine learning. |
| 2. | To understand objective/loss functions, regularization, and empirical risk minimization. |
| 3. | To study unconstrained, constrained, convex, and non-convex optimization methods. |
| 4. | To analyze optimization algorithms for convergence, stability, efficiency, and generalization. |
| 5. | To apply optimization techniques to model training, tuning, and real-world problems. |

| **Module – 1** | **No. of Hours** |
|---|---|
| **Foundations of Optimization for Machine Learning:** Introduction, objective functions, loss functions, empirical risk minimization, overfitting and regularization. Mathematical preliminaries including vectors, matrices, norms, inner products, gradients, Hessian matrix, Jacobian matrix, Taylor series approximation, convex sets, convex functions, strongly convex functions, Lipschitz continuity, local and global minima. Study of common ML loss functions such as Mean Squared Error, Cross-Entropy Loss, Hinge Loss, Logistic Loss, and regularization terms including L1 and L2 regularization. | 9 |
| **Module – 2** | **No. of Hours** |
| **Unconstrained Optimization Techniques:**Introduction, first-order, and second-order optimality conditions. The analysis of Gradient Descent, learning rate selection, step size strategies, convergence analysis, batch gradient descent, stochastic gradient descent, and mini-batch gradient descent. Study of second-order methods, including Newton's method, quasi-Newton methods, BFGS, and L-BFGS. Discussion on limitations of second-order methods in large-scale machine learning and practical issues such as saddle points, ill-conditioning, and vanishing gradients. | 9 |
| **Module – 3** | **No. of Hours** |
| **Constrained Optimization and Convex Optimization:** Introduction to constrained optimization problems, equality and inequality constraints, feasible region, active and inactive constraints. Study of Lagrange multipliers, Karush-Kuhn-Tucker conditions, primal and dual problems, strong and weak duality. Convex optimization problems, quadratic programming, linear programming overview, projection methods, barrier methods, penalty methods, and augmented Lagrangian methods. Applications to Support Vector Machines, constrained regression, sparse learning, and regularized machine learning models. | 9 |
| **Module – 4** | **No. of Hours** |
| **Optimization Algorithms for Machine Learning and Deep Learning:** Introduction, Momentum-based gradient descent, Nesterov Accelerated Gradient, AdaGrad, RMSProp, Adam, AdamW, Nadam, and learning rate scheduling techniques. Adaptive learning rate methods, weight decay, gradient clipping, batch normalization, their effects on optimization, early stopping, warm-up strategies, cosine annealing, cyclical learning rates, and optimization challenges in training deep neural networks. Comparative analysis of optimizers based on convergence speed, generalization, stability, and computational cost. | 9 |
| **Module – 5** | **No. of Hours** |
| **Advanced and Practical Optimization Techniques:** Large-scale optimization for machine learning, distributed optimization, coordinate descent, proximal gradient methods, alternating direction method of multipliers, expectation-maximization algorithm, Bayesian optimization, hyperparameter optimization, grid search, random search, and population-based search. Introduction to non-convex optimization, optimization landscapes, saddle points, sharp and flat minima, generalization behavior, and regularization through optimization. Case studies involving linear regression, logistic regression, support vector machines, neural network training, clustering, and hyperparameter tuning using Python-based ML frameworks. | **9** |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Explain basic optimization concepts used in machine learning. |
| CO2 | Apply unconstrained optimization methods for ML problems. |
| CO3 | Analyze constrained and convex optimization techniques. |
| CO4 | Evaluate gradient-based and adaptive optimizers for ML/DL models. |
| CO5 | Develop optimization-based solutions for machine learning applications. |

| **Text Books** | |
|---|---|
| 1. | Stephen Boyd and LievenVandenberghe, *Convex Optimization*, Cambridge University Press, 2004. |
| 2. | Jorge Nocedal and Stephen J. Wright, *Numerical Optimization*, 2nd Edition, Springer, 2006. |
| 3. | SuvritSra, Sebastian Nowozin, and Stephen J. Wright, Optimization for Machine Learning, MIT Press, 2011. |

| **Reference Text Books** | |
|---|---|
| 1. | Ian Goodfellow, YoshuaBengio, and Aaron Courville, Deep Learning, MIT Press, 2016. |
| 2. | Dimitri P. Bertsekas, *Nonlinear Programming*, 3rd Edition, Athena Scientific, 2016. |
| 3. | Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006. |
| 4. | Kevin P. Murphy, *Machine Learning: A Probabilistic Perspective*, MIT Press, 2012. |
| 5. | AurélienGéron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 3rd Edition, O'Reilly Media, 2022. |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Theory** | **Internal Assessment-1** | **50** | **30 (Average of Best two Assessments)** | **50** |
| | **Internal Assessment-2** | **50** | | |
| | **Internal Assessment-3** | **50** | | |
| **AAT** | **Two Assessments as per regulations** | **20** | **20** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total Marks** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | - | - | - | - | - | - |
| CO2 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - |
| CO3 | 2 | 3 | 2 | 3 | 2 | - | - | - | - | - | - |
| CO4 | 2 | 3 | 2 | 3 | 2 | - | - | - | - | - | 1 |
| CO5 | 2 | 3 | 3 | 2 | 3 | - | - | 1 | 1 | - | 1 |

Level 3 - High, Level 2 - Moderate, Level 1 - Low

| **Semester -V** | | | | | |
|---|---|---|---|---|---|
| **Data Engineering for AI**<br>**Category: PEC-I** | | | | | |
| Course Code | : | **B24AI563** | CIE | : | 50 Marks |
| Teaching Hours L:T:P:S | : | 3:0:0:3 | SEE | : | 50 Marks |
| Total Hours | : | 45 | Total | : | 100 Marks |
| Credits | : | 3 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To understand data engineering fundamentals and their role in AI systems. |
| 2. | To apply techniques for data ingestion, storage, and large-scale processing. |
| 3. | To build data pipelines for structured and unstructured data. |
| 4. | To use distributed frameworks and cloud-based data engineering tools. |
| 5. | To enable the design of scalable and reliable data systems for AI and machine learning applications. |

| **Module – 1** | **No. of Hours** |
|---|---|
| **Introduction to Data Engineering:** Introduction to data engineering, role of data engineering in AI and machine learning, types of data including structured, semi-structured, and unstructured data, data lifecycle and data ecosystem, data sources and data collection methods, overview of data engineering architecture, introduction to databases and data warehouses, basics of SQL. | 9 |
| **Module – 2** | **No. of Hours** |
| **Data Storage and Data Management:** Relational databases and NoSQL databases, data modeling concepts, schema design, normalization and denormalization, distributed file systems, introduction to Hadoop Distributed File System (HDFS), data lakes and data warehouses, data governance, data quality, and metadata management. | 9 |
| **Module – 3** | **No. of Hours** |
| **Data Processing and ETL Pipelines:** Data ingestion techniques, including batch and streaming data, ETL and ELT processes, data transformation techniques, workflow orchestration, introduction to Apache Airflow, data pipeline design and implementation, and data integration from multiple sources. | 9 |
| **Module – 4** | **No. of Hours** |
| **Big Data Processing Frameworks:** Fundamentals of big data concepts, MapReduce paradigm, Apache Hadoop ecosystem, Apache Spark architecture, RDDs and Dataframe, batch and stream processing, introduction to real-time data processing tools such as Kafka, applications in AI systems. | 9 |
| **Module – 5** | **No. of Hours** |
| **Cloud Data Engineering and AI Integration:** Introduction to cloud platforms for data engineering, data services in AWS, Azure, and Google Cloud, data storage and processing in cloud environments, data security and privacy, MLOps basics, data pipelines for machine learning, and deployment considerations for AI systems. | 9 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Explain the fundamentals of data engineering and its role in AI systems. |
| CO2 | Design and manage data storage systems using relational and NoSQL databases. |
| CO3 | Develop data pipelines using ETL processes and data integration techniques. |
| CO4 | Apply big data frameworks for large-scale data processing. |
| CO5 | Implement cloud-based data engineering solutions for AI applications. |

| **Text Books** | |
|---|---|
| 1. | Joe Reis and Matt Housley, *Fundamentals of Data Engineering*, O'Reilly Media, 2022. |
| 2. | Martin Kleppmann, *Designing Data-Intensive Applications*, O'Reilly Media, 2017. |

| **Reference Text Books** | |
|---|---|
| 1. | Bill Chambers and MateiZaharia, *Spark: The Definitive Guide*, O'Reilly Media, 2018. |
| 2. | Tom White, *Hadoop: The Definitive Guide*, 4th Edition, O'Reilly Media, 2015. |
| 3. | Foster Provost and Tom Fawcett, Data Science for Business, O'Reilly Media, 2013. |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Theory** | **Internal Assessment-1** | **50** | **30 (Average of Best two Assessments)** | **50** |
| | **Internal Assessment-2** | **50** | | |
| | **Internal Assessment-3** | **50** | | |
| **AAT** | **Two Assessments as per regulations** | **20** | **20** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total Marks** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | - | - | - | - | - | 1 |
| CO2 | 2 | 3 | 2 | 2 | 3 | - | - | - | 1 | - | 1 |
| CO3 | 3 | 2 | 3 | 2 | 3 | - | - | - | - | - | 1 |
| CO4 | 2 | 3 | 3 | 3 | 3 | - | - | 1 | 1 | 1 | 2 |
| CO5 | 2 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | 1 | 1 | 2 |

Level 3 - High, Level 2 - Moderate, Level 1 – Low

| **Semester -V** | | | | | |
|---|---|---|---|---|---|
| **Big Data Analytics**<br>**Category: PEC-I** | | | | | |
| Course Code | : | **B24IC564** | CIE | : | 50 Marks |
| Teaching Hours L : T : P : S | : | 3:0:0:3 | SEE | : | 50 Marks |
| Total Hours | : | 45 | Total | : | 100 Marks |
| Credits | : | 3 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To implement MapReduce programs for processing big data. |
| 2. | To realize storage and processing of big data using MongoDB, Pig, Hive and Spark. |
| 3. | To analyze big data using machine learning techniques. |

| **Module – 1** | **No. of Hours** |
|---|---|
| **Introduction:** Dawn of the Big Data Era, Definition and Features of Big Data, Big Data Value, The Development of Big Data, Challenges of Big Data. RELATED TECHNOLOGIES: Cloud Computing - Cloud Computing Preliminaries, Relationship Between Cloud Computing and Big Data, IoT - IoT Preliminaries, Relationship Between IoT and Big Data, Data Center, Hadoop - Hadoop Preliminaries, Relationship between Hadoop and Big Data. | 9 |
| **Module – 2** | **No. of Hours** |
| **Big Data Generation And Acquisition:** Big Data Generation-Enterprise Data, IoT Data, Internet Data, BioSemester - VII 242 G V P College of Engineering (Autonomous) 2016 IT medical Data, Data Generation from Other Fields, Big Data Acquisition - Data Collection, Data Transportation, Data Pre-processing. | 9 |
| **Module – 3** | **No. of Hours** |
| **Big Data Storage:** Storage System for Massive Data, Distributed Storage System, Storage Mechanism for Big Data - Database Technology, Design Factors, Database Programming Model.<br>**Hadoop & Map Reduce:** Data Storage and Analysis, Comparison with Other Systems, A Brief History of Hadoop , Apache Hadoop and the Hadoop Ecosystem, A Weather Dataset, Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop (Map and Reduce, Java MapReduce), Scaling Out, Hadoop Streaming, Hadoop Pipes. | 9 |
| **Module – 4** | **No. of Hours** |
| **Big Data Analysis**: Traditional Data Analysis, Big Data Analytic Methods, Architecture for Big Data Analysis - Real-Time vs. Offline Analysis, Analysis at Different Levels, Analysis with Different Complexity, Tools for Big Data Mining and Analysis. | 9 |
| **Module – 5** | **No. of Hours** |
| **Big Data Applications**: Application Evolution, Big Data Analysis Fields - Structured Data Analysis, Text Data Analysis, Web Data Analysis, Multimedia Data Analysis, Network Data Analysis, Mobile Traffic Analysis, Key Applications - Application of Big Data in Enterprises, Application of IoT Based Big Data, Application of Online Social Network-Oriented Big Data, Applications of Healthcare and Medical Big Data, Collective Intelligence, Smart Grid. | 9 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Understand big data analytics as the next wave for businesses looking for competitive advantage. |
| CO2 | Understand the financial value of big data analytics. |
| CO3 | Explore tools and practices for working with big data. |
| CO4 | Understand how big data analytics can leverage into a key component. |
| CO5 | Learn about stream computing. |

| **Text Books** | |
|---|---|
| 1. | Min Chen, Shiwen Mao, Yin Zhang,Victor C.M. Leung, “Big Data: Related Technologies, Challenges and Future Prospects”, Springer; 2014 edition. |

| **Reference Text Books** | |
|---|---|
| 1. | Tom White, “Hadoop- The Definitive Guide”, O’reilly, 2nd Edition |
| 2. | VigneshPrajapati,”Big Data Analytics with R and Hadoop”, PACKT Publishing, November 2013. |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Theory** | **Internal Assessment-1** | **50** | **30 (Average of Best two Assessments)** | **50** |
| | **Internal Assessment-2** | **50** | | |
| | **Internal Assessment-3** | **50** | | |
| **AAT** | **Two Assessments as per regulations** | **20** | **20** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Grand Total** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | - | - | - | - | - | - | - | - | - | - |
| CO2 | 3 | - | - | - | - | - | - | - | - | - | - |
| CO3 | 3 | 3 | - | - | 3 | - | - | - | - | - | 3 |
| CO4 | 3 | 2 | - | - | 2 | - | - | - | - | - | 2 |
| CO5 | 3 | 2 | - | - | 2 | - | - | - | - | - | 2 |

Level 3 - High, Level 2 - Moderate, Level 1 - Low

| **Semester-V** | | | | | |
|---|---|---|---|---|---|
| **Angular JS Lab**<br>**Category: AEC-V** | | | | | |
| Course Code | : | **B24CS581** | CIE | : | 50 Marks |
| Teaching Hours L : T : P : S | : | 0:0:2:0 | SEE | : | 50 Marks |
| Total Hours | : | 30 | Total | : | 100 Marks |
| Credits | : | 1 | SEE Duration | : | 3Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To learn the basics of Angular JS framework. |
| 2. | To understand the Angular JS Modules, Forms, inputs, expression, data bindings and Filters |
| 3. | To gain experience of modern tool usage (VS Code, Atom or any other] in developing Web applications |

| **Sl. No** | **Name of the Programs / List of the experiments** |
|---|---|
| 1. | Develop Angular JS program that allows user to input their first name and last name and display their full name. Note: The default values for first name and last name may be included in the program. |
| 2. | Develop an Angular JS application that displays a list of shopping items. Allow users to add and remove items from the list using directives and controllers. Note: The default values of items may be included in the program |
| 3. | Develop a simple Angular JS calculator application that can perform basic mathematical operations (addition, subtraction, multiplication, division) based on user input. |
| 4. | Write an Angular JS application that can calculate factorial and compute square based on given user input |
| 5. | Develop Angular JS application that displays a details of students and their CGPA. Allow users to read the number of students and display the count. Note: Student details may be included in the program |
| 6. | Develop an AngularJS program to create a simple to-do list application. Allow users to add, edit, and delete tasks.Note: The default values for tasks may be included in the program |
| 7. | Write an AngularJS program to create a simple CRUD application (Create, Read, Update, and Delete) for managing users. |
| 8. | Develop AngularJS program to create a login form, with validation for the username and password fields |
| 9. | Create an AngularJS application that displays a list of employees and their salaries. Allow users to search for employees by name and salary. Note: Employee details may be included in the program |
| 10. | Create AngularJS application that allows users to maintain a collection of items. The application should display the current total number of items, and this count should automatically update as items are added or removed. Users should be able to add items to the collection and remove them as needed. Note: The default values for items may be included in the program |
| 11. | Create AngularJS application to convert student details to Uppercase using angular filters. Note: The default details of students may be included in the program |
| 12. | Create an Angular JS application that displays the date by using date filter parameters |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Develop Angular JS programs using basic features |
| CO2 | Develop dynamic Web applications using Angular JS modules |
| CO3 | Make use of form validations and controls for interactive applications |
| CO4 | Consume RESTful APIs and integrate with backend services. |
| CO5 | Use Angular JS best practices for performance optimization and testing. |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal

Evaluation) and SEE (Semester End Examination) taken together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Laboratory** | **Lab Conduction & Record** | **Evaluating each expt. for 10 marks** | **20** | **50** |
| | **Laboratory Test -1** | **50** | **15** | |
| | **Laboratory Test -2** | **50** | **15** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total Marks** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
4. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
5. Change of experiment is allowed only once and 15% of Marks allotted to the Conduction procedure part are to be made zero. The minimum duration of SEE is 03 hour.

**CO-PO Mapping**

| CO / PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 3 | - | 3 | - | - | - | - | - | - |
| CO2 | 2 | 3 | 3 | - | 3 | - | - | - | - | 1 | - |
| CO3 | 1 | 2 | 3 | - | 3 | - | - | - | - | 2 | - |
| CO4 | 2 | 1 | 1 | - | - | - | -- | - | - | - | - |
| CO5 | 2 | 1 | - | - | - | - | - | - | - | - | - |

Level 3 - High, Level 2 - Moderate, Level 1 - Low

| **Semester-V** | | | | | |
|---|---|---|---|---|---|
| **Innovation, startup and Incubation Lab**<br>**Category: AEC-V** | | | | | |
| Course Code | : | **B24AI582** | CIE | : | 50 Marks |
| Teaching Hours L : T : P : S | : | 0:0:2:0 | SEE | : | 50 Marks |
| Total Hours | : | 30 | Total | : | 100 Marks |
| Credits | : | 1 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To understand the innovation, startup, entrepreneurship, and incubation ecosystem. |
| 2. | To identify real-world problems and convert them into feasible innovation opportunities. |
| 3. | To apply design thinking, customer discovery, and market validation techniques. |
| 4. | To develop business model canvas, value proposition canvas, and prototype/MVP. |
| 5. | To prepare startup pitch deck and incubation proposal for commercialization. |

| **Sl. No.** | **List of the experiment** |
|---|---|
| 1. | Introduction to innovation, entrepreneurship, startup ecosystem, incubation centers, and accelerators. |
| 2. | Identification of societal, technical, or industry problems. |
| 3. | Design thinking: empathize, define, ideate, prototype, and test. |
| 4. | Customer discovery through survey, interview, or observation. |
| 5. | Preparation of business model canvas. |
| 6. | Market study and competitor analysis. |
| 7. | Prototype / MVP design using software, hardware, simulation, mock-up, or model. |
| 8. | Basic financial planning, cost estimation, revenue model, and funding requirement. |
| 9. | Study of IPR, patents, copyrights, trademarks, startup registration, and DPIIT recognition. |
| 10. | Preparation of startup pitch deck. |
| 11. | Preparation of incubation proposal. |
| 12. | Final startup pitch and prototype demonstration. |

**Suggested Startup Domains**

1. AI-based education tools
2. Smart agriculture
3. Healthcare and assistive technology
4. IoT-based smart systems
5. Cyber security solutions
6. Green energy and sustainability
7. Waste management
8. Smart mobility
9. Fin Tech applications
10. Women safety and social innovation

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Identify real-world problems and convert them into innovation opportunities. |
| CO2 | Apply design thinking and customer validation methods to refine startup ideas. |
| CO3 | Prepare value proposition canvas, business model canvas, and market analysis. |
| CO4 | Develop a prototype or minimum viable product for the selected startup idea. |
| CO5 | Present a startup pitch with business, incubation, and commercialization plan. |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Laboratory** | **Lab Conduction & Record** | **Evaluating each expt. for 10 marks** | **20** | **50** |
| | **Laboratory Test -1** | **50** | **15** | |
| | **Laboratory Test -2** | **50** | **15** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total Marks** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
4. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
5. Change of experiment is allowed only once and 15% of Marks allotted to the Conduction procedure part are to be made zero. The minimum duration of SEE is 03 hour.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 2 | 1 | 1 | 3 | 2 | 1 | 2 | 2 | 2 |
| CO2 | 1 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 2 |
| CO3 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 3 | 3 |
| CO4 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 3 | 2 | 2 |
| CO5 | 1 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 3 | 3 | 3 |

Level 3 – High, Level 2 – Moderate, Level 1 -Low

| **Semester-V** | | | | | |
|---|---|---|---|---|---|
| **Julia Programming Lab**<br>**Category: AEC- V** | | | | | |
| Course Code | : | **B24AI583** | CIE | : | 50 Marks |
| Teaching Hours L : T : P : S | : | 0:0:2:0 | SEE | : | 50 Marks |
| Total Hours | : | 30 | Total | : | 100 Marks |
| Credits | : | 1 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To introduce the Julia programming language for scientific and numerical computing. |
| 2. | To develop skills in matrix operations, numerical analysis, and data manipulation using Julia. |
| 3. | To apply Julia for scientific computing, optimization, and machine learning tasks. |
| 4. | To understand high-performance computing concepts using Julia. |
| 5. | To build small applications using Julia libraries for data analysis and visualization. |

| **Sl. No.** | **Title of the program/list of the experiment** |
|---|---|
| 1. | Introduction to Julia programming environment – syntax, variables, data types, and functions. |
| 2. | Write Julia programs demonstrating control structures:<br>• conditional statements<br>• loops<br>• Functions. |
| 3. | Array, vector, and matrix operations using the Linear Algebra library. |
| 4. | Program to perform matrix addition, multiplication, and transpose operations. |
| 5. | Implement numerical computing methods:<br>• root finding<br>• numerical differentiation<br>• Numerical integration. |
| 6. | Write Julia programs for solving linear algebra problems using built-in libraries. |
| 7. | Perform statistical data analysis using Julia packages. |
| 8. | Data visualization using Julia libraries such as:<br>• plots<br>• graphs<br>• Charts. |
| 9. | Implement optimization problems using Julia packages. |
| 10. | Performance comparison of numerical computations using Julia. |
| 11. | Develop a **mini project** using Julia.<br>Examples:<br>• Data analysis and visualization system<br>• Machine learning model (prediction/classification)<br>• Optimisation-based application<br>• Scientific computing simulation<br>• Any related topics. |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Understand the fundamentals of the Julia programming language. |
| CO2 | Apply Julia for numerical and matrix computations. |
| CO3 | Implement data analysis and visualization using Julia libraries. |
| CO4 | Develop scientific computing applications using Julia. |
| CO5 | Evaluate the performance advantages of Julia for computational problems. |

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Laboratory** | **Lab Conduction & Record** | **Evaluating each expt. for 10 marks** | **20** | **50** |
| | **Laboratory Test -1** | **50** | **15** | |
| | **Laboratory Test -2** | **50** | **15** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total Marks** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
4. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
5. Change of experiment is allowed only once and 15% of Marks allotted to the Conduction procedure part are to be made zero. The minimum duration of SEE is 03 hour

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | - | - | 3 | - | - | - | - | - | 2 |
| CO2 | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | 2 |
| CO3 | 2 | 3 | 2 | 2 | 3 | - | - | 1 | - | 1 | 2 |
| CO4 | 2 | 2 | 3 | 3 | 3 | - | - | 2 | 1 | 2 | 2 |
| CO5 | 2 | 2 | 1 | 2 | 3 | - | 1 | - | - | - | 3 |

Level 3 – High, Level 2 – Moderate, Level 1 -Low

| **Semester-V** | | | | | |
|---|---|---|---|---|---|
| **Big Data Analytics with Python Lab**<br>**Category: AEC - V** | | | | | |
| Course Code | : | **B24IC584** | CIE | : | 50 Marks |
| Teaching Hours L:T:P:S | : | 0:0:2:0 | SEE | : | 50 Marks |
| Total Hours | : | 30 | Total | : | 100 Marks |
| Credits | : | 1 | SEE Duration | : | 3Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To implement MapReduce programs for processing big data. |
| 2. | To realize storage of big data using MongoDB |
| 3. | To analyze big data using machine learning techniques such as Decision tree |

| **Sl. No** | **Name of the Programs / List of the experiments** |
|---|---|
| 1. | Install, configure and run python, numPy and Pandas. |
| 2. | Install, configure and run Hadoop and HDFS. |
| 3. | Visualize data using basic plotting techniques in Python |
| 4. | Implement No SQL Database Operations: CRUD operations, Arrays using MongoDB. |
| 5. | Implement Functions: Count – Sort – Limit – Skip – Aggregate using MongoDB. |
| 6. | Implement word count / frequency programs using MapReduce. |
| 7 | Implement a MapReduce program that processes a dataset. |
| 8 | Implement clustering techniques using SPARK. |
| 9 | Implement an application that stores big data in MongoDB / Pig using Hadoop / R. |
| 10. | Develop a Map Reduce Programme to find the grades of students. |
| 11. | Develop a Map Reduce Programme to implement matrix multiplication. |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Learn to install & configuration |
| CO2 | Learn to plot the graphs |
| CO3 | Learn the database method like MongoDB |
| CO4 | Learn to clustering and mapreduce |
| CO5 | Learn to implement the real time applications |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| **CIE** | **Type of Assessment** | **Max. Marks** | **Max. Marks Scaling Down to** | **Total Marks** |
|---|---|---|---|---|
| **Laboratory** | **Lab Conduction & Record** | **Evaluating each expt. for 10 marks** | **20** | **50** |
| | **Laboratory Test -1** | **50** | **15** | |
| | **Laboratory Test -2** | **50** | **15** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total Marks** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
4. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
5. Change of experiment is allowed only once and 15% of Marks allotted to the Conduction procedure part are to be made zero. The minimum duration of SEE is 03 hour.

**CO-PO Mapping:**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 1 | - | - | - | - | 2 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 1 | - | - | - | - | 2 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 2 | - | - | - | - | 1 | 3 | 3 |
| CO4 | 3 | 2 | 2 | 2 | - | - | - | - | 1 | 3 | 3 |
| CO5 | 3 | 2 | 2 | 1 | - | - | - | - | 1 | 3 | 3 |

Level 3 - High, Level 2 – Moderate, Level 1 - Low

| **Semester -V** | | | | | |
|---|---|---|---|---|---|
| **Mini - Project**<br>**Category: SDC** | | | | | |
| Course Code | : | **B24AIP511** | CIE | : | 50 Marks |
| Teaching Hours L : T : P : S | : | 0:0:4:0 | SEE | : | 50 Marks |
| Total Hours | : | 60 | Total | : | 100 Marks |
| Credits | : | 2 | SEE Duration | : | 3 Hrs |

## Mini-Project Work Evaluation:

Mini Project is a hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small applications etc. Based on the ability/abilities of the student/s and recommendations of the supervisor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

**CIE procedure for Mini-project:** (i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the **Project Reviews, Project report and Viva-Voce in the ratio of 60:20:20**. The marks awarded for the project report shall be the same for all the batches mates.
(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

**CIE Evaluation:** The CIE marks awarded for the Mini-project, shall be based on the evaluation of the **Project Reviews, Project report and Viva-Voce in the ratio of 60:20:20**. The marks awarded for the project report shall be the same for all the batches mates.

**SEE Evaluation**: SEE for project work will be conducted by the two examiners appointed by the Principal / CoE. The SEE marks awarded for the project work shall be based on the evaluation of **Write-up, Presentation Skills, Project Demonstration and Viva-Voce** in the ratio of 20:60:20

## Rubrics for Mini-Project

| **Sl. No** | **Criteria** | **Scale of Assessment** | | |
|---|---|---|---|---|
| | | **Satisfactory (0-5)** | **Good (6-8)** | **Excellent (9-10)** |
| 1 | Objective, Existing method with proposed method | Incomplete justification to the objectives proposed;<br><br>Steps are mentioned but unclear; without justification to objectives | Good justification to the objectives; Methodology to be followed is specified but detailing is not done | All objectives of the proposed work are well defined.<br><br>Steps to be followed to solve the defined problem are clearly specified. |
| 2 | Analysis/Description of the project | Incomplete explanation of the key concepts and in-sufficient description of the technical requirements of the project | Complete explanation of the key concepts but in-sufficient description of the technical requirements of the project | Complete explanation of the key concepts and strong description of the technical requirements of the project |

| | | | | |
|---|---|---|---|---|
| 3 | Result Analysis | • All defined objectives are achieved.<br>• Modules are working well in isolation and properly demonstrated<br>• Modules of project are not properly integrated. | • All defined objectives are achieved.<br>• Each module working well and properly demonstrated.<br>• Integration of all modules not done and system working is not very satisfactory. | • All defined objectives are achieved.<br>• Each module working well and properly demonstrated<br>• All modules of project are well integrated and system working is accurate |
| 4 | Project Report | • Project report is according to the specified format but some mistakes.<br>• In-sufficient references | • 1. Project report is according to the specified format.<br>• References are appropriate but not mentioned well. | • Project report is according to the specified Format.<br>• References are appropriate and well mentioned |
| 5 | Queries | Lacks sufficient knowledge and awareness | Fair knowledge and awareness related to the project. | Extensive knowledge and awareness related to the project |

| **Semester - VI** | | | | | |
|---|---|---|---|---|---|
| **Deep Learning**<br>**Category: PCC** | | | | | |
| Course Code | : | **B24AI601** | CIE | : | 50 Marks |
| Teaching Hours L:T:P:S | : | 2:2:0:2 | SEE | : | 50 Marks |
| Total Hours | : | 55 | Total | : | 100 Marks |
| Credits | : | 3 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To understand the fundamentals of neural networks and deep learning. |
| 2. | To explore deep learning architectures and their applications. |
| 3. | To develop skills in training and optimizing deep neural networks. |
| 4. | To analyze advanced models for sequence and image data. |
| 5. | To apply deep learning techniques to real-world problems. |

| **Module – 1** | **No. of Hours** |
|---|---|
| **Introduction to Neural Networks:** Introduction to Deep Learning and its significance, Biological and artificial neurons, perceptron model, multilayer perceptron, activation functions, forward propagation, loss functions, gradient descent, backpropagation algorithm. Challenges in training neural networks, including overfitting and vanishing gradients. | 11 |
| **Module – 2** | **No. of Hours** |
| **Optimization and Regularization:** Optimization techniques, including stochastic gradient descent, mini-batch gradient descent, momentum, RMS Prop, and Adam. Weight initialization techniques, batch normalization, regularization methods including L1, L2, and dropout, and hyper parameter tuning strategies. | 11 |
| **Module – 3** | **No. of Hours** |
| **Convolutional Neural Networks**: Convolution operation, padding, and stride, pooling layers, CNN architectures such as LeNet, AlexNet, and VGG. Feature extraction by training convolutional networks, transfer learning concepts. Applications of CNN. | 11 |
| **Module –4** | **No. of Hours** |
| **Recurrent Neural Networks:** Sequence modeling concepts, Recurrent Neural Networks, backpropagation through time, long short-term memory (LSTM) networks, gated recurrent units (GRU), sequence-to-sequence models, applications RNN. | 11 |
| **Module –5** | **No. of Hours** |
| **Advanced Deep Learning Models:** Autoencoders and representation learning, generative adversarial networks (GANs), attention mechanisms, introduction to transformers, transfer learning and fine-tuning, overview of deep learning frameworks such as TensorFlow and PyTorch, and real-world applications in AI systems. | 11 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Explain fundamental concepts of neural networks and deep learning. |
| CO2 | Apply optimization and regularization techniques for training deep models. |
| CO3 | Develop convolutional neural network models for image-based tasks. |
| CO4 | Implement recurrent neural networks for sequence modeling problems. |
| CO5 | Analyze advanced deep learning architectures and their applications. |

| **Text Books** | |
|---|---|
| 1. | Simon Haykin, *Neural Networks and Learning Machines*, 3rd Edition, Pearson Education, 2016. |
| 2. | Ian Goodfellow, Yoshua Bengio, and Aaron Courville, *Deep Learning*, MIT Press, 2016. |
| 3. | Francois Chollet, *Deep Learning with Python*, 2nd Edition, Manning Publications, 2021. |

| **Reference Text Books** | |
|---|---|
| 1. | Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow*, 2nd Edition, O'Reilly Media, 2019. |
| 2. | Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006. |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

**CONTINIOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Theory** | **Internal Assessment-1** | **50** | **30 (Average of Best two Assessments)** | **50** |
| | **Internal Assessment-2** | **50** | | |
| | **Internal Assessment-3** | **50** | | |
| **AAT** | **Two Assessments as per regulations** | **20** | **20** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total Marks** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |
| CO2 | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | 2 |
| CO3 | 2 | 3 | 3 | 3 | 3 | - | - | - | 1 | - | 2 |
| CO4 | 2 | 3 | 2 | 3 | 3 | - | - | - | 1 | - | 2 |
| CO5 | 2 | 3 | 3 | 2 | 3 | - | - | - | 1 | - | 3 |

Level 3 - High, Level 2 - Moderate, Level 1 - Low

| **Semester-VI** | | | | | |
|---|---|---|---|---|---|
| **Natural Language Processing**<br>**Category: IPCC** | | | | | |
| Course Code | : | **B24AI602** | CIE | : | 50 Marks |
| Teaching Hours L : T : P : S | : | 3:0:2:3 | SEE | : | 50 Marks |
| Total Hours/Semester | : | 45+30 | Total | : | 100 Marks |
| Credits | : | 4 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To understand fundamental concepts of NLP and computational linguistics. |
| 2. | To apply text preprocessing and representation techniques. |
| 3. | To use statistical and machine learning methods for NLP tasks. |
| 4. | To explore advanced NLP models, including sequence models and transformers. |
| 5. | To apply NLP techniques to real-world applications such as sentiment analysis and machine translation. |

| **Module – 1** | **No. of Hours** |
|---|---|
| **Introduction to Natural Language Processing:** Overview of natural language processing, challenges in language understanding, levels of language analysis including lexical, syntactic, and semantic processing, applications of NLP, corpus and text resources, basics of text preprocessing including tokenization, stop-word removal, and stemming. | 9 |
| **Module – 2** | **No. of Hours** |
| **Introduction to Natural Language Processing**: Text representation techniques, including bag-of-words, TF-IDF, and n-grams, vector space model, word embeddings including Word2Vec and GloVe, language modeling concepts, statistical language models, and evaluation of language models. | 9 |
| **Module – 3** | **No. of Hours** |
| **NLP using Machine Learning**: Classification techniques for text, including Naïve Bayes, logistic regression, and support vector machines, feature extraction methods, sequence labeling problems, part-of-speech tagging, named entity recognition, and evaluation metrics for NLP models. | 9 |
| **Module – 4** | **No. of Hours** |
| **Deep Learning for NLP**: Neural network models for NLP, Recurrent Neural Networks(RNN), LSTM, and GRU models, attention mechanisms, sequence-to-sequence models, introduction to transformer architecture, and pre-trained language models. | 9 |
| **Module – 5** | **No. of Hours** |
| **Applications of NLP**: Sentiment analysis, text classification, machine translation, question answering systems, chatbots and conversational AI, information retrieval, evaluation of NLP systems, and ethical considerations in NLP applications. | 9 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Explain fundamental concepts and challenges in natural language processing. |
| CO2 | Apply text preprocessing and representation techniques for NLP tasks. |
| CO3 | Develop machine learning models for text classification and sequence labeling. |
| CO4 | Implement deep learning models for advanced NLP applications. |
| CO5 | Analyze real-world NLP systems and their performance. |

| **Text Books** | |
|---|---|
| 1. | Daniel Jurafsky and James H. Martin, *Speech and Language Processing*, 3rd Edition (Draft), Pearson.2023 |
| 2. | Jacob Eisenstein, *Introduction to Natural Language Processing*, MIT Press, 2019. |

| **Reference Text Books** | |
|---|---|
| 1. | Steven Bird, Ewan Klein and Edward Loper, *Natural Language Processing with Python*, O'Reilly Media, 2009. |
| 2. | Yoav Goldberg, *Neural Network Methods for Natural Language Processing*, Morgan & Claypool, 2017. |
| 3. | Christopher D. Manning, PrabhakarRaghavan and HinrichSchütze, *Introduction to Information Retrieval*, Cambridge University Press, 2008. |

## LABORATORY

| Sl. No | Name of the experiments |
|---|---|
| 1. | Installation and setup of NLP environment using Python, PyTorch/TensorFlow, and HuggingFace Transformers; loading and exploring pre-trained models. |
| 2. | Implementation of advanced text preprocessing using HuggingFacetokenizers, including subword tokenization (BPE, WordPiece). |
| 3. | Text classification using pre-trained transformer models such as BERT for sentiment analysis. |
| 4. | Named Entity Recognition using transformer-based models and evaluation using standard metrics. |
| 5. | Fine-tuning BERT or DistilBERT on a custom dataset for text classification. |
| 6. | Implementation of question answering systems using pre-trained transformer models. |
| 7. | Text summarization using transformer models such as BART or T5. |
| 8. | Machine translation using transformer architectures and HuggingFace pipelines. |
| 9. | Text generation using GPT-based models and control of generation parameters (temperature, top-k, top-p). |
| 10. | Prompt engineering techniques for LLMs, including zero-shot and few-shot learning. |
| 11. | **Mini-project**: involving development of an NLP application such as a chatbot, document summarizer, or intelligent Q&A system using LLMs. |

| **Web links and Video lectures (e-Resources):** |
|---|
| 1. https://web.stanford.edu/class/cs224n/?utm_source=chatgpt.com |
| 2. https://huggingface.co/learn/llm-course/chapter1/1 |
| 3. https://www.coursera.org/specializations/natural-language-processing?utm_source=chatgpt.com |
| 4. https://www.nltk.org/?utm_source=chatgpt.com |
| 5. https://www.youtube.com/playlist?list=PLoROMvodv4rMFqRtEuo6SGjY4XbRIVRd4 |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| Component | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Theory** | **Internal Assessment-1** | **50** | **30** (Average of Best Two Assessments) | **50/2 = 25** |
| | **Internal Assessment-2** | **50** | | |
| | **Internal Assessment-3** | **50** | | |
| **AAT** | Any One Assessments as per regulations | **20** | **20** | |
| **Laboratory** | **Lab conduction & Record** | Evaluating each expt. for 10 marks. | **05** | **25** |
| | **Lab Internal Test** | **50** | **20** | |
| **Continuous Internal Evaluation (CIE)** | | | | **50** |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total Marks** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice. Students should answer five full questions, selecting one full question from each module.
5. Students have to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
6. The maximum marks from the practical component to be included in the SEE question paper is **16 marks.**
7. Question papers to be set as per the Blooms Taxonomy levels.
8. The laboratory component of the **integrated course** shall be CIE only. However, in SEE, the questions from the practical component shall be included.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | - | 2 | 2 | - | - | - | - | - | 2 |
| CO2 | 2 | 3 | 2 | 2 | 2 | - | - | - | - | - | 2 |
| CO3 | 2 | 3 | 2 | 2 | 3 | - | - | - | - | - | 2 |
| CO4 | 2 | 3 | 1 | 2 | 3 | - | - | - | - | - | 2 |
| CO5 | 2 | 2 | 2 | 2 | 2 | - | - | - | - | - | 2 |

Level 3 - High, Level 2 - Moderate, Level 1 - Low

| **Semester -VI** | | | | | |
|---|---|---|---|---|---|
| **AI in Cloud and Distributed Systems**<br>**Category: PEC-II** | | | | | |
| Course Code | : | **B24AI631** | CIE | : | 50 Marks |
| Teaching Hours L:T:P:S | : | 3:0:0:3 | SEE | : | 50 Marks |
| Total Hours | : | 45 | Total | : | 100 Marks |
| Credits | : | 3 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To introduce the principles of distributed computing and their relevance to AI systems. |
| 2. | To provide knowledge of cloud computing models and services for scalable AI applications. |
| 3. | To develop skills in processing large-scale data using distributed frameworks. |
| 4. | To understand cloud-based tools and platforms for machine learning and AI deployment. |
| 5. | To enable the design of scalable, reliable, and efficient AI solutions using distributed and cloud environments. |

| **Module - 1** | **No. of Hours** |
|---|---|
| **Introduction to Distributed Computing**: Fundamentals of distributed systems, characteristics and challenges, types of distributed architectures, client-server and peer-to-peer models, distributed system components, communication protocols, consistency, fault tolerance, scalability, distributed computing applications in AI. | 9 |
| **Module - 2** | **No. of Hours** |
| **Fundamentals of Cloud Computing**: Introduction to cloud computing, evolution and characteristics, service models including IaaS, PaaS, and SaaS, deployment models such as public, private, hybrid, and community cloud, virtualization concepts, containers and microservices, cloud architecture. | 9 |
| **Module - 3** | **No. of Hours** |
| **Big Data Processing Frameworks**: Introduction to big data, distributed storage systems, Hadoop Distributed File System (HDFS), MapReduce programming model, Apache Spark architecture, RDDs and DataFrames, batch and stream processing, applications in AI and machine learning. | 9 |
| **Module - 4** | **No. of Hours** |
| **Cloud Platforms and AI Services**: Overview of cloud platforms including AWS, Microsoft Azure, and Google Cloud, cloud storage and compute services, AI and ML services on cloud platforms, serverless computing, data pipelines for machine learning, deployment of AI models on cloud infrastructure. | 9 |
| **Module - 5** | **No. of Hours** |
| **Advanced Topics and Applications**: Distributed machine learning concepts, model parallelism and data parallelism, container orchestration using Kubernetes, MLOps fundamentals, security and privacy in cloud computing, real-time analytics, applications in recommendation systems, smart systems, and large-scale AI applications. | 9 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Explain concepts of distributed systems and their role in AI applications. |
| CO2 | Describe cloud computing models and services for scalable computing. |
| CO3 | Apply distributed frameworks for large-scale data processing. |
| CO4 | Utilize cloud platforms for deploying machine learning models. |
| CO5 | Design scalable and efficient AI systems using distributed and cloud technologies. |

| **Text Books** | |
|---|---|
| 1. | Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, *Distributed and Cloud Computing: From Parallel Processing to the Internet of Things*, Morgan Kaufmann, 2012. |
| 2. | Rajkumar Buyya, Christian Vecchiola and S. Thamarai Selvi, *Mastering Cloud Computing: Foundations and Applications Programming*, McGraw Hill Education, 2013. |

| **Reference Text Books** | |
|---|---|
| 1. | Tom White, *Hadoop: The Definitive Guide*, 4th Edition, O'Reilly Media, 2015. |
| 2. | Bill Chambers and Matei Zaharia, *Spark: The Definitive Guide*, O'Reilly Media, 2018. |
| 3. | Brendan Burns, Joe Beda and Kelsey Hightower, *Kubernetes: Up and Running*, O'Reilly Media, 2019. |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Theory** | **Internal Assessment-1** | **50** | **30 (Average of Best two Assessments)** | **50** |
| | **Internal Assessment-2** | **50** | | |
| | **Internal Assessment-3** | **50** | | |
| **AAT** | **Two Assessments as per regulations** | **20** | **20** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total Marks** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 1 |
| CO2 | 2 | 2 | 3 | 2 | 3 | - | - | 1 | - | 1 | 1 |
| CO3 | 2 | 3 | 3 | 3 | 3 | - | - | 1 | 1 | 1 | 1 |
| CO4 | 2 | 3 | 3 | 3 | 3 | - | 1 | 1 | 1 | 1 | 2 |
| CO5 | 2 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | 1 | 1 | 3 |

Level 3 - High, Level 2 - Moderate, Level 1 - Low

| **Semester -VI** | | | | | |
|---|---|---|---|---|---|
| **Vision AI**<br>**Category: PEC-II** | | | | | |
| Course Code | : | **B24AI632** | CIE | : | 50 Marks |
| Teaching Hours L:T:P:S | : | 3:0:0:3 | SEE | : | 50 Marks |
| Total Hours | : | 45 | Total | : | 100 Marks |
| Credits | : | 3 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective** | |
|---|---|
| 1. | To understand the fundamentals of digital image processing and enhancement techniques. |
| 2. | To learn feature extraction and geometric methods for image analysis. |
| 3. | To gain knowledge of CNN architectures for vision tasks. |
| 4. | To apply object detection and segmentation algorithms. |
| 5. | To explore advanced vision topics like video analysis and GANs. |

| **Module – 1** | **No. of Hours** |
|---|---|
| **Digital Image Fundamentals & Pre-processing:** Introduction to the digital image pipeline, including sampling, quantization, and the basic relationship between pixels. Focus on spatial domain enhancements such as histogram equalization, spatial filtering for noise reduction (median, Gaussian), and sharpening filters. The Discrete Wavelet Transform (DWT) is introduced to understand image restoration and denoising. | 9 |
| **Module – 2** | **No. of Hours** |
| **Feature Extraction & Classical Geometry:** Focus on extracting meaningful information through edge detection (Canny, Sobel) and corner detection (Harris). Study of shape descriptors, Hough Transform for line and circle detection, and robust feature matching using SIFT, SURF, or ORB. Introduction to camera geometry, including pinhole camera models, intrinsic/extrinsic parameters, and the basics of stereo vision and depth estimation. | 9 |
| **Module – 3** | **No. of Hours** |
| **Foundations of Neural Networks for Vision**: Transition from classical features to the architecture of Convolutional Neural Networks (CNNs). Detailed study of convolution layers, pooling, activation functions (ReLU, Softmax), and backpropagation in a visual context. Analysis of landmark architectures like AlexNet and VGGNet, focusing on the concepts of transfer learning and fine-tuning for specific vision datasets. | 9 |
| **Module – 4** | **No. of Hours** |
| **Object Detection & Image Segmentation**: Exploration of localized vision tasks, region-based detection (Faster R-CNN) and single-shot detectors (YOLO, SSD). Understanding the difference between semantic, instance, and panoptic segmentation. Detailed study of the U-Net architecture for medical imaging and Mask R-CNN for pixel-level object masking, emphasizing loss functions like Intersection over Union (IoU). | 9 |
| **Module – 5** | **No. of Hours** |
| **Advanced Vision & Generative Models:** Temporal vision through video analysis, optical flow, and action recognition using Recurrent Neural Networks (RNNs). Introduction to Generative Adversarial Networks (GANs) for image synthesis and style transfer. | 9 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Apply image processing techniques for enhancement and restoration. |
| CO2 | Analyze and extract features using classical methods. |
| CO3 | Build CNN models for image classification. |
| CO4 | Implement object detection and segmentation methods. |
| CO5 | Evaluate advanced vision techniques for real-world applications. |

| **Text Books** | |
|---|---|
| 1. | Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, 4th Edition, Pearson Education, 2018. |
| 2. | Richard Szeliski, *Computer Vision: Algorithms and Applications*, Springer, 2022. |

| **Reference Text Books** | |
|---|---|
| 1. | Deepak Kumar and Amit Kumar, Computer Vision and Deep Learning, Wiley India, 2020. |
| 2. | Simon J. D. Prince, *Computer Vision: Models, Learning and Inference*, Cambridge University Press, 2012. |
| 3. | Ian Goodfellow, YoshuaBengio and Aaron Courville, *Deep Learning*, MIT Press, 2016. |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Theory** | **Internal Assessment-1** | **50** | **30 (Average of Best two Assessments)** | **50** |
| | **Internal Assessment-2** | **50** | | |
| | **Internal Assessment-3** | **50** | | |
| **AAT** | **Two Assessments as per regulations** | **20** | **20** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total Marks** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 2 | 2 | – | – | – | – | – | 1 |
| CO2 | 3 | 3 | 2 | 2 | 3 | – | – | – | – | – | 1 |
| CO3 | 3 | 3 | 2 | 2 | 3 | – | – | – | – | – | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 1 | – | – | 1 | – | 2 |
| CO5 | 2 | 3 | 2 | 2 | 3 | 1 | – | – | 1 | – | 2 |

Level 3, High, Level 2, Moderate, Level 1, Low

| **Semester -VI** | | | | | |
|---|---|---|---|---|---|
| **Exploratory Data Analysis**<br>**Category: PEC II** | | | | | |
| Course Code | : | **B24AI633** | CIE | : | 50 Marks |
| Teaching Hours L:T:P:S | : | 3:0:0:3 | SEE | : | 50 Marks |
| Total Hours | : | 45 | Total | : | 100 Marks |
| Credits | : | 3 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To understand core exploratory data analysis (EDA) techniques. |
| 2. | To perform data cleaning, transformation, and visualization. |
| 3. | To apply statistical methods to summarize and interpret data. |
| 4. | To identify patterns, relationships, and anomalies in datasets. |
| 5. | To use EDA as a foundation for machine learning model development. |

| **Module – 1** | **No. of Hours** |
|---|---|
| **Introduction to Exploratory Data Analysis**: Introduction to exploratory data analysis, importance in data science and machine learning, types of data, data collection and data quality, data cleaning techniques, handling missing values, noise removal, outlier detection, introduction to data transformation and normalization. | 9 |
| **Module - 2** | **No. of Hours** |
| **Descriptive Statistics and Data Summarization:** Measures of central tendency, including mean, median, and mode, measures of dispersion, such as variance and standard deviation, skewness and kurtosis, summary statistics, data distribution analysis, correlation and covariance, and introduction to statistical interpretation of data. | 9 |
| **Module – 3** | **No. of Hours** |
| **Data Visualization Techniques**: Principles of data visualization, Graphical representations: bar charts, histograms, box plots, scatter plots, line plots, Correlation visualization using heatmaps. Visualization libraries: Matplotlib, Seaborn. Interactive visualization tools (Plotly). | 9 |
| **Module – 4** | **No. of Hours** |
| **Multivariate Analysis and Feature Engineering:** Bivariate and multivariate data analysis, correlation analysis, feature selection techniques, feature extraction, dimensionality reduction methods including Principal Component Analysis (PCA), handling categorical data, data encoding techniques. | 9 |
| **Module – 5** | **No. of Hours** |
| **Advanced EDA and Applications**: Pattern recognition and anomaly detection, handling data imbalance, time-series exploratory analysis, data profiling, automated EDA tools, integration of EDA with machine learning pipelines, and case studies in real-world domains such as healthcare, finance, and business analytics. | 9 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Explain the importance and techniques of exploratory data analysis. |
| CO2 | Apply statistical methods to summarize and interpret datasets. |
| CO3 | Develop visualizations to analyze patterns and relationships in data. |
| CO4 | Perform feature engineering and dimensionality reduction. |
| CO5 | Analyze complex datasets and prepare them for machine learning applications. |

| **Text Books** | |
|---|---|
| 1. | John W. Tukey, *Exploratory Data Analysis*, Addison-Wesley, 1977. |
| 2. | Catherine M. Marsh and Andrew Gelman, *Data Analysis Using Regression and Multilevel/Hierarchical Models*, Cambridge University Press. |

| **Reference Text Books** | |
|---|---|
| 1. | Wes McKinney, *Python for Data Analysis*, 2nd Edition, O'Reilly Media, 2017. |
| 2. | Hadley Wickham and Garrett Grolemund, *R for Data Science*, O'Reilly Media, 2017. |
| 3. | Joel Grus, *Data Science from Scratch*, 2nd Edition, O'Reilly Media, 2019. |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Theory** | **Internal Assessment-1** | **50** | **30 (Average of Best two Assessments)** | **50** |
| | **Internal Assessment-2** | **50** | | |
| | **Internal Assessment-3** | **50** | | |
| **AAT** | **Two Assessments as per regulations** | **20** | **20** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total Marks** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 2 | - | - | - | - | - | 2 |
| CO2 | 2 | 3 | 2 | 2 | 3 | - | - | - | - | - | 2 |
| CO3 | 2 | 3 | 3 | 2 | 3 | - | - | - | - | - | 2 |
| CO4 | 2 | 3 | 2 | 3 | 3 | - | - | - | - | - | 2 |
| CO5 | 2 | 2 | 2 | 2 | 3 | - | - | - | - | - | 2 |

Level 3 - High, Level 2 - Moderate, Level 1 - Low

| **Semester -VI** | | | | | |
|---|---|---|---|---|---|
| **Robotic Process Automation Design and Development** **Category: PEC- II** | | | | | |
| Course Code | : | **B24AI634** | CIE | : | 50 Marks |
| Teaching Hours L:T:P:S | : | 3:0:0:3 | SEE | : | 50 Marks |
| Total Hours | : | 45 | Total | : | 100 Marks |
| Credits | : | 3 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To introduce the concepts and fundamentals of Robotic Process Automation (RPA). |
| 2. | To understand RPA architecture, tools, and automation workflows. |
| 3. | To explain techniques used for process automation and integration with enterprise systems. |
| 4. | To explore advanced automation concepts, including intelligent automation. |
| 5. | To analyze deployment, governance, and security aspects of RPA systems. |

| **Module – 1** | **No. of Hours** |
|---|---|
| **Introduction to Robotic Process Automation:** Overview of business process automation, Introduction to Robotic Process Automation (RPA), Evolution of RPA, Benefits and challenges of RPA, RPA lifecycle. Types of bots (attended, unattended, and hybrid), RPA architecture and components, Comparison between traditional automation and RPA. | 9 |
| **Module – 2** | **No. of Hours** |
| **RPA Tools and Workflow Design:** Popular RPA platforms, Features of RPA tools, Automation workflow design, Task recording and process automation, Variables and data handling, Control flow in automation, Debugging automation workflows, Exception handling concepts. | 9 |
| **Module – 3** | **No. of Hours** |
| **Automation Development Techniques:** Screen scraping techniques, Web automation, Data extraction methods, Email automation, File and folder automation, Excel automation, Database connectivity, Scheduling automation processes, Handling exceptions in automated processes. | 9 |
| **Module – 4** | **No. of Hours** |
| **Intelligent Automation and Integration:** Introduction, Integration of RPA with AI, Optical Character Recognition (OCR), Natural Language Processing for automation, Machine learning in automation, Process mining and analytics, Cognitive automation systems. | 9 |
| **Module – 5** | **No. of Hours** |
| **Deployment, Security and Governance:** Bot deployment strategies, RPA infrastructure, Bot Monitoring, and maintenance. Security issues in automation. Governance models for RPA, Compliance and risk management, Scalability of RPA solutions, and industrial case studies in the banking, healthcare, and manufacturing sectors. | 9 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Explain the concepts and architecture of Robotic Process Automation |
| CO2 | Analyze automation workflows and development techniques |
| CO3 | Interpret the integration of RPA with AI technologies |
| CO4 | Evaluate deployment strategies and governance models in RPA |
| CO5 | Identify real-world applications of RPA in different industries |

| **Text Books** | |
|---|---|
| 1. | Mary C. Lacity and Leslie P. Willcocks, *Robotic Process Automation and Risk Mitigation: The Definitive Guide*, SB Publishing, 2017. |
| 2. | Alok Mani Tripathi, *Learning Robotic Process Automation*, Packt Publishing, 2018. |

| **Reference Text Books** | |
|---|---|
| 1. | Tom Taulli, *The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems*, Apress, 2020. |
| 2. | HannesHapke and Catherine Nelson, *Building Machine Learning Pipelines*, O'Reilly Media, 2020. |
| 3 | GerardusBlokdyk, *Robotic Process Automation A Complete Guide*, 5STARCooks, 2019. |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

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**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| Theory | Internal Assessment-1 | 50 | 30 (Average of Best two Assessments) | 50 |
| | Internal Assessment-2 | 50 | | |
| | Internal Assessment-3 | 50 | | |
| AAT | Two Assessments as per regulations | 20 | 20 | |
| SEE | Semester End Examination | 100 | 50 | 50 |
| Total Marks | | | | 100 |

**SEMESTER END EXAMINATION (SEE)**

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | – | – | 2 | – | – | – | – | – | 2 |
| CO2 | 3 | 3 | 2 | 2 | 2 | – | – | – | – | – | 2 |
| CO3 | 2 | 2 | 2 | 2 | 3 | – | – | 1 | – | – | 2 |
| CO4 | 2 | 2 | 2 | 2 | 2 | 1 | 3 | – | – | – | 2 |
| CO5 | 2 | 2 | 1 | – | 2 | – | 2 | – | – | – | 2 |

Level 3 - High, Level 2 - Moderate, Level 1 - Low

| **Semester –VI** | | | | | |
|---|---|---|---|---|---|
| **Introduction to Data Structures**<br>**Category: OEC-I**<br>**(Common to CSE, CSD, CSE(IC), AIML, ISE)** | | | | | |
| Course Code | : | **B24CS641** | CIE | : | 50 Marks |
| Teaching Hours L:T:P:S | : | 3:0:0:3 | SEE | : | 50 Marks |
| Total Hours | : | 45 | Total | : | 100 Marks |
| Credits | : | 3 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To introduce primitive and non-primitive data structures |
| 2. | To understand the various types of data structure along their operations |
| 3. | To study various searching and sorting algorithms |
| 4. | To assess appropriate data structures during program development / problem solving |

| **Module – 1** | **No. of Hours** |
|---|---|
| **Arrays:** Introduction, One-Dimensional Arrays, Two-Dimensional Arrays, Initializing Two Dimensional Arrays, Multidimensional arrays.<br>**Pointers:** Introduction, Pointer Concepts, Accessing Variables through Pointers, Pointer Applications, Dynamic Memory Allocation Functions.<br>**Structures and Unions:** Introduction, Declaring Structures, Giving Values to Members, Structure Initialization, Comparison of Structure Variables, Arrays of Structures, Arrays within Structures, Nested Structures, Unions, Size of Structures. | 9 |
| **Module – 2** | **No. of Hours** |
| **Stacks:** Introduction, Stack Operations, Stack Implementation using Arrays, Applications of Stacks.<br>**Queues:** Introduction, Queue Operations, Queue Implementation using Arrays, Different Types of Queues: Circular Queues, Double-Ended Queues, Priority Queues, Applications of Queues. | 9 |
| **Module – 3** | **No. of Hours** |
| **Linked Lists**: Introduction, Singly Linked List, Self-Referential Structures, Operations on Singly Linked Lists: Insert-Delete-Display, Implementation of Stacks and Queues using Linked List, Concatenate two Lists, Reverse a List without Creating a New Node, Static Allocation Vs Linked Allocation. Circular Singly Linked List: Introduction, Operations: Insert-Delete-Display. | 9 |
| **Module – 4** | **No. of Hours** |
| **Trees:** Introduction, Basic Concepts, Representation of Binary Trees, Operations on Binary Trees: Insertion-Traversals-Searching-Copying a Tree, Binary Search Trees, Operations on Binary Search Trees: Insertion-Searching-Find Maximum and Minimum Value-Count Nodes, Expression Trees. | 9 |
| **Module – 5** | **No. of Hours** |
| **Sorting:** Introduction, Bubble Sort, Selection Sort, Insertion Sort. Searching: Introduction, Linear Search, Binary Search. | 9 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Develop C programs utilizing fundamental concepts such as arrays, pointers and structures. |
| CO2 | Apply data structures like stacks and queues to solve problems. |
| CO3 | Develop C programs using linked lists and their various types. |
| CO4 | Explain the fundamental concepts of trees and their practical applications. |
| CO5 | Demonstrate different sorting and searching algorithms and determine their algorithmic complexities. |

| **Text Books** | |
|---|---|
| 1. | E Balagurusamy, “C Programming and Data Structures”, 4th Edition, McGraw-Hill, 2007. |
| 2. | A M Padma Reddy, “Systematic Approach to Data Structures using C”, 9th Revised Edition, Sri Nandi Publications, 2009. |

| **Reference Text Books** | |
|---|---|
| 1. | Ellis Horowitz and Sartaj Sahni, “Fundamentals of Data Structures in C”, 2nd Edition, Universities Press, 2014. |
| 2. | Seymour Lipschutz, “Data Structures Schaum’s Outlines”, Revised 1st Edition, McGraw-Hill, 2014. |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

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**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| Theory | Internal Assessment-1 | 50 | 30 (Average of Best two Assessments) | 50 |
| | Internal Assessment-2 | 50 | | |
| | Internal Assessment-3 | 50 | | |
| AAT | Two Assessments as per regulations | 20 | 20 | |
| SEE | Semester End Examination | 100 | 50 | 50 |
| Total Marks | | | | 100 |

**SEMESTER END EXAMINATION (SEE)**

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 2 | - | 1 | - | 1 | - | - | - | - |
| CO2 | 3 | 1 | - | - | - | - | - | - | - | - | - |
| CO3 | 1 | 3 | 2 | - | - | - | - | 1 | - | - | - |
| CO4 | 2 | - | - | - | - | - | - | - | - | - | - |
| CO5 | 1 | 2 | 3 | - | - | - | - | - | - | - | - |

Level 3 - High, Level 2 - Moderate, Level 1 - Low

| **Semester -VI** | | | | | |
|---|---|---|---|---|---|
| **Introduction to Cybersecurity**<br>**Category: OEC-I** | | | | | |
| Course Code | : | **B24IC642** | CIE | : | 50 Marks |
| Teaching Hours L:T:P:S | : | 3:0:0:3 | SEE | : | 50 Marks |
| Total Hours | : | 45 | Total | : | 100 Marks |
| Credits | : | 3 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To understand the cybercrime terminologies and perspectives. |
| 2. | To understand Cyber Offenses and Botnets. |
| 3. | To gain knowledge on tools and methods used in cybercrimes. |
| 4. | To understand phishing and computer forensics. |

| **Module - 1** | **No. of Hours** |
|---|---|
| **Introduction to Cybercrime:** Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? Classifications of Cybercrimes, An Indian Perspective, Hacking and Indian Laws, Global Perspectives. | 9 |
| **Module - 2** | **No. of Hours** |
| **Cyber Offenses:** How Criminals Plan Them-Introduction, How criminals plan the attacks, Social Engineering, Cyber Stalking, Cybercafé & cybercrimes.<br>**Botnets:** The fuel for cybercrime, Attack Vector. | 9 |
| **Module - 3** | **No. of Hours** |
| **Tools and Methods used in Cybercrime:** Introduction, Proxy Servers, Anonymizers, Phishing, Password Cracking, Key Loggers and Spy ways, Virus and Worms, Trozen Horses and Backdoors, Steganography, DoS and DDOS Attacks, Attacks on Wireless networks. | 9 |
| **Module - 4** | **No. of Hours** |
| **Phishing and Identity Theft:** Introduction, methods of phishing, phishing, phishing techniques, spear phishing, types of phishing scams, phishing toolkits and spy phishing, counter measures, Identity Theft. | 9 |
| **Module - 5** | **No. of Hours** |
| **Understanding Computer Forensics:** Introduction, Historical Background of Cyber forensics, Digital Forensics Science, Need for Computer Forensics, Cyber Forensics and Digital Evidence, Digital Forensic Life cycle, Chain of Custody Concepts, network forensics. | 9 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Understanding the concepts of cybercrime terminologies. |
| CO2 | Understanding the Cyber offenses and Botnets. |
| CO3 | Illustrate Tools and Methods used on Cybercrime. |
| CO4 | Explain Phishing and Identity Theft. |
| CO5 | Justify the need of computer forensics. |

| **Text Books** | |
|---|---|
| 1. | Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81- 265-21791, 2011, First Edition (Reprinted 2018) |

| **Web links and Video lectures (e-Resources)** |
|---|
| https://www.youtube.com/watch?v=yC_hFm0BX28&list=<br>PLxApjaSnQGi6Jm7LLSxvmNQjS_rt9swsu<br>https://www.youtube.com/watch?v=nzZkKoREEGo&list=<br>PL9ooVrP1hQOGPQVeapGsJCktzIO4DtI4_<br>https://www.youtube.com/watch?v=6wi5DI6du-4&list=PL_uaeekrhGzJlB8XQBxU3z_hDwT95xlk<br>https://www.youtube.com/watch?v=KqSqyKwVuA8 |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Theory** | **Internal Assessment-1** | **50** | **30 (Average of Best two Assessments)** | **50** |
| | **Internal Assessment-2** | **50** | | |
| | **Internal Assessment-3** | **50** | | |
| **AAT** | **Two Assessments as per regulations** | **20** | **20** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total Marks** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 1 | - | 2 | - | - | - | - | 2 | - |
| CO2 | 2 | 2 | 2 | - | 2 | - | - | - | - | 2 | - |
| CO3 | 2 | 2 | 2 | - | 2 | - | - | - | - | 2 | - |
| CO4 | 2 | 2 | 2 | - | 2 | 1 | - | - | - | 2 | - |
| CO5 | 2 | 2 | 2 | 1 | 2 | 1 | - | 1 | - | 2 | - |

Level 3 - High, Level 2 - Moderate, Level 1 - Low

| **Semester-VI** | | | | | |
|---|---|---|---|---|---|
| **Fundamentals of Operating Systems**<br>**Category: OEC- I** | | | | | |
| Course Code | : | **B24CS643** | CIE | : | 50 Marks |
| Teaching Hours L:T:P:S | : | 3:0:0:3 | SEE | : | 50 Marks |
| Total Hours | : | 45 | Total | : | 100 Marks |
| Credits | : | 3 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1 | To explain the need and different types of OS |
| 2 | To discuss suitable techniques for management of different resources |
| 3 | To analyze different memory, storage, and file system management strategies. |
| 4 | To understand the concept of deadlocks and analyse the Memory Management Techniques |
| 5 | To understand and familiar with virtual memory management and files |

| **Module - 1** | **No. of Hrs** |
|---|---|
| **Introduction**: What operating systems do; Computer System organization; Computer System Organization, Computer System architecture; Operating System operations; Resource Management Operating System Structures: Operating System Services, User and Operating System interface; System calls, Application Program Interface, Types of system calls. | 9 |
| **Module - 2** | **No. of Hrs** |
| **Process Management:** Process concept; Process scheduling; Operations on processes; Inter process Communication Multi-threaded Programming: Overview; Multithreading models, Thread Libraries | 9 |
| **Module - 3** | **No. of Hrs** |
| **CPU Scheduling:** Basic Concepts, Scheduling criteria, Scheduling algorithms, Thread Scheduling, Process Synchronization: Synchronization: The critical section problem; Peterson's solution; Semaphores; Classical problems of synchronization; | 9 |
| **Module - 4** | **No. of Hrs** |
| **Deadlocks:** System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock. Memory Management: Background; Contiguous memory allocation; Paging; Structure of page table | 9 |
| **Module - 5** | **No. of Hrs** |
| **Virtual Memory Management:** Background; Demand paging; Copy-on-write; Page replacement; File System Interface: File concept; Access methods; Directory Structure, Protection, File System Implementation: File System Structure, File System Operations, File System Internals: File Systems, File System Mounting; Partition and Mounting, File sharing; | 9 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| **CO1** | Explain the fundamentals of operating systems. |
| **CO2** | Apply appropriate CPU scheduling algorithm for the given scenarios. |
| **CO3** | Analyze the various techniques for process synchronization and deadlock handling. |
| **CO4** | Apply the various techniques for memory management. |
| **CO5** | Analyze the importance of File System Mounting and File Sharing. |

| **Text Books** | |
|---|---|
| 1 | Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts" II, 10th Edition, John Wiley and Sons Inc., 2018. |
| 2 | Andrew S Tanenbaum, "Modern Operating Systems", Pearson, 5th Edition, 2022 New Delhi. |
| **Reference Text Books** | |
| 1 | RamazElmasri, A. Gil Carrick, David Levine, "Operating Systems – A Spiral Approach", Tata McGraw Hill Edition, 2010. |
| 2 | William Stallings, "Operating Systems: Internals and Design Principles", 7th Edition, Prentice Hall, 2018. |
| 3 | T V Geetha, "Understanding Natural Language Processing – Machine Learning and Deep Learning Perspectives", Pearson, 2024. |

| **Web links and Video lectures (e-Resources)** |
|---|
| 1. https://archive.nptel.ac.in/courses/106/105/106105214/ |
| 2. https://archive.nptel.ac.in/courses/106/102/106102132/ |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| Theory | Internal Assessment-1 | 50 | 30 (Average of Best two Assessments) | 50 |
| | Internal Assessment-2 | 50 | | |
| | Internal Assessment-3 | 50 | | |
| AAT | Two Assessments as per regulations | 20 | 20 | |
| SEE | Semester End Examination | 100 | 50 | 50 |
| Total Marks | | | | 100 |

**SEMESTER END EXAMINATION (SEE)**

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and it carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

**CO-PO Mapping:**

| CO / PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | – | 1 | – | – | – | 1 | – | 1 |
| CO2 | 3 | 3 | 2 | 2 | 2 | – | – | – | – | – | 1 |
| CO3 | 3 | 3 | 2 | 2 | 2 | 1 | – | – | – | – | 1 |
| CO4 | 3 | 3 | 2 | 2 | 3 | 1 | – | – | – | – | 1 |
| CO5 | 2 | 3 | 2 | 1 | 2 | 2 | 1 | – | 1 | – | 1 |

Level 3 - High, Level 2 - Moderate, Level 1 - Low

| **Semester-VI** | | | | | |
|---|---|---|---|---|---|
| **AI for Everyone**<br>**Category: OEC -1** | | | | | |
| Course Code | : | **B24AI644** | CIE | : | 50 Marks |
| Teaching Hours L:T:P:S | : | 3:0:0:3 | SEE | : | 50 Marks |
| Total Hours | : | 45 | Total | : | 100 Marks |
| Credits | : | 3 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To understand fundamental AI concepts in a non-technical, interdisciplinary context. |
| 2. | To analyze the impact of AI on industries, business processes, and society. |
| 3. | To understand the lifecycle and workflow of AI-driven projects. |
| 4. | To examine ethical, legal, and societal challenges in AI systems. |
| 5. | To identify practical AI applications across diverse domains. |

| **Module –1** | **No. of Hours** |
|---|---|
| **Foundations of Artificial Intelligence:** Overview of artificial intelligence, historical evolution, types of AI, including narrow and general AI, key concepts such as machine learning, deep learning, and data science, comparison between AI-driven systems and traditional programming, and broad applications of AI across industries. | 9 |
| **Module –2** | **No. of Hours** |
| **AI in Business and Industry:** Role of AI in digital transformation, applications in healthcare, finance, retail, manufacturing, and smart services, automation and workforce transformation, AI-enabled decision-making, introduction to data-driven organizations, and case studies illustrating successful AI adoption. | 9 |
| **Module –3** | **No. of Hours** |
| **AI Project Lifecycle and Workflow:** Problem identification and formulation for AI solutions, data collection and labeling, data preparation and feature understanding, model selection and evaluation, deployment considerations, interaction between technical and non-technical stakeholders, and an overview of commonly used AI tools and platforms. | 9 |
| **Module –4** | **No. of Hours** |
| **Ethics, Bias, and Governance in AI:** Ethical principles in AI, sources of bias in datasets and models, fairness and accountability, transparency and explainability, privacy and data protection, regulatory considerations, responsible AI development, and governance frameworks. | 9 |
| **Module –5** | **No. of Hours** |
| **AI Applications and Future Trends:** Applications of AI in natural language processing, computer vision, robotics, and recommendation systems. Introduction to generative AI, AI for sustainability and smart systems, emerging trends in AI, challenges, risks, and opportunities in widespread AI adoption. | 9 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Explain fundamental concepts and types of artificial intelligence. |
| CO2 | Analyze the impact of AI on business processes and societal transformation. |
| CO3 | Understand and describe the workflow of AI projects and data-driven problem solving |
| CO4 | Evaluate ethical, legal, and social implications of AI technologies. |
| CO5 | Identify and assess opportunities for applying AI in real-world scenarios. |

| **Text Books** | |
|---|---|
| 1. | Andrew Ng, *AI for Everyone*, DeepLearning.AI, 2019. |
| 2. | Ajay Agrawal, Joshua Gans, and Avi Goldfarb, *Prediction Machines: The Simple Economics of Artificial Intelligence*, Harvard Business Review Press, 2018. |

| **Reference Text Books** | |
|---|---|
| 1. | Melanie Mitchell, *Artificial Intelligence: A Guide for Thinking Humans*, Farrar, Straus and Giroux, 2019. |
| 2. | Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach*, 4th Edition, Pearson Education, 2020. |
| 3. | Kai-Fu Lee, *AI Superpowers: China, Silicon Valley, and the New World Order*, Houghton Mifflin Harcourt, 2018. |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of continuous Internal Evaluation (CIE) is 50% and for the Semester End Examination (SEE) is 50%. The minimum passing mark for the CIE is 40% of maximum marks (20 marks out of 50). The minimum passing mark for SEE is 35% of maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. Student has to secure a minimum 40% (40 marks out of 100) in the total of the CIE and SEE together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Theory** | **Internal Assessment-1** | **50** | **30 (Average of Best two Assessments)** | **50** |
| | **Internal Assessment-2** | **50** | | |
| | **Internal Assessment-3** | **50** | | |
| **AAT** | **Two Assessments as per regulations** | **20** | **20** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total Marks** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. The question paper will have two parts: Part-A and Part-B.
3. **Part-A** should contain minimum **Two or Four** quiz questions from each module of 02 marks/ 01 marks each. **Part-A is Compulsory** and carries 20 Marks.
4. **Part-B** contains total 10 questions.
5. Two questions of 16 marks (with minimum of 3 sub questions) from each module with internal choice.
6. Students should answer five full questions, selecting one full question from each module.
7. Question papers to be set as per the Blooms Taxonomy levels.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | - | 1 | - | 1 | - | 1 |
| CO2 | 2 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 |
| CO3 | 2 | 3 | 3 | 2 | 2 | - | 1 | 1 | 2 | 1 | 1 |
| CO4 | 1 | 3 | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 |
| CO5 | 1 | 2 | 2 | 2 | 3 | 2 | 3 | 1 | 2 | 1 | 2 |

Level 3 - High, Level 2 - Moderate, Level 1 - Low

| **Semester-VI** | | | | | |
|---|---|---|---|---|---|
| **Deep Learning Laboratory**<br>**Category: PCCL** | | | | | |
| Course Code | : | **B24AI605L** | CIE | : | 50 Marks |
| Teaching Hours L:T:P:S | : | 0:0:2:0 | SEE | : | 50 Marks |
| Total Hours | : | 30 | Total | : | 100 Marks |
| Credits | : | 1 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To implement deep learning models using standard frameworks. |
| 2. | To build complete pipelines: data loading → preprocessing → training → evaluation. |
| 3. | To compare optimizers, regularization methods, and architectures to improve generalization. |
| 4. | To work with vision and sequence tasks using CNNs, RNNs/LSTMs, and Transformers. |
| 5. | To deliver an end-to-end mini project-style experiment with reporting. |

| **Sl. No.** | **Title of the program/list of the experiment** |
|---|---|
| 1. | **DL Environment Setup + Dataset Loading**<br>Set up PyTorch/TensorFlow environment, verify GPU/CPU, load MNIST/CIFAR-10 dataset, create train/validation split, and implement Data Loader pipeline. |
| 2. | **Data Preprocessing, Augmentation, and Visualization**<br>Perform normalization, resizing, batching, and implement augmentations (flip/rotate/crop). Visualize samples and class distribution. |
| 3. | **MLP for Classification (MNIST)**<br>Implement a multi-layer perceptron for MNIST classification. Train and report accuracy, loss curves, and confusion matrix. |
| 4. | **Optimizer Comparison (SGD vs Adam)**<br>Train the same MLP/CNN model using SGD, Momentum, RMSProp, and Adam. Compare convergence speed and final accuracy. |
| 5. | **CNN for Image Classification (CIFAR-10/Fashion-MNIST)**<br>Design a CNN with convolution, pooling, and dropout. Train and evaluate using accuracy, precision/recall, and a confusion matrix. |
| 6. | **Regularization Study (Dropout, Batch Norm, Weight Decay)**<br>Take the CNN model and compare results with/without dropout, batch normalization, and L2 regularization. Show over-fitting control using train vs validation curves. |
| 7. | **Transfer learning using a pre-trained model**<br>Use a pre-trained Res Net/Mobile Net/VGG for a custom dataset (flowers/pets). Freeze base layers and fine-tune top layers. Compare performance. |
| 8. | **Sequence Modeling using LSTM/GRU (Sentiment / Time-Series)**<br>Implement an LSTM/GRU model for sentiment classification (IMDB) or time-series forecasting. Use embeddings (for NLP) and report metrics. |
| 9. | **Transformer-based Text Classification (Intro)**<br>Use a pre-trained transformer (Distil BERT/BERT) for text classification. Fine-tune and compare against the LSTM baseline on accuracy/F1. |
| 10 | **Model Evaluation and Hyperparameter Tuning**<br>Evaluation metrics, validation techniques, tuning learning rate, epochs, batch size. |
| 11. | **Mini Project Program (End-to-End DL Pipeline)**<br>Choose one application (vision/NLP) and build an end-to-end solution: dataset → model → training → evaluation → improvement (tuning/augmentation/regularization). Submit a report with metrics and conclusions. |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Prepare datasets and build reproducible training pipelines using DL tools. |
| CO2 | Implement and train an MLP with backpropagation and compare optimizers. |
| CO3 | Build and evaluate CNN models for image classification tasks. |
| CO4 | Build and evaluate sequence models for NLP/time-series tasks. |
| CO5 | Apply transfer learning, tuning, and present results with proper metrics and |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Laboratory** | **Lab Conduction & Record** | **Evaluating each expt. for 10 marks** | **20** | **50** |
| | **Laboratory Test -1** | **50** | **15** | |
| | **Laboratory Test -2** | **50** | **15** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total Marks** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
4. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
5. Change of experiment is allowed only once and 15% of Marks allotted to the Conduction procedure part are to be made zero. The minimum duration of SEE is 03 hours.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | 2 | 3 | - | - | 1 | 1 | - | 2 |
| CO2 | 2 | 3 | 2 | 3 | 3 | - | - | 1 | 1 | - | 2 |
| CO3 | 2 | 3 | 3 | 3 | 3 | - | - | 1 | 1 | - | 2 |
| CO4 | 2 | 3 | 3 | 3 | 3 | - | 1 | 1 | 1 | - | 2 |
| CO5 | 2 | 3 | 3 | 3 | 3 | - | 1 | 2 | 2 | 1 | 3 |

Level 3 – High, Level 2 – Moderate, Level 1 -Low

| **Semester-VI** | | | | | |
|---|---|---|---|---|---|
| **Explainable AI** **Category: AEC-VI** | | | | | |
| Course Code | : | **B24AI681** | CIE | : | 50 Marks |
| Teaching Hours L:T:P:S | : | 0:0:2:0 | SEE | : | 50 Marks |
| Total Hours | : | 30 | Total | : | 100 Marks |
| Credits | : | 1 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To introduce the concepts and importance of Explainable Artificial Intelligence (XAI). |
| 2. | To apply interpretability techniques to machine learning and deep learning models. |
| 3. | To analyze model predictions using explainability tools and visualization techniques. |
| 4. | To evaluate fairness, transparency, and bias in AI systems. |
| 5. | To develop practical skills to build interpretable AI models for real-world applications. |

| **Sl. No.** | **Title of the program/list of the experiment** |
|---|---|
| 1. | Installation and setup of Explainable AI tools and libraries; introduction to datasets and preprocessing techniques. |
| 2. | Development of a basic machine learning classification model and evaluation of model performance. |
| 3. | Implementation of feature importance analysis for machine learning models |
| 4. | Global model interpretation using visualization techniques |
| 5. | Local explanation of model predictions using the LIME technique |
| 6. | Model interpretation using SHAP values. |
| 7. | Visualization of feature contributions using SHAP plots |
| 8. | Evaluation of model bias and fairness in machine learning systems. |
| 9. | Interpretation of deep learning models using visualization methods such as saliency maps or Grad-CAM. |
| 10 | Comparative Study of XAI Techniques: Compare LIME, SHAP, and feature importance methods. |
| 11. | **Mini project:** Development of an explainable AI model using a real-world dataset and presentation of interpretation results. |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Understand the importance of explainability in artificial intelligence systems. |
| CO2 | Apply interpretability techniques to analyze machine learning models. |
| CO3 | Interpret model predictions using visualization and explanation tools. |
| CO4 | Evaluate bias, fairness and transparency in AI models. |
| CO5 | Develop explainable AI solutions for practical applications. |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of Continious Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| **Component** | **Type of Assessment** | **Max. Marks** | **Max. Marks Scaling Down to** | **Total Marks** |
|---|---|---|---|---|
| **Laboratory** | **Lab Conduction & Record** | **Evaluating each expt. for 10 marks.** | **20** | **50** |
| | **Laboratory Test -1** | **50** | **15** | |
| | **Laboratory Test -2** | **50** | **15** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total Marks** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
4. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
5. Change of experiment is allowed only once and 15% of Marks allotted to the Conduction procedure part are to be made zero. The minimum duration of SEE is 03 hour

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | – | – | 2 | – | – | – | – | – | 2 |
| CO2 | 3 | 3 | 2 | 2 | 3 | – | – | – | – | – | 2 |
| CO3 | 2 | 3 | 2 | 2 | 3 | – | – | 1 | – | – | 2 |
| CO4 | 2 | 2 | 1 | 2 | 2 | 1 | 3 | – | – | – | 2 |
| CO5 | 2 | 2 | 3 | 3 | 3 | – | 2 | 2 | 1 | 1 | 2 |

Level 3 – High, Level 2 – Moderate, Level 1 -Low

| **Semester-V1** | | | | | |
|---|---|---|---|---|---|
| **MAD using Flutter**<br>**Category: AEC-VI** | | | | | |
| Course Code | : | **B24CS682** | CIE | : | 50 Marks |
| Teaching Hours L: T: P : S | : | 0:0:2:0 | SEE | : | 50 Marks |
| Total Hours | : | 30 | Total | : | 100 Marks |
| Credits | : | 1 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To introduce the fundamentals of mobile application development using Flutter. |
| 2. | To provide hands-on experience with Flutter widgets, layouts, and UI design. |
| 3. | To develop skills in building cross-platform mobile applications. |
| 4. | To implement data handling, navigation, and API integration in Flutter apps. |
| 5. | To understand the deployment and testing of mobile applications. |

| **Sl. No.** | **List of Experiments** |
|---|---|
| 1. | **Flutter Development Environment Setup:** Install Flutter SDK and development tools. Configure Android Studio / VS Code. Create and run a simple Flutter application. |
| 2. | **Flutter Widgets and Layouts:** Explore basic widgets such as Text, Image, Container, Row, and Column. Design simple UI layouts using Flutter widgets. |
| 3. | **User Interface Design:** responsive layouts using Stack, List View, and Grid View. Implement styling and themes in Flutter apps. |
| 4. | **Navigation in Flutter:** Create multiple screens in Flutter. Implement navigation using routes and the Navigator class |
| 5. | **Input Handling and Forms:** Create input fields using Text Field and Form widgets. Validate user inputs |
| 6. | **State Management:** Implement stateful widgets. Manage dynamic UI updates based on user interactions |
| 7. | **Working with Local Data:** Use local storage techniques such as Shared Preferences. Save and retrieve application data. |
| 8. | **API Integration:** Fetch data from REST APIs. Display API data in Flutter UI. |
| 9. | **List and Dynamic Data Display:** Implement list View and dynamic item loading. Create interactive lists. |
| 10 | **App Testing and Deployment**<br>Testing apps on the emulator/device and generating APK. |
| 11. | **Mini Project: Mobile Application** Design application interface. Implement navigation and data handling. Integrate APIs or local storage. Test and run the mobile application. |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Understand the Flutter framework and mobile app development environment. |
| CO2 | Design user interfaces using Flutter widgets and layouts. |
| CO3 | Develop mobile applications with navigation and data handling. |
| CO4 | Integrate external APIs and services into Flutter applications. |
| CO5 | Build and deploy complete mobile applications using Flutter. |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Laboratory** | **Lab Conduction & Record** | **Evaluating each expt. for 10 marks** | **20** | **50** |
| | **Laboratory Test -1** | **50** | **15** | |
| | **Laboratory Test -2** | **50** | **15** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total Marks** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
4. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
5. Change of experiment is allowed only once and 15% of Marks allotted to the Conduction procedure part are to be made zero. The minimum duration of SEE is 03 hour.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | – | – | 3 | – | – | – | – | – | 2 |
| CO2 | 3 | 3 | 3 | 2 | 3 | – | – | 1 | – | – | 2 |
| CO3 | 2 | 3 | 3 | 2 | 3 | – | – | 2 | 1 | 1 | 2 |
| CO4 | 2 | 2 | 3 | 2 | 3 | – | – | 2 | 1 | – | 2 |
| CO5 | 2 | 2 | 3 | 3 | 3 | – | 2 | 2 | 1 | 1 | 2 |

Level 3 – High, Level 2 – Moderate, Level 1 -Low

| **Semester-VI** | | | | | |
|---|---|---|---|---|---|
| **Cloud Computing and Services**<br>**Category: AEC-VI** | | | | | |
| Course Code | : | **B24CS683** | CIE | : | 50 Marks |
| Teaching Hours L:T:P:S | : | 0:0:2:0 | SEE | : | 50 Marks |
| Total Hours | : | 30 | Total | : | 100 Marks |
| Credits | : | 1 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To introduce students to cloud computing environments and service models. |
| 2. | To provide hands-on experience with virtualization, cloud storage, and cloud platforms. |
| 3. | To develop skills in deploying applications and managing resources in cloud environments. |
| 4. | To explore containerization, serverless computing, and cloud databases. |
| 5. | To understand cloud security, monitoring, and scalability mechanisms. |

| **Sl. No.** | **List of Experiments** |
|---|---|
| 1. | **Cloud Environment Setup:** Create an account in a cloud platform (AWS / Azure / Google Cloud). Explore the cloud dashboard and service management interface. Identify major services: compute, storage, and networking |
| 2. | **Virtual Machine Creation and Management:** Launch a virtual machine instance. Configure operating system settings. Access the VM through SSH or remote desktop. Stop, start and terminate instances. |
| 3. | **Cloud Storage Services:** Create cloud storage buckets. Upload and download files. Manage storage permissions and access control. Implement versioning for stored files |
| 4. | **Deploying Web Applications on Cloud:** Install a web server on a cloud VM. Deploy a basic web application. Configure network access and ports. Test web application accessibility |
| 5. | **Cloud Database Services:** Create a cloud database instance. Connect the application to the cloud database. Perform data insertion, retrieval, and updates |
| 6. | **Cloud Database Services:** Create a cloud database instance. Connect the application to the cloud database. Perform data insertion, retrieval, and updates |
| 7. | **Serverless Computing:** Create serverless functions using a cloud platform. Configure triggers for serverless functions. Execute functions using cloud events. |
| 8. | **Cloud Resource Monitoring:** Use monitoring tools to track resource usage. Analyze CPU, memory, and storage metrics. Generate alerts for abnormal resource usage. |
| 9. | **Cloud Security Implementation:** Configure identity and access management policies. Implement role-based access control. Secure cloud storage and network access. |
| 10 | **Load Balancing and Auto Scaling**<br>Configure the load balancer and auto-scaling group. |
| 11. | **Mini Project – Cloud-Based Application:** Design a cloud application architecture. Deploy application components in cloud services. Implement storage and database services. Demonstrate the working of the application.<br>Example Projects:<br>• Cloud-based data storage system<br>• Online file sharing application<br>• Cloud-hosted web service<br>• Any related topics |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Apply cloud computing concepts for deploying applications. |
| CO2 | Implement virtualization and container-based solutions. |
| CO3 | Utilize cloud services for storage, databases, and computing. |
| CO4 | Deploy scalable and secure applications on cloud platforms. |
| CO5 | Design end-to-end cloud-based solutions for real-world problems. |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Laboratory** | **Lab Conduction & Record** | **Evaluating each expt. for 10 marks** | **20** | **50** |
| | **Laboratory Test -1** | **50** | **15** | |
| | **Laboratory Test -2** | **50** | **15** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total Marks** | | | | **100** |

**SEMESTER END EXAMINATION (SEE)**

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
4. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
5. Change of experiment is allowed only once and 15% of Marks allotted to the Conduction procedure part are to be made zero. The minimum duration of SEE is 03 hour.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | – | – | 2 | – | – | – | – | – | – |
| CO2 | 3 | 3 | 2 | 2 | 3 | – | – | – | – | – | – |
| CO3 | 2 | 3 | 3 | 2 | 3 | – | – | – | 1 | – | – |
| CO4 | 2 | 2 | 3 | 3 | 3 | – | – | – | 2 | 1 | 1 |
| CO5 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 2 | – | – | – |

Level 3 – High, Level 2 – Moderate, Level 1 -Low

| **Semester-VI** | | | | | |
|---|---|---|---|---|---|
| **Agentic AI**<br>**Category: AEC-V** | | | | | |
| Course Code | : | **B24AI684** | CIE | : | 50 Marks |
| Teaching Hours L:T:P:S | : | 0:0:2:0 | SEE | : | 50 Marks |
| Total Hours | : | 30 | Total | : | 100 Marks |
| Credits | : | 1 | SEE Duration | : | 3 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To introduce the concepts of Agentic AI and autonomous AI agents. |
| 2. | To provide hands-on experience in designing AI agents capable of decision-making and task automation. |
| 3. | To develop skills in building LLM-based agents and multi-agent systems. |
| 4. | To implement task planning, tool usage, and workflow automation using AI agents. |
| 5. | To explore practical applications of Agentic AI in real-world systems. |

| **Sl. No.** | **Title of the program/list of the experiment** |
|---|---|
| 1. | **Introduction to Agentic AI Environment:** Install required Python libraries. Explore agent frameworks and development tools. Implement a simple rule-based AI agent |
| 2. | **Designing Simple AI Agents:** Implement a reflex agent for a simple environment. Simulate agent perception and action |
| 3. | **Goal-Based AI Agents:** Define agent goals and actions. Implement decision-making logic. |
| 4. | **LLM-Based Agents:** Connect LLM APIs. Create conversational AI agents. Execute task-based interactions. |
| 5. | **Tool-Using Agents:** Integrate APIs or software tools. Enable agents to retrieve information and perform tasks |
| 6. | **Workflow Automation using Agents:** Design automated task pipelines. Implement sequential task execution |
| 7. | **Multi-Agent Systems:** Create multiple agents interacting with each other. Implement communication and coordination |
| 8. | **Memory and Context in AI Agents:** Store interaction history. Enable contextual reasoning. |
| 9. | **Agent Evaluation and Debugging:** Analyze agent decision processes. Improve agent behavior using feedback. |
| 10 | **Agent Deployment**<br>Deploy an agent as a web app or API (Streamlit / FastAPI). |
| 11. | **Mini Project: Agentic AI Application.** Identify a real-world problem. Develop an agent-based solution. Integrate tools and APIs. Demonstrate agent workflow. |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Understand the fundamentals of Agentic AI and autonomous agents. |
| CO2 | Develop AI agents capable of performing automated tasks. |
| CO3 | Implement agent-based workflows using LLM frameworks. |
| CO4 | Integrate tools and APIs within agent-based systems. |
| CO5 | Design and evaluate multi-agent AI applications. |

**ASSESSMENT DETAILS BOTH (CIE AND SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks).

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CONTINUOUS INTERNAL EVALUATION (CIE)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Laboratory** | **Lab Conduction & Record** | **Evaluating each expt. for 10 marks** | **20** | **50** |
| | **Laboratory Test -1** | **50** | **15** | |
| | **Laboratory Test -2** | **50** | **15** | |
| **SEE** | **Semester End Examination** | **100** | **50** | **50** |
| **Total Marks** | | | | **50** |

**SEMESTER END EXAMINATION (SEE)**

1. SEE marks for the practical course are 50 Marks. Practical examinations are to be conducted between the schedules mentioned in the academic calendar of the Institution.
2. All laboratory experiments are to be included for practical examination.
3. Evaluation of test write-up, conduction procedure, result and viva will be conducted jointly by examiners.
4. Rubrics suggested for SEE, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
5. Change of experiment is allowed only once and 15% of Marks allotted to the Conduction procedure part are to be made zero. The minimum duration of SEE is 03 hour.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | – | – | 2 | – | – | – | – | – | 2 |
| CO2 | 3 | 3 | 2 | 2 | 3 | – | – | – | – | – | 2 |
| CO3 | 2 | 3 | 3 | 2 | 3 | – | – | 1 | – | – | 2 |
| CO4 | 2 | 2 | 3 | 2 | 3 | – | – | 2 | 1 | 1 | 2 |
| CO5 | 2 | 2 | 3 | 3 | 3 | – | 2 | 2 | 1 | 1 | 2 |

Level 3 – High, Level 2 – Moderate, Level 1 -Low

MOOGAMBIGAI CHARITABLE AND EDUCATIONAL TRUST

# Rajarajeswari College of Engineering

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)
#14, Ramohalli Cross, Kumbalagodu, Mysore Road, Bengaluru–560074


# Common Courses

## V & VI Semester

## UG – B.E (2024 Scheme)

# INDEX

| Semester-V | | | | | |
|---|---|---|---|---|---|
| **Biology for Engineers**<br>**Category: BSC**<br>**(Common to All)** | | | | | |
| Course Code | : | **B24BEK507** | CIE | : | 50 Marks |
| Teaching Hours L : T : P : S | : | 2:0:0:2 | SEE | : | 50 Marks |
| Total Hours | : | 30 | Total | : | 100 Marks |
| Credits | : | 2 | SEE Duration | : | 2 Hrs |

| **Course Learning Objective is** | |
|---|---|
| 1. | To familiarize the students with the basic biological concepts and their engineering applications. |
| 2. | To enable the students with an understanding of biodesign principles to create novel devices and structures. |
| 3. | To provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems. |
| 4. | To motivate the students to develop interdisciplinary vision of biological engineering. |

| **Module– 1** | **No. of Hours** |
|---|---|
| **Introduction to Biology:** The cell: the basic unit of life, Structure and functions of a cell. The Plant Cell and animal cell, Prokaryotic and Eukaryotic cell, Stem cells and their application.<br>**Biomolecules:** Properties and functions of Carbohydrates, Nucleic acids, proteins, lipids. Importance of special biomolecules; Enzymes (Classification (with one example each), Properties and functions), vitamins and hormones. | 6 |
| **Module– 2** | **No. of Hours** |
| **Application of Biomolecules:** Carbohydrates in cellulose-based water filters production, PHA and PLA in bio plastics production, Nucleic acids in vaccines and diagnosis, Proteins in food production. | 6 |
| **Module– 3** | **No. of Hours** |
| **Adaptation of Anatomical Principles for Bioengineering Design:** Brain as a CPU system. Robotic arms for prosthetics. Engineering solutions for Parkinson's disease. Eye as a Camera system, bionic eye. Heart as a pump system, pace makers, defibrillators. Lungs as purification system, Heart-lung machine. Kidney as a filtration system, dialysis systems. | 6 |
| **Module– 4** | **No. of Hours** |
| **Nature-Bioinspired Materials and Mechanisms:** Echolocation, Photosynthesis. Bird flying, Lotus leaf effect, Shark skin, Kingfisher beak. Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perflourocarbons (PFCs). | 6 |
| **Module– 5** | **No. of Hours** |
| **Trends in Bioengineering:** DNA origami and Biocomputing, Bioprinting techniques and materials. Bioimaging and Artificial Intelligence for disease diagnosis. Bioconcrete. Biomining. | 6 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Elucidate the basic biological concepts via relevant industrial applications and case studies. |
| CO2 | Evaluate the principles of design and development, for exploring novel bioengineering projects. |
| CO3 | Corroborate the concepts of biomimetics for specific requirements. |
| CO4 | Think critically towards exploring innovative biobased solutions for socially relevant problems. |

| **Text Books** | |
|---|---|
| 1. | Biology for Engineers, Rajendra Singh C and Rathnakar Rao N, Rajendra Singh C and Rathnakar Rao N Publishing, Bengaluru, 2023. |
| 2. | Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022 |

| **Web links and Video Lectures (E-Resources)** |
|---|
| • https://nptel.ac.in/courses/121106008<br>• https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists<br>https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009 |

| | |
|---|---|
| • https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006<br>• https://www.coursera.org/courses?query=biology | |
| **Activity Based Learning (Suggested Activities in Class)/ Practical Based learning** | |
| 1. | Group Discussion of Case studies. |
| 2. | Model Making and seminar/poster presentations. |
| 3. | Design of novel device/equipment like Cellulose-based water filters, Filtration system. |

**ASSESSMENT DETAILS (BOTH CIE AND SEE)**

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks. To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.

## CONTINUOUS INTERNAL EVALUATION (CIE):

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Theory** | **Internal Assessment1** | **50** | **30** | **50** |
| | **Internal Assessment2** | **50** | **(Average of Best two** | |
| | **Internal Assessment3** | **50** | **Assessments)** | |
| **AAT** | **Any Two Assessments as per Regulations** | **20** | **20** | |
| **SEE** | **Semester End Examination** | **50** | **50** | **50** |
| **Total Marks** | | | | **100** |

## SEMESTER END EXAMINATION (SEE):

1. The Question paper shall be set for 50 marks and duration of SEE is 2 Hours.
2. Two questions of 10 marks ( with minimum two sub questions) from each module with internal choice.
3. Students should answer five full questions, selecting one full question from each module.
4. Mention COs, POs, Bloom's Taxonomy levels in the question paper.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO8 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | - | - | - | - | 1 | 1 | - | 1 | 1 | 1 |
| CO2 | 1 | - | - | - | - | 1 | - | 1 | - | 1 | 1 |
| CO3 | 1 | - | - | - | - | 1 | - | 1 | - | 1 | 1 |
| CO4 | 1 | - | - | - | - | 1 | 2 | - | 2 | 1 | 1 |
| CO5 | 1 | - | - | - | - | 1 | 2 | 2 | 1 | 2 | 1 |

Level 3 - High, Level 2 - Moderate, Level 1 - Low

| Semester-V | | | | | |
|---|---|---|---|---|---|
| **Environmental Science and E-Waste Management**<br>**Category: NCMC**<br>**(Common to All)** | | | | | |
| Course Code | : | **B24ESK510** | CIE | : | 100 Marks |
| Teaching Hours L : T : P : S | : | 2:0:0:0 | SEE | : | - |
| Total Hours/Semester | : | 30 | Total | : | 100 Marks |
| Credits | : | PP | SEE Duration | : | - |

| **Course Learning Objective is** | |
|---|---|
| 1. | To identify the major challenges of environment issues. |
| 2. | To develop skills, critical thinking and demonstrate socio-economic skills for Environmental protection. |
| 3. | To analyze the impact of issues w. r. t. waste management. |

| **Module– 1** | **No. of Hours** |
|---|---|
| **Ecosystem and Sustainability:** Ecosystems: Structure of Ecosystem, Types: Forest, Desert, Wetlands, Riverine, Oceanic ecosystems.<br>**Sustainability:** 17SDG targets and possible actions. | 6 |
| **Module– 2** | **No. of Hours** |
| **Natural Resources and Energy:** Natural Resources: Water resources-Availability & Quality aspects, Water borne diseases & water induced diseases, Fluoride problem in drinking water.<br>**Energy:** Different types of energy, Conventional sources & Non-Conventional sources of energy, solar energy. Wind energy, Hydrogen as an alternative energy. | 6 |
| **Module– 3** | **No. of Hours** |
| **Environmental Pollution:** Water Pollution, Noise pollution, Air pollution (Sources, Impacts, Preventive measures and public Health Aspects.<br>**Global Environmental Concerns (Concept, policies and case-studies):** Ground water depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problem in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology. | 6 |
| **Module– 4** | **No. of Hours** |
| **Waste management:** Solid Waste Management, types and sources, functional elements of SWM, Biomedical Waste Management-Sources, Characteristics.<br>**Environmental Legislation:** Solid Waste Management Rules, 2016, Biomedical Waste Management Rules, 2016. | 6 |
| **Module– 5** | **No. of Hours** |
| **E-Waste Management:** E-waste; composition and generation. Global context in e-waste; E-Waste pollutants, E-waste hazardous properties, Effects of pollutant (E-waste) on human health and surrounding environment, domestic e-waste disposal, Basic principles of E waste management, Component of E Waste management.<br>E-waste (Management and Handling) Rules, 2011; and E-waste (Management) Rules, 2022-Salient Features and its implications. | 6 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | Comprehend the principles of ecology and environmental issues pertaining to air, land and water on a global scale. |
| CO2 | Acquire observation skills for solving problems related to the environment. |
| CO3 | Conduct survey to describe the realities of waste management system. |

| **Text Books** | |
|---|---|
| 1. | S M Prakash, "Environmental Studies" 3rd Edition, Elite Publishing House, Mangalore, 2018. |
| 2. | Hester R.E., and Harrison R.M, Electronic Waste Management. Science, 2009. |

| **Reference Text Books** | |
|---|---|
| 1. | Benny Joseph (2005), "Environmental Studies" , Tata McGraw – Hill Publishing Company Limited. |
| 2. | Johri R., E-waste: implications, regulations, and management in India and current global best practices, TERI Press, New Delhi. |

| Web links and Video Lectures (e-Resources): | |
|---|---|
| 1. | https://www.youtube.com/playlist?list=PLXTQoJ3yDR1Tp9O8R7RZGmm_GdheHqM2w |
| 3. | https://sdgs.un.org/goals |
| 4. | https://kspcb.karnataka.gov.in/waste-management/biomedical-waste |
| 5. | E Waste (Management) Rules, 2022: https://kspcb.karnataka.gov.in/sites/default/files/inlinefiles/ E%20Waste%20%28Management%29%20Rules%2C%202022.pdf |

**ASSESSMENT DETAILS (CIE only)**

The weightage of Continuous Internal Evaluation (CIE) is 100%. The minimum passing mark for the CIE is 40% of the maximum marks (40 marks out of 100).

**CONTINUOUS INTERNAL EVALUATION (MCQs)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Theory** | **Internal Assessment-1** | **50** | **50 (Average of Best two Assessments)** | **100** |
| | **Internal Assessment-2** | **50** | | |
| | **Internal Assessment-3** | **50** | | |
| **AAT** | **Two Assessments as per Regulations** | **50** | **50** | |
| **Total Marks** | | | | **100** |

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 0 | 0 | 0 | 0 | 3 | 2 | 0 | 0 | 0 | 0 |
| CO2 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| CO3 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 2 |

Level 3 - High, Level 2 - Moderate, Level 1 - Low

| Semester-V | | | | | |
|---|---|---|---|---|---|
| **Research Methodology & IPR (RMIPR)**<br>**Category: AEC** | | | | | |
| Course Code | : | **B24RMK606** | CIE | : | 50 Marks |
| Teaching Hours L:T: P : S | : | 1 : 0 : 0 : 3 | SEE | : | 50 Marks |
| Total Hours/Semester | : | 15 | Total | : | 100 Marks |
| Credits | : | 1 | SEE Duration | : | 1 Hours |

| **Course Learning Objective is** | |
|---|---|
| 1. | To understand the fundamentals of research, types of research methodologies, and ethical practices involved in engineering research. |
| 2. | To develop the ability to conduct effective literature review, technical reading, and identify research gaps for problem formulation. |
| 3. | To design research methodologies, apply appropriate sampling techniques, and perform data collection and hypothesis testing. |
| 4. | To analyze, interpret, and present research findings through structured technical reports and research papers using standard tools and formats. |
| 5. | To understand Intellectual Property Rights (IPR), patenting processes, and their role in innovation, society, and sustainable development. |

| **Module – 1** | **No. of Hours** |
|---|---|
| **Introduction to Research & Research Methodology:** Meaning, Objectives of Engg. Research & Characteristics of good research, Research Methods v/s Research Methodology, Types of engineering research, Descriptive v/s Analytical, Applied v/s Fundamental, Quantitative v/s Qualitative, Conceptual v/s Empirical, Research, Criteria of good research, Developing a research plan, Ethics & plagiarism in Engineering Research with Research Practice for different types of Research Misconducts, Case Study and Practice Sessions | 3 |
| **Module – 2** | **No. of Hours** |
| **Literature Review and Technical Reading:** What is literature review or survey, New & Existing Knowledge, Bibliographic Databases, Search Engines, Google & Google Scholar, Effective Search, Conceptualizing Research Reviews, Gaps in research, Critical and Creative Reading, Taking Notes While Reading, Defining research problems, Datasheets, Importance of literature review in defining a problem, Primary and secondary sources of info - Review articles, treatise, monographs, papers from conferences & journals, case-studies, reports, patents, web and net searching ; Identifying gap areas from literature review, Citations, Acknowledgments, Case Studies and Practice sessions. | 3 |
| **Module – 3** | **No. of Hours** |
| **Research Design and Methods:** Research design, Basic Principles, Need for research design, Features of good design, Development of Models, Developing a research plan, Exploration, Description, Diagnosis, Simulation and Experimentations, Determining experimental and sample designs, Sampling design, Steps in sampling design, Characteristics of a good sample design, Types of sample designs, Measurement and scaling techniques, Methods of data collection, Collection of primary & secondary data, Data collection instruments, Hypothesis - Basic Concepts, Testing of hypotheses, flow diagram for hypotheses testing, Case Study and Practice Sessions. | 3 |
| **Module – 4** | **No. of Hours** |
| **Technical Report & Paper Writing:** Interpretation and report writing, Techniques of interpretations, Structure and components of scientific reports, Different steps in the report preparation – Layout, organization, structure and language of the report, Illustrations and tables with result analysis (simulation or experimentation), Types of reports, technical reports, project reports (mini & major) and research thesis, Research tools for writing, Conclusions, Future works, Flow of a research article, Research paper writing for conference & journals, text-books, Case Study and Practice Sessions. | 3 |
| **Module – 5** | **No. of Hours** |
| **IPRs & Copyrights:** Intellectual Property, what are patents & copyrights in IP? Role of IP in the Economic and Cultural Development of the Society, IP Governance, Invention and Creativity, Importance and Protection of Intellectual Property Rights (IPRs), A brief summary of - Patents, Monographs, Copyrights ©, Registered Firms ®, Trademarks ™, Industrial Designs (Design Patent, | 3 |

| | |
|---|---|
| Utility Patent, Granted Patent, Commercialized Patent) – Indian &Foreign Patents, Steps in Patenting — Application and Procedures with Searches, Case Study and Practice Sessions. | |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| **CO1** | Explain research fundamentals, methodologies, and ethical practices in engineering research. |
| **CO2** | Perform literature review, identify research gaps, and formulate research problems. |
| **CO3** | Design research experiments, collect data, and apply hypothesis testing methods. |
| **CO4** | Analyze results and prepare technical reports and research papers. |
| **CO5** | Apply IPR concepts including patents, copyrights, and trademarks in research and innovation. |

**Research Papers & Technical References (Web-links & Video Resources)**

- IEEE Xplore – https://ieeexplore.ieee.org
- Scopus – https://www.scopus.com
- Science Direct – https://www.sciencedirect.com
- Google Scholar – https://scholar.google.com
- Research Gate – https://www.researchgate.net

**ASSESSMENT DETAILS (BOTH CIE AND SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CONTINUOUS INTERNAL EVALUATION (MCQs)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| Theory | Internal Assessment-1 | 50 | 30 (Average of Best two Assessments) | 50 |
| | Internal Assessment-2 | 50 | | |
| | Internal Assessment-3 | 50 | | |
| AAT | Two Assessments as per regulations | 20 | 20 | |
| SEE | Semester End Examination | 50 | | 50 |
| Total Marks | | | | 100 |

**SEMESTER END EXAMINATION (SEE)**

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | 1 | - | - | 2 | - | - | - | 2 |
| **CO2** | 3 | 3 | - | 2 | 1 | - | 1 | 1 | 1 | - | 2 |
| **CO3** | 2 | 3 | 3 | 3 | 2 | - | 1 | 2 | - | - | 2 |
| **CO4** | 2 | 2 | 3 | 3 | 3 | - | 1 | 2 | 3 | 1 | 2 |
| **CO5** | 1 | 1 | - | - | 1 | 3 | 3 | 1 | 2 | 2 | 2 |

L = Low (**1**), M = Medium (**2**), H = High (**3**) - Blank = No significant mapping correlation levels

| Semester - VI | | | | | |
|---|---|---|---|---|---|
| **Capstone Project Work: Phase - I**<br>**Category: SDC** | | | | | |
| Course Code | : | **B24PRJ607** | CIE | : | 100 Marks |
| Teaching Hours L:T:P:S | : | 0:0:4:0 | SEE | : | - |
| Total Hours | : | 60 | Total | : | 100 Marks |
| Credits | : | 2 | SEE Duration | : | - |

## Capstone Project: Phase -I and Phase - II

The Capstone project is a comprehensive, year-long project carried out in two phases during **6th and 7th** semesters of the undergraduate program. It integrates knowledge and skills acquired from multiple courses and disciplines to address a complex, real-world problem.

This project provides students with an opportunity to apply scientific principles, engineering methodologies, and technological tools to conceive, design, implement and evaluate an engineering solution.

It serves as a culminating academic experience to demonstrate program outcomes, including problem-solving ability, teamwork, communication skills, and practical application of engineering principles. Students can take up project individually or in a group not exceeding 4 students. The group may have students from the same discipline and drawn from different disciplines.

**Types of Capstone Projects**: Capstone projects undertaken for one year may fall into one or more of the following categories:

a) Research-Oriented Projects :
   • Focus on investigating new concepts, theories, or technologies.
   • Aim to generate new knowledge or contribute to academic research.

b) Experimental/Analytical Projects
   • Based on laboratory or field experiments to validate a hypothesis or study a phenomenon.
   Simulation/ Modelling Projects
   • Including detailed data collection, analysis, and interpretation.
   • Use computational tools to model, simulate, and predict system behavior.
   • Reduce the need for physical prototyping in the initial stages.

c) Industrial/Industry-Sponsored Projects
   • Carried out in collaboration with an industry partner.
   • Address real-world engineering problems faced by the organization.

d) Interdisciplinary/Multidisciplinary Projects
   • Combine knowledge and techniques from multiple engineering domains or other fields such as management, medicine, or environmental sciences.

e) Entrepreneurial/Innovation Projects
   • Focus on product or service innovation with potential for commercialization.

- Phase I Evaluation: Capstone Project Phase-I shall have only Continuous Internal Evaluation (CIE).
- In case disciplinary capstone project, the CIE shall be conducted by the Departmental Project Review Committee, which consists of a Senior Professor, the Project Guide, and one additional faculty member appointed by the principal for projects within the parent discipline.
- For Interdisciplinary Projects, the Project Review Committee will consist of one Senior Professor, the department and interdepartmental Project Guides and one faculty member from a department related to the interdisciplinary project. The committee members are appointed by the principal of the college.
- Phase I evaluation shall be based on rubrics designed to measure graduate attributes defined by NBA. Successful completion of Phase-I allows the student to proceed to Phase-II.
- Phase II Evaluation: CIE of Phase shall be evaluated as indicated with phase -I evaluation. The SEE shall be conducted by two examiners. The assessment shall be based on rubrics designed to measure graduate attributes.

| **Review #** | **Agenda** | **Assessment** | **Review Assessment Weightage** |
|---|---|---|---|
| **Review1** | Project Synopsis / Proposal Evaluation | Rubric R1 | 15 |
| **Review2** | Mid-Term Project Evaluation | Rubric R2 | 30 |
| **Review3** | End Semester Project Evaluation | Rubric R3 | 30 |
| **Review4** | Project Report Evaluation | Rubric R4 | 15 |
| **Review5** | Evaluation by Guide | Rubric R5 | 10 |
| **Continuous Internal Evaluation (CIE)** | | | 100 |
| **Total Marks** | | | 100 |

## Rubric #R1: Project Synopsis / Proposal Evaluation Maximum Marks: 15

| | | Excellent (5 Marks) | Good (4 Marks) | Average (3 Marks) | Acceptable (2 Marks) | Unacceptable (1 Marks) |
|---|---|---|---|---|---|---|
| a | **Identification of Problem Domain and Detailed Analysis** | Detailed and extensive explanation of the purpose and need of the project | Good explanation of the purpose and need of the project | Average explanation of the purpose and need of the project | Moderate explanation of the purpose and need of the project | Minimal explanation of the purpose and need of the project |
| b | **Study of the Existing Systems and Feasibility of Project Proposal** | Detailed and extensive explanation of the specifications and the limitations of the existing systems | Collects a great deal of information and good study of the existing systems | Moderate study of the existing systems; collects some basic information | Explanation of the specifications and the limitations of the existing systems not very satisfactory; limited information | Minimal explanation of the specifications and the limitations of the existing systems; incomplete information |
| c | **Objectives and Methodology of the Proposed Work** | All objectives of the proposed work are well defined; Steps to be followed to solve the defined problem are clearly specified | Good justification to the objectives; Methodology to be followed is specified but detailing is not done | Incomplete justification to the objectives proposed; Steps are mentioned but unclear; without justification to objectives | Only Some objectives of the proposed work are well defined; Steps to be followed to solve the defined problem are not specified properly | Objectives of the proposed work are either not identified or not well defined; Incomplete and improper specification |

## Rubric #R2: Mid-term Project Evaluation Maximum Marks: 30

| | | Level of Achievement | | | | |
|---|---|---|---|---|---|---|
| | | **Excellent(10)** | **Good (8)** | **Average(6)** | **Acceptable(4)** | **Unacceptable (2)** |
| a | **Design Methodology** | • Division of problem in to modules and good selection of computing framework.<br>• Appropriate design methodology and properly justification. | • Division of problem into modules and good selection of computing frame work.<br>• Design methodology not properly justified. | • Division of problem into modules but in appropriate selection of computing framework.<br>• Design methodology not defined properly. | • Partial division of problem into modules and inappropriate selection of computing framework.<br>• Design methodology not defined properly. | • Modular approach not adopted.<br>• Design methodology not defined. |
| b | **Planning of Project Work and Team Structure** | • Time frame properly specified and being followed.<br>• Appropriate distribution of project work. | • Time frame properly specified and being followed.<br>• Distribution of project work inappropriate. | • Time frame properly specified, but not being followed.<br>• Distribution of project work un-even. | • Time frame properly specified, but not being followed.<br>• Un-even distribution of Project work and no synchronization. | • Time frame not properly specified.<br>• In-appropriate distribution of project work. |

| | | | | | | |
|---|---|---|---|---|---|---|
| c | **Demonstration and Presentation** | • Objectives achieved as per time frame.<br>• Contents of presentations are appropriate and well arranged.<br>• Proper eye contact with audience and clear voice with good spoken language. | • Objectives achieved as per time frame<br>• Contents of presentations are appropriate but not well arranged<br>Satisfactory demonstration, clear voice with good spoken language but eye contact not proper | • Objectives achieved as per time frame.<br>• Contents of presentations are appropriate but not well arranged.<br>• Presentation not satisfactory and average demonstration | • Objectives not achieved as per time frame.<br>• Contents of presentations are not appropriate.<br>• Eye contact with few people and unclear voice. | • No objectives achieved.<br>• Contents of Presentations are not appropriate and not well delivered.<br>• Poor delivery of presentation. |

## Rubric #R3: End Semester Internal Project Evaluation Maximum Marks: 30

| | | Excellent(10) | Good (8) | Average(6) | Acceptable(4) | Unacceptable (2) |
|---|---|---|---|---|---|---|
| a | **Incorporation of Suggestions** | Changes are made as per modifications suggested during midterm evaluation and new innovations added | Changes are made as per modifications suggested during mid-term evaluation and good justification | All major changes are made as per modifications suggested during midterm evaluation | Few changes are made as per modifications suggested during midterm evaluation | Suggestions during mid-term evaluation are not incorporated |
| b | **Project Demonstration** | • All defined objectives are achieved.<br>• Each module working well and properly demonstrated.<br>• All modules of project are well integrated and system working is accurate. | • All defined objectives are achieved.<br>• Each module working well and properly demonstrated.<br>• Integration of all modules not done and system working is not very satisfactory. | • All defined objectives are achieved.<br>• Modules are working well in isolation and properly demonstrated.<br>• Modules of project are not properly integrated. | • Some of the defined objectives are achieved.<br>• Modules are working well in isolation and properly demonstrated<br>• Modules of project are not properly integrated. | • Defined objectives are not achieved.<br>• Modules are not in proper working form that further leads to failure of integrated system. |
| c | **Presentation** | • Contents of presentations are appropriate and well delivered.<br>• Proper eye contact with audience and clear voice with good spoken language | • Contents of presentations are appropriate and well delivered.<br>• Clear voice with good spoken language but less eye contact with audience | • Contents of presentations are appropriate but not well delivered .<br>• Eye contact with few people and unclear voice | • Contents of presentations are not appropriate.<br>• Eye contact with few people and unclear voice | • Contents of presentations are not appropriate and not well delivered .<br>• Poor delivery of presentation |

## Rubric #R4: Project Report Evaluation Maximum Marks: 15

| Level of Achievement | | | | | | |
|---|---|---|---|---|---|---|
| | | **Excellent(5)** | **Good (4)** | **Average(3)** | **Acceptable(2)** | **Unacceptable (1)** |
| **a** | **Project Report** | • Project report is according to the specified format.<br>• References and citations are appropriate and well mentioned. | • Project report is according to the specified format.<br>• References and citations are appropriate but not mentioned well. | • Project report is according to the specified format but some mistakes.<br>• In-sufficient references and citations. | • Project report is not fully according to the specified format.<br>• In-sufficient references and citations | • Project report not prepared according to the specified format.<br>• References and citations are not appropriate |
| **b** | **Description of Concepts and Technical Details** | • Complete explanation of the key concepts.<br>• Strong description of the technical requirements of the project. | • Complete explanation of the key concepts.<br>• In-sufficient description of the technical requirements of the project. | • Complete explanation of the key concepts but little relevance to literature.<br>• In-sufficient description of the technical requirements of the project. | • All key concepts are not explained and very little relevant to literature.<br>• In-sufficient description of the technical requirements of the Project. | • Inappropriate explanation of the key concepts.<br>• Poor description of the technical requirements of the project. |
| **c** | **Conclusion and Discussion** | • Results are presented in very appropriate manner<br>• Project work is well summarized and concluded.<br>• Future extensions in the project are well specified. | • Results are presented in good manner.<br>• Project work summary and conclusion not very appropriate.<br>• Future extensions in the project are specified. | • Results presented are not much Satisfactory.<br>• Project work summary and conclusion not very appropriate.<br>• Future extensions in the project are specified. | • Results presented are not much satisfactory.<br>• Project work summary and conclusion not very appropriate.<br>• Future extensions in the project are not specified. | • Results are not presented properly.<br>• Project work is not summarized and concluded.<br>• Future extensions in the project are not specified. |

## Rubric #R5: Evaluation by Guide Maximum Marks: 10

| Level of Achievement | | | | |
|---|---|---|---|---|
| | | **Excellent (5)** | **Satisfactory(3)** | **Unsatisfactory(2)** |
| **a** | **Self-Motivation, Determination and Regularity** | • Approaches the project with self-motivation and follows it through to completion.<br>• Reports to the guide regularly and consistent in work. | • Completes the project but sometimes lacks self-motivation.<br>• Reports to the guide but lacks consistency | • Lacks self-motivation and determination.<br>• Irregular in attendance and in consistent in work. |
| **b** | **Working with in a Team & Technical Knowledge and Awareness related to the Project** | • Collaborates and communicates in a group situation and integrates the views of others.<br>• Extensive knowledge related to the project. | • Exchanges some views but requires guidance to collaborate with others.<br>• Fair knowledge related to the project | • Makes little or no attempt to collaborate in a group situation.<br>• Lack sufficient knowledge. |

| Semester-VI | | | | | |
|---|---|---|---|---|---|
| **Indian Knowledge Systems**<br>**Category: HSMC**<br>**(Common to All)** | | | | | |
| Course Code | : | **B24IKK610** | CIE | : | 100 Marks |
| Teaching Hours L:T:P:S | : | 2:0:0:0 | SEE | : | - |
| Total Hours/Semester | : | 30 | Total | : | 100 Marks |
| Credits | : | PP | SEE Duration | : | - |

| **Course Learning Objective is** | |
|---|---|
| 1. | To Understand the knowledge on basics of research and its types. |
| 2. | To Learn the concept of Literature Review, Technical Reading, Attributions and Citations. |
| 3. | To learn Ethics in Engineering Research. |
| 4. | To Discuss the concepts of Intellectual Property Rights in engineering. |

| **Module– 1** | **No. of Hours** |
|---|---|
| **Introduction:** Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research, Finding and Solving a Worthwhile Problem.<br>Ethics in Engineering Research, Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship. | 6 |
| **Module– 2** | **No. of Hours** |
| **Literature Review and Technical Reading:** New and Existing Knowledge, Analysis and Synthesis of Prior Art Bibliographic Databases, Web of Science, Google and Google Scholar, Effective Search: The Way Forward Introduction to Technical Reading Conceptualizing Research, Critical and Creative Reading, Taking Notes While Reading, Reading Mathematics and Algorithms, Reading a Datasheet.<br>**Attributions and Citations:** Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions, What Should Be Acknowledged, Acknowledgments in, Books Dissertations, Dedication or Acknowledgments. | 6 |
| **Module– 3** | **No. of Hours** |
| **Introduction To Intellectual Property:** Role of IP in the Economic and Cultural Development of the Society, IP Governance, IP as a Global Indicator of Innovation, Origin of IP History of IP in India. Major Amendments in IP Laws and Acts in India.<br>**Patents:** Conditions for Obtaining a Patent Protection, To Patent or Not to Patent an Invention. Rights Associated with Patents. Enforcement of Patent Rights. Inventions Eligible for Patenting. Non-Patentable Matters. Patent Infringements. Avoid Public Disclosure of an Invention before Patenting. Process of Patenting.<br>**Process of Patenting:** Prior Art Search. Choice of Application to be Filed. Patent Application Forms. Jurisdiction of Filing Patent Application. Publication. Pre-grant Opposition. Examination. Grant of a Patent. Validity of Patent Protection. Post-grant Opposition. Commercialization of a Patent. Need for a Patent Attorney/Agent. Can a Worldwide Patent be Obtained? Do I Need First to File a Patent in India? Patent Related Forms. Fee Structure. Types of Patent Applications. Commonly Used Terms in Patenting. National Bodies Dealing with Patent Affairs. Utility Models. | 6 |
| **Module– 4** | **No. of Hours** |
| **Copyrights and Related Rights:** Classes of Copyrights. Criteria for Copyright. Ownership of Copyright. Copyrights of the Author. Copyright Infringements. Copyright Infringement is a Criminal Offence. Copyright Infringement is a Cognizable Offence. Fair Use Doctrine. Copyrights and Internet. Non-Copyright Work. Copyright Registration. Judicial Powers of the Registrar of Copyrights. Fee Structure. Copyright Symbol. Validity of Copyright. Copyright Profile of India. Copyright and the word 'Publish'. Transfer of Copyrights to a Publisher. Copyrights and the Word 'Adaptation'. Copyrights and the Word 'Indian Work'. Joint Authorship. Copyright Society. Copyright Board. Copyright Enforcement Advisory Council (CEAC). International Copyright Agreements, Conventions and Treaties. Interesting Copyrights Cases.<br>**Trademarks:** Eligibility Criteria. Who Can Apply for a Strademark? Acts and Laws. | 6 |

| | |
|---|---|
| Designation of Trademark Symbols. Classification of Trademarks. Registration of a Trademark is Not Compulsory. Validity of Trademark. Types of Trademark Registered in India. Trademark Registry. Process for Trademarks Registration. Prior Art Search. Famous Case Law: Coca-Cola Company v/s. Bisleri International Pvt. Ltd. | |
| **Module– 5** | **No. of Hours** |
| **Industrial Designs:** Eligibility Criteria. Acts and Laws to Govern Industrial Designs. Design Rights. Enforcement of Design Rights. Non-Protectable Industrial Designs India. Protection Term. Procedure for Registration of Industrial Designs. Prior Art Search. Application for Registration. Duration of the Registration of a Design. Importance of Design Registration. Cancellation of the Registered Design. Application Forms. Classification of Industrial Designs. Designs Registration Trend in India. International Treaties. Famous Case Law: Apple Inc. vs. Samsung Electronics Co.<br>**Geographical Indications:** Acts, Laws and Rules Pertaining to GI. Ownership of GI. Rights Granted to the Holders. Registered GI in India. Identification of Registered GI. Classes of GI. Non-Registerable GI. Protection of GI. Collective or Certification Marks. Enforcement of GI Rights. Procedure for GI Registration Documents Required for GI Registration. GI Ecosystem in India.<br>**Case Studies on Patents.** Case study of Curcuma (Turmeric) Patent, Case study of Neem Patent, Case study of Basmati patent. **IP Organizations In India. Schemes and Programmes** | 6 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
|---|---|
| CO1 | To know the meaning of engineering research. |
| CO2 | To know the procedure of the literature Review and Technical Reading. |
| CO3 | To understand the fundamentals of the patent laws and drafting procedure. |
| CO4 | Understanding the copyright laws and subject matters of copyrights and designs. |
| CO5 | Understanding the basic principles of design rights. |

| **Text Books** | |
|---|---|
| 1. | Dr. Santosh M Nejakar, Dr. Harish Bendigeri "Research Methodology and Intellectual Property Rights", ISBN 978-93-5987-928-4, Edition: 2023-24. |
| **Reference Text Books** | |
| 1. | David V. Thiel "Research Methods for Engineers" Cambridge University Press, 978-1-107-03488-4 |
| 2. | Intellectual Property Rights by N.K.Acharya Asia Law House 6th Edition. ISBN: 978-93-81849-30-9 |

**ASSESSMENT DETAILS (CIE only)**
The weightage of Continuous Internal Evaluation (CIE) is 100%. The minimum passing mark for the CIE is 40% of the maximum marks (40 marks out of 50).

**CONTINUOUS INTERNAL EVALUATION (MCQs)**

| CIE | Type of Assessment | Max. Marks | Max. Marks Scaling Down to | Total Marks |
|---|---|---|---|---|
| **Theory** | **Internal Assessment-1** | **50** | **30 (Average of Best two Assessments)** | **50** |
| | **Internal Assessment-2** | **50** | | |
| | **Internal Assessment-3** | **50** | | |
| **AAT** | **Two Assessments as per regulations** | **20** | **20** | |
| **SEE** | **Semester End Examination** | **50** | **50** | **50** |
| **Total Marks** | | | | **100** |

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 0 | 0 | 0 | 0 | 3 | 2 | 0 | 0 | 0 | 0 |
| CO2 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| CO3 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 2 |

Level 3 - High, Level 2 - Moderate, Level 1 - Low

| SEMESTER-V & VI | | | | | |
|---|---|---|---|---|---|
| **NATIONAL SERVICE SCHEME (NSS)**<br>**Category: NCMC** | | | | | |
| Course Code | : | B24NCK591/691 | CIE | : | 100 Marks |
| Teaching Hours L : T : P | : | 1:0:0 | SEE | : | --- |
| Total Hours | : | 50 | Total | : | 100 Marks |
| Credits | : | -- | SEE Duration | : | -- |

| **Course Objectives** | |
|---|---|
| 1. | Understand the community in which they work |
| 2. | Identify the needs and problems of the community and involve the min problem-solving |
| 3. | Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems |
| 4. | Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes |
| 5. | Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony |

| **CONTENT** | **No. of Hours** |
|---|---|
| 1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.<br>2. Waste management–Public, Private and Govt. organization.<br>3. Setting of the information imparting club for women leading to contribution in social and economic issues.<br>4. Water conservation techniques–Role of different take holders–Implementation.<br>5. Preparing an actionable business proposal for enhancing the village income and approach for implementation.<br>6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.<br>7. Developing Sustainable Water management system for rural areas and implementation approaches.<br>8. Contribution to any national level initiative of Government of India.Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.<br>9. Spreading public awareness under rural outreach programs.(minimum 5 programs).<br>10. Social connect and responsibilities.<br>11. Plantation and adoption of plants. Know your plants.<br>12. Organize National integration and social harmony events/ workshops / seminars. (Minimum 02 programs).<br>13. Govt. school Rejuvenation and helping them to achieve good infrastructure.<br>**NOTE:**<br>Students have to take up any one activity on the above said topics and have to prepare content for awareness and technical contents for implementation of the projects and have to present strategies for implementation of the same. Compulsorily students have to attend one camp.<br>CIE will be evaluated based on their presentation, approach and implementation strategies. | 50 |

| **Course Outcomes:** After completing the course, the students will be able to | |
|---|---|
| CO1 | Understand the importance of his/her responsibilities towards society. |
| CO2 | Analyze the environmental and societal problems/issues and will be able to design solutions for the same. |
| CO3 | Evaluate the existing system and to propose practical solutions for the same for sustainable development. |
| CO4 | Implement government or self-driven projects effectively in the field. |

**CO-PO Mapping**

| PO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | - | - | 3 | - | - | - | - | - | - |
| CO2 | 3 | 2 | - | - | 3 | - | - | - | - | - | - |
| CO3 | 3 | 2 | - | - | 3 | - | - | - | - | - | - |
| CO4 | 3 | 2 | - | - | 3 | - | - | - | - | - | - |

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped

| SEMESTER-V & VI<br>NATIONAL CADET CORPS (NCC)<br>Category: NCMC | | | | | |
|---|---|---|---|---|---|
| Course Code | : | B24NCK592/692 | CIE | : | 100 Marks |
| Teaching Hours L : T : P | : | 1:0:0 | SEE | : | -- |
| Total Hours | : | 50 | Total | : | 100 Marks |
| Credits | : | -- | SEE Duration | : | -- |

| Course Objectives | |
|---|---|
| 1. | To develop character, camaraderie, discipline, secular outlook, the spirit of adventure, sportsman spirit, and ideals of selfless service amongst cadets by working in teams, honing qualities such as self-discipline, self-confidence, self-reliance, and dignity of labour in the cadets. |
| 2. | To create a pool of organized, trained, and motivated youth with leadership qualities from all walks of life, who will serve the Nation regardless of which career they choose |
| 3. | To provide a conducive environment to motivate young Indians to choose the Armed Forces as a career |

| Content | No. of Hours |
|---|---|
| **Unit 1. Personality Development:** Group Discussions - Change your Mindset, Public Speaking.<br><br>**Unit 2.LeadershipDevelopment:** Case Studies– APJ Abdul Kalam, DeepaMalik, Maharana Pratap, N Narayan Murthy etc.<br><br>**Unit 3. Disaster management:** Disaster Management Capsule, Organization, Types of Disasters, Essential Services, Assistance, Civil Defense Organization.<br><br>**Unit 4.Adventure:**AdventureActivities<br><br>**Unit 5. Border & Coastal Areas:** History, Geography &Topography of Border/ Coastal Areas.<br><br>**Unit 6. Drill:** Arm Drill, Rifle ke saath Savdhan, Vishram aur Aram se, Rifle ke saath Parade Paraur Saj, Riflekesaath Visarjan, LineTod, Bhumi Shastra aur Uthao Shastra, BagalShastra aur Baju Shastra.<br><br>**Unit 7.WeaponTraining**: Short Range firing.<br><br>**Unit 8.MapReading:**SettingofMap,FindingsNorthandOwnPosition<br><br>**Unit 9.Field Craft & Battle Craft:** Observation, Camouflage, Concealment.<br><br>**Unit 10. Obstacle Training:** Obstacle training - Introduction, Safety-measures, Benefits. Obstacle Course- Straight balance, Clear Jump, Gate Vault, Zig- Zag Balance, High Wall | 50 |

| SEMESTER-V & VI | | | | | |
|---|---|---|---|---|---|
| **PHYSICAL EDUCATION(PE)**<br>**Category: NCMC** | | | | | |
| Course Code | : | B24NCK593/693 | CIE | : | 100 Marks |
| Teaching Hours L : T : P | : | 1:0:0 | SEE | : | -- |
| Total Hours | : | -- | Total | : | 100 Marks |
| Credits | : | -- | SEE Duration | : | -- |

| Semester | Course |
|---|---|
| III | Fitness Components<br>Kabaddi / KhoKho |
| IV | Athletics<br>Volleyball<br>Throw ball |
| V | Athletics<br>Football / Hockey |
| V | Athletics<br>Cricket / Base ball |
| VI | Athletics<br>Netball / Basketball |
| VI | Individual Games<br>Handball / Badminton |

**Notes:**

- One Hour of Lecture is equal to 1 Credit
- One Hour of Tutorial is equal to1 Credit (Except Languages)
- Two Hours of Practical is equal to 1 Credit
- SEE: Semester End Examination
- CIE: Continuous Internal Examination
- L+T+P: Lecture + Tutorial + Practical

## Guideline for Athletic and Sports

| Semester & Course Code | Course Title | Content | No. of Hours |
|---|---|---|---|
| 3rd Semester<br><br>B24NCK393 | **Fitness Components**<br><br>Speed<br>Strength<br>Endurance<br>Agility<br>Flexibility | Meaning and Importance, Fit India Movement, Definition of fitness, Components of fitness, Benefits of fitness, Types of fitness and Fitness tips.<br>***Practical Components: Speed, Strength, Endurance, Flexibility, and Agility***<br>**KABADDI**<br>**A. Fundamental skills**<br>➢ Skills in Raiding: Touching with hands, Use of leg-toe touch, squat leg thrust, side kick, mule kick, arrow fly kick, crossing of baulk line. Crossing of Bonus line.<br>➢ Skills of holding the raider: Various formations, catching from particular position, different catches, catching formation and techniques.<br>➢ Additional skills in raiding: Escaping from various holds, techniques of escaping from chain formation, offense and defense.<br>➢ Game practice with application of Rules and Regulations.<br>**B. Rules and their interpretations and duties of the officials.** | Total-32 hours<br>2 hours / week |
| | Kho kho | **A. Fundamental skills**<br>➢ Skills in Chasing: Sit on the box (Parallel & Bullet toe method), Get up from the box (Proximal & Distal foot method), Give Kho (Simple, Early, Late & Judgment), Pole Turn, Pole Dive, Tapping, Hammering, Rectification of foul.<br>➢ Skills in running: Chain Play, Ring play and Chain & Ring mixed play.<br>➢ Game practice with application of Rules and Regulations.<br>**B. Rules and their interpretations and duties of the officials.** | |
| | Kabaddi | **A. Fundamental skills**<br>1. Skills in Raiding: Touching with hands, Use of leg-toe touch, squat leg thrust, side kick, mule kick, arrow fly kick, crossing of baulk line. Crossing of Bonus line.<br>2. Skills of holding the raider: Various formations, catching from particular position, different catches, catching formation and techniques.<br>3. Additional skills in raiding: Escaping from various holds, techniques of escaping from chain formation, offense and defense.<br>4. Game practice with application of Rules and Regulations.<br>**B. Rules and their interpretations and duties of the officials** | |

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| **4th Semester**<br><br>**B24NCK493** | **Athletics**<br>**Track-**Sprints<br>**Jumps-**Long Jump<br>**Throws-**Shot Put | **Track Events**<br>➢ Starting Techniques: Standing start and Crouch start (its variations) use of Starting Block.<br>➢ Acceleration with proper running techniques.<br>➢ Finishing technique: Run Through, Forward Lunging and Shoulder Shrug.<br>**Long Jump**: Approach Run, Take-off, Flight in the air (Hang Style / Hitch Kick) and Landing<br>**Shot put:** Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique) | Total-32 hours<br>2 hours / week |
| | Volleyball | **A. Fundamental skills**<br>Service: Under arm service, Side arm service, Tennis service, Floating service.<br>Pass: Under arm pass, Over head pass.<br>Spiking and Blocking.<br>Game practice with application of Rules and Regulations<br>**B. Rules and their interpretation and duties of officials.** | |
| | Throw ball | **A. Fundamental skills**<br>Overhand service, Side arm service, two hand catching, one hand overhead return, side arm return.<br>**B. Rules and their interpretations and duties of officials** | |

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| **5th Semester**<br><br>**B24NCK593** | **<u>Athletics</u>**<br>**Track-11**0&400 Meters Hurdles<br>**Jumps-**High Jump<br>**Throws-**Discuss Throw | **110 Meters and 400 Meters:**<br>Hurdling Technique: Lead leg Technique, Trail leg Technique, Side Hurdling, Over the Hurdles<br>Crouch start (its variations) use of Starting Block.<br>Approach to First Hurdles, In Between Hurdles, Last Hurdles to Finishing.<br>**High jump**: Approach Run, Take-off, Bar Clearance (Straddle) and Landing.<br>**Discus Throw**: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle). | |

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| **5th Semester**<br><br>**B24NCK593** | Football | **A. Fundamental Skills**<br>➢ Kicking: Kicking the ball with inside of the foot, Kicking the ball with Full Instep of the foot, Kicking the ball with Inner Instep of the foot, Kicking the ball with Outer Instep of the foot and Lofted Kick.<br>➢ Trapping: Trapping-the Rolling ball, and the Bouncing ball with sole of the foot.<br>➢ Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot.<br>➢ Heading: In standing, running and jumping condition.<br>➢ Throw-in: Standing throw-in and Running throw-in.<br>➢ Feinting: With the lower limb and upper part of the body.<br>➢ Tackling: Simple Tackling, Slide Tackling.<br>➢ Goal Keeping: Collection of Ball, Ballclearance-kicking, throwing and deflecting.<br>➢ Game practice with application of Rules and Regulations.<br>**B. Rules and their interpretation and duties of officials.** | Total-32 hours<br>2 hours / week |
| | Hockey | **A. Fundamental Skills**<br>➢ Passing: Short pass, Long pass, push pass, hit<br>➢ Trapping.<br>➢ Dribbling and Dozing.<br>➢ Penalty stroke practice.<br>➢ Penalty corner practice.<br>➢ Tackling: Simple Tackling, Slide Tackling.<br>➢ Goal Keeping, Ball clearance-kicking, and deflecting.<br>➢ Game practice with application of Rules and Regulations.<br>**B. Rules and their interpretation and duties of officials.** | |
| | **Athletics**<br>**Track**-Relays<br>**Jumps**-Triple Jump<br>**Throws**-Javelin Throw | **Relay Race**: Starting, Baton Holding / Carrying, Baton Exchange in between zone, and Finishing.<br>**Triple Jump**: Approach Run, Take-off, Flight in the Hop, Step, Jump and Landing.<br>**Javelin Throw**: Grip, Carry, and Recovery (3/5 Impulse stride).<br>Release. | Total-32 hours<br>2 hours / week |
| | **CRICKET** | **A. Fundamental Skills**<br>➢ Batting-Forward Defense Stroke, Backward Defense Stroke, Off Drive, On Drive, Straight Drive, Cover Drive, Square Cut.<br>➢ Bowling-Out-swing, In-swing, Off Break, Leg Break and Googly.<br>➢ Fielding: Catching - The High Catch, The Skim Catch, The Close Catch and throwing at the stumps from different angles. Long Barrier and Throw, Short Throw, Long Throw, Throwing on the Turn.<br>➢ Wicket Keeping<br>**B. Rules and their interpretation and duties of officials.** | |

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| | **BASEBALL** | **A. Fundamental Skills**<br>Player Stances–walking, extending walking, L stance, cat stance.<br>Grip – standard grip, choke grip.<br>Batting – swing and bunt.<br>Pitching.<br>Baseball: Slider, fast pitch, curve ball, drop ball, rise ball, change up, knuckle ball, screw ball.<br>**B. Rules and their interpretation and duties of officials.** | |

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| **6th Semester**<br><br>**B24NCK693** | **Athletics**<br>Combined Events-Heptathlon & Decathlon<br>**Jumps**- Pole Vault<br>**Throws**-Hammer Throw | Combined Events: Heptathlon all the7 events<br>Decathlon: All10Events<br>**Pole Vault**: Approach Run, Planting the Pole, Take-off, Bar Clearance and Landing.<br>**Hammer Throw**: Holding the Hammer, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle). | Total-32 hours<br>2 hours / week |
| | **Basketball** | **A. Fundamental Skills**<br>➢ Passing: Two hands Chest Pass, Two hands Bounce Pass, One hand Base ball Pass, Side arm Pass, Overhead Pass, Hook Pass.<br>➢ Receiving: Two hand receiving, one hand receiving, Receiving in stationary position, receiving while jumping and Receiving while Running.<br>➢ Dribbling: How to start dribble, drop dribble, High Dribble, Low Dribble, Reverse Dribble, Rolling Dribble.<br>➢ Shooting: Lay-up shot and its variations, one hand set shot, two hands jump shot, Hook shot, Free Throw.<br>➢ Rebounding: Defensive rebound and Offensive rebound.<br>➢ Individual Defence: Guarding the player with the ball and without the ball, pivoting.<br>➢ Game practice with application of Rules and Regulations.<br>**B. Rules and their interpretation and duties of officials.** | |
| | **Netball** | **A. Fundamental skills**<br>➢ Catching: one handed, two handed, with feet grounded and in flight.<br>➢ Throwing (Different passes and their uses): One hand passes (shoulder, high shoulder, underarm, bounce, lob), two hand passes (Push, overhead and bounce).<br>➢ Footwork: Landing on one foot, landing on two feet, Pivot, Running pass.<br>➢ Shooting: One hand, forward step shot, and back ward step shot. | |

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| | | ➢ Techniques of free dodge and sprint, sudden sprint, sprint and stop, sprinting with change at speed.<br>➢ Defending: Marking the player, marking the ball, blocking, inside the circle, outside the circle. Defending the circle edge against the passing.<br>➢ Intercepting: Pass and shot.<br>➢ Game practice with application of Rules and Regulations.<br>**B. Rules and their interpretation and duties of officials.** | |
| | **Individual games**<br>Shuttle Badminton | **A. Fundamental skills**<br>➢ Basic Knowledge: Various parts of the Racket and Grip.<br>➢ Service: Short service, Long service, Long-high service.<br>➢ Shots: Over head shot, Defensive clear shot, Attacking clear shot, Drop shot, Net shot, Smash.<br>➢ Game practice with application of Rules and Regulations.<br>**B. Rules and their interpretation and duties of officials.** | Total-32 hours<br>2 hours / week |
| | Table Tennis | **A. Fundamental skills**<br>➢ Basic Knowledge: Various parts of the Racket and Grip (Shake Hand & Pen Hold Grip).<br>➢ Stance: Alternate & Parallel.<br>➢ Push and Service: Backhand & Forehand.<br>➢ Chop: Backhand & Forehand.<br>➢ Receive: Push and Chop with both Backhand & Forehand.<br>➢ Game practice with application of Rules and Regulations.<br>**B. Rules and their interpretation and duties of officials.** | |
| | Hand ball | **A. Fundamental skills**<br>➢ Catching, Throwing and Ball control,<br>➢ Goal Throws: Jump shot, Center shot, Dive shot, Reverse shot.<br>➢ Dribbling: High and low.<br>➢ Attack and counter attack, simple counter attack, counter attack from two wings and center.<br>➢ Blocking, Goal Keeping and Defensive skills.<br>➢ Game practice with application of Rules and Regulations.<br>**B. Rules and their interpretation and duties of officials.** | |
| | Ball Badminton | **A. Fundamental skills**<br>➢ Basic Knowledge: Various parts of the Racket and Grip.<br>➢ Service: Short service, Long service, Long-high service.<br>➢ Shots: Over head shot, Defensive clear shot, Attacking clear shot, Drop shot, Net shot, Smash.<br>➢ Game practice with application of Rules and Regulations.<br>**B. Rules and their interpretation and duties of officials.** | |

**REFERENCES**

1. Saha, A. K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
2. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata.
3. Petipus, et al. Athlete's Guide to Career Planning, Human Kinetics.
4. Dharma, P. N. Fundamentals of Track and Field, Khel Sahitya Kendra, New Delhi.
5. Jain, R. Play and Learn Cricket, Khel Sahitya Kendra, New Delhi.
6. Vivek Thani, Coaching Cricket, Khel Sahitya Kendra, New Delhi.
7. Saha, A. K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
8. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata
9. Naveen Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
10. Dubey, H. C. Basketball, Discovery Publishing House, New Delhi.
11. Rachana Jain, Teach Yourself Basketball, Sports Publication.
12. Jack Nagle, Power Pattern Of fences for winning basketball, Parker Publishing Co., New York. 13 Renu Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
13. Sally Kus, Coaching Volleyball Successfully, Human Kinetics.
14. Saha, A. K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
15. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata

| SEMESTER-V & VI | | | | | |
|---|---|---|---|---|---|
| YOGA<br>Category: NCMC | | | | | |
| Course Code | : | B24NCK594/694 | CIE | : | 100 Marks |
| Teaching Hours L : T : P | : | 1:0:0 | SEE | : | -- |
| Total Hours | : | -- | Total | : | 100 Marks |
| Credits | : | -- | SEE Duration | : | -- |

| Semester | Course |
|---|---|
| III Semester | 1) Introduction of Yoga, Aim and Objectives of yoga, Prayer<br>2) Brief introduction of yogic practices for common man<br>3) Rules and regulations<br>4) Misconceptions of yoga<br>5) Suryanamaskara<br>6) Different types of Asanas<br>a. Sitting<br>b. Standing<br>c. Prone line<br>d. Supine line |
| IV Semester | 1) Patanjali's Ashtanga Yoga<br>2) Suryanamaskara<br>3) Different types of Asanas<br>a. Sitting<br>b. Standing<br>c. Prone line<br>d. Supine line<br>4) Kapalbhati<br>5) Pranayama |
| V Semester | 1) Patanjali's Ashtanga Yoga<br>2) Surya namaskara<br>3) Different types of Asanas<br>a. Sitting<br>b. Standing<br>c. Proneline<br>d. Supineline<br>4) Kapalbhati<br>5) Pranayama |

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| | 1) Patanjali's Ashtanga Yoga<br>2) Suryanamaskara<br>3) Different types of Asanas<br>a. Sitting<br>b. Standing<br>c. Prone line<br>d. Supine line<br>4) Kapalbhati<br>5) Pranayama |
| VI Semester | 1) Patanjali's Ashtanga Yoga<br>2) Suryanamaskara<br>3) Different types of Asanas<br>a. Sitting<br>b. Standing<br>c. Prone line<br>d. Supine line<br>4) Kapalbhati<br>5) Pranayama |
| | 1) Patanjali's AshtangaYoga<br>2) Suryanamaskara<br>3) Different types of Asanas<br>a. Sitting<br>b. Standing<br>c. Prone line<br>d. Supine line<br>4) Kapalbhati<br>5) Pranayama<br>6) Shat Kriyas |

**Notes:**

- One Hour of Lectureisequalto1Credit
- One Hour of Tutorial is equal to 1Credit (Except Languages)
- Two Hours of Practical is equal to 1Credit
- SEE: Semester End Examination
- CIE: Continuous Internal Examination
- L+T+P: Lecture + Tutorial + Practical

## Guidelines for Yoga Syllabus

| Semester & Course Code | Course Title | Content | No. of Hours |
|---|---|---|---|
| 3rd Semester<br><br>B24NCK394 | Introduction of Yoga, Aim and Objectives of yoga, Prayer | Yoga, its origin, history and development. Yoga, its meaning, definitions.<br>Different schools of yoga, importance of prayer | Total-32 hours<br>2 hours / week |
| | Brief introduction of yogic practices for common man | Yogic practices for common man to promote positive health | |
| | Rules and regulations | Rules to be followed during yogic practices by practitioner | |
| | Misconceptions of yoga | Yoga its misconceptions,<br>Difference between yogic and non yogic practices. | |
| | Suryanamaskara | Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar12 count, 2 rounds | |
| | Different types of Asanas<br>Sitting<br>➢ Padmasana<br>➢ Vajrasana<br>Standing<br>➢ Vrikshana<br>➢ Trikonasana<br>Prone line<br>➢ Bhujangasana<br>➢ Shalabhasana<br>Supine line<br>➢ Utthitadvipadasana<br>➢ Ardhahalasana | Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits of each asana. | |

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| **4th Semester**<br><br>**B24NCK494** | Patanjali's Ashtanga Yoga<br>➢ Yama<br>➢ Niyama | Patanjali's Ashtanga Yoga its need and importance.<br>Yama: Ahimsa, satya, asteya, brahmacarya, aparigraha.<br>Niyama: shoucha, santosh, tapa, svaadhyaya, Eshvara pranidhan | Total-32 hours<br>2 hours / week |
| | Suryanamaskara | Suryanamaskar 12 count, 4 rounds | |
| | Different types of Asanas<br>Sitting<br>➢ Sukhasana<br>➢ Paschimottanasana<br>Standing<br>➢ Ardhakati Chakrasana<br>➢ Parshva Chakrasana<br>Prone line<br>➢ Dhanurasana<br>Supine line<br>➢ Halasana<br>➢ Karna Peedasana | Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits of each asana. | |
| | Kapalabhati | Meaning, importance and benefits of Kapalabhati.<br>40 strokes/min, 3 rounds | |
| | Pranayama<br>➢ Suryanuloma–Viloma<br>➢ Chandranuloma-Viloma<br>➢ Suryabhedana<br>➢ ChandraBhedana<br>➢ Nadishodhana | Meaning, Need, importance of Pranayama. Different types. Meaning by name, technique, precautionary measures and benefits of each Pranayama | |

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| **5th Semester**<br><br>**B24NCK594** | Ashtanga Yoga<br>➢ Asana<br>➢ Pranayama | Patanjali's Ashtanga Yoga its need and importance. | Total-32 hours<br>2 hours / week |
| | Suryanamaskara | Suryanamaskar 12 count, 6 rounds | |
| | Different types of Asanas<br>Sitting<br>➢ Ardha Ushtrasana<br>➢ Vakrasana<br>Standing<br>➢ Urdhva Hastothanasana<br>➢ Hastapadasana<br>Prone line<br>➢ Padangushtha Dhanurasana<br>Supine line<br>➢ Sarvangasana<br>➢ Chakraasana | Asana, Need, importance of Asana. Different types. Asana its meaning by name, technique, precautionary measures and benefits of each asana. | |
| | Kapalabhati | Revision of practice 50 strokes/min, 3 rounds | |
| | Pranayama<br>➢ Surya Bhedana<br>➢ Ujjayi | Meaning, Need, importance of Pranayama. Different types. Meaning by name, technique, Precautionary measures and benefits of each Pranayama. | |
| | Ashtanga Yoga<br>➢ Pratyahara<br>➢ Dharana | Patanjali's Ashtanga Yoga its need and importance. | Total-32 hours<br>2 hours / week |
| | Suryanamaskara | Revisionofpractice12count, 8 rounds | |
| | Different types of Asanas<br>Sitting<br>➢ AakarnaDhanurasana<br>➢ YogamudrainPadmasana<br>Standing<br>➢ ParivrittaTrikonasana<br>➢ Utkatasana<br>Prone line<br>➢ PoornaBhujangasana/ | Asana, Need, importance of Asana.<br>Different types, Asana by name, technique, precautionary measures and benefits of each asana. | |

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| | Rajakapotasana<br>Supine line<br>➢ Navasana/Noukasana<br>➢ Pavanamuktasana | | |
| | Kapalabhati | Revision of practice 60 strokes/min, 3 rounds | |
| | Pranayama<br>➢ Sheetali<br>➢ Sheektari | Meaning, Need, importance of Pranayama. Different types. Meaning by name, technique, precautionary measures and benefits of each Pranayama | |

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| **6th Semester**<br><br>**B24NCK694** | Ashtanga Yoga<br>➢ Dhyana (Meditation)<br>➢ Samadhi | Patanjali's Ashtanga Yoga its need and importance. | Total-32 hours<br>2 hours / week |
| | Suryanamaskara | Revision of practice 12count, 10rounds. | |
| | Different types of Asanas<br>Sitting<br>➢ Vibhakta Paschimottanasana<br>➢ Yogamudra inVajrasana<br>Standing<br>➢ Parshvakonasana<br>➢ Ekapadbaddhapadmottanasana<br>Prone line balancing<br>➢ Mayurasana<br>Supine line<br>➢ Sarvangasana<br>➢ Setubandhasana<br>➢ Shavasanaa (Relaxation poisture) | Asana, Need, Importance of Asana.<br>Different types, Asana by name, technique, precautionary measures and benefits of each asana. | |
| | Kapalabhati | Revision of practice 80 strokes/min, 3 rounds | |

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| | Pranayama<br>➢ Bhastrika<br>➢ Bhramari | Meaning, Need, importance of Pranayama. Different types. Meaning by name, technique, Precautionary measures and benefits of each Pranayama. | |
| | Suryanamaskara | Revision of practice 12count, 12 rounds. | Total-32 hours<br>2 hours / week |
| | Different types of Asanas<br>Sitting<br>➢ Bakasana<br>➢ Hanumanasana<br>➢ Ekapada Rajakapotasana<br>Standing<br>➢ Vatayanasana<br>➢ Garudasana<br>➢ Natarajasana<br>Balancing<br>➢ Sheershasana<br>Supine line<br>➢ 1.Setubandha Sarvangasana<br>➢ Shavasanaa (Relaxation poisture) | Asana, Need, importance of Asana.<br>Different types, Asana by name, technique, precautionary measures and benefits of each asana. | |
| | Kapalabhati | Revision of practice 100 strokes/min, 3 rounds. | |
| | Pranayama<br>➢ Nadishodhana<br>➢ Ujjai<br>➢ Bhramari | Revision of practices | |
| | ShatKriyas<br>➢ Jalaneti & sutraneti<br>➢ Nouli (only for men)<br>➢ Sheetkarma Kapalabhati | Meaning, Need, importance of Shatkriya. Different types. Meaning by name, technique, precautionary measures and benefits of each Kriya | |

**Book for Reference:**


- Swami Kuvulyananda: Asma (Kavalyadhama, Lonavala)
- Tiwari, O P: Asana Why and How

- Ajitkumar: Yoga Pravesha (Kannada)
- Swami Satyananda Saraswati: Asana Pranayama, Mudra, Bandha (Bihar School of yoga, Munger)
- Swami Satyananda Saraswati: Surya Namaskar (BiharSchoolofyoga,Munger)
- Nagendra H R: The art and science of Pranayama
- Tiruka: Shatkriyegalu (Kannada)
- Iyengar B K S: Yoga Pradipika (Kannada)
- Iyengar B K S: Light on Yoga (English)

| SEMESTER-V & VI | | | | | |
|---|---|---|---|---|---|
| **MUSIC**<br>**Category: NCMC** | | | | | |
| Course Code | : | B24NCK595/695 | CIE | : | 100 Marks |
| Teaching Hours L : T : P | : | 1:0:0 | SEE | : | -- |
| Total Hours | : | -- | Total | : | 100 Marks |
| Credits | : | -- | SEE Duration | : | -- |

| **Course Objectives** | |
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| 1. | Identify the major traditions of Indian music, both through notations and aurally. |
| 2. | Analyze the compositions with respect to musical and lyrical content |
| 3. | Demonstrate an ability to use music technology appropriately in a variety of setting. |

| **Module – 1** | **No. of Hours** |
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| **Preamble:** Contents of the curriculum intend to promote music as language to develop an analytical, Creative, and intuitive Understanding. For this the student must experience music through study and direct participation in improvisation and composition. Origin of the Indian Music: Evolution of the Indian music system, Understanding of Shruthi, Nada, Swara, Laya, Raga Tala, Mela. | 3 |
| **Module – 2** | **No. of Hours** |
| **Compositions:** Introduction to the types of composition in Carnatic Music- Geethe, Jath i, Swara, Swarajathi, Varna, Krithi, and Thillana, Notation System. | 3 |
| **Module – 3** | **No. of Hours** |
| **Composers:** Biography and contributions of Purandaradasa, Thyagaraja, Mysoro Vasudevacharya. | 3 |
| **Module – 4** | **No. of Hours** |
| **Music Instruments:** Classification and construction of string instruments, wind instrurments, percussion instruments, Idiophones (Ghana Vaadya), Examples of each class of Instrum ents | 3 |
| **Module – 5** | **No. of Hours** |
| **Abhyasa Gana:** Singing the swara exercises (Sarale Varase Only), Botation writing for Sarale Varase and Suladi Saptha Tala (Only in Mayamalavagowla Raga), Singing 4 Geethe in M alahari, and one jathi Swara, One Krithi in a Mela raga | 14 |

| **Course Outcomes**: At the end of the course, the students will be able to | |
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| CO1 | Discuss the Indian system of music and relate it to other genres (Cognitive DOmain) |
| CO2 | Experience the emotions of composer and develop empathy (Affective Domain) |
| CO3 | Respond to queries on various patterns in a composition (Psycho Motor Domain) |

| **Text Books** | |
|---|---|
| 1. | Vidushi Vasantha Madhavi, "Theory of Music", Prism Publication, 2007. |
| 2. | T Sachidevi and T Sharadha (Thirumalai Sisters), Karnataka Sangeetha Dharpana- Vol. 1 (English), Shreenivaas Prakaashana, 2018. |

| **Reference Text Books** | |
|---|---|
| 1. | Lakshminarayana Subramaniam, Viji Subramanaim, "Classical Music of India: A Practical Guige", Tranqueber 2018. |
| 2. | R. Rangaramanuja Ayyangar, "History of South Indian (Carnatic) Music", Vipanci Charitable Trust; Third edition, 2019. |
| 3. | Ethel Rosenthal, "The Story of Indian Music and Its Istruments: A Study of the Present and a Record of the Past", Pilgrims Publishing, 2007. |
| 4. | Carnatic Music, National Institute of Open Schooling, 2019. |