RV College of Engineering®

# Undergraduate Programs


Bachelor of Engineering (B.E) in

## Industrial Engineering and Management

Scheme and Syllabus of V & VI Semester (2022 Scheme)

B.E. Programs : AS, BT, CH, CS, CS - AI, CS - CD, CS - CY, CV, EC, EE, EI, ET, IM, IS, ME.
M. Tech (13) MCA, M.Sc. (Engg.)

2024

**99TH**
NIRF RANKING IN ENGINEERING (2024)

TIMES HIGHER EDUCATION WORLD UNIVERSITY RANKINGS-2023
**1501+**
TIMES HIGHER EDUCATION WORLD UNIVERSITY RANKINGS-2023 (ASIA)
**501-600**

EDUFUTURE EXCELLENCE AWARD
BEST PRIVATE ENGINEERING UNIVERSITY (SOUTH)
BY ZEE DIGITAL

**1001+**
SUBJECT RANKING (ENGINEERING)

**801+**
SUBJECT RANKING (COMPUTER SCIENCE)

**IIRF 2023**
ENGINEERING RANKING INDIA
NATIONAL RANK-10
STATE RANK - 2
ZONE RANK - 5

QS-IGUAGE DIAMOND UNIVERSITY RATING (2021-2024)

## CURRICULUM STRUCTURE

**61** CREDITS PROFESSIONAL CORES (PC)

**23** CREDITS BASIC SCIENCE

**22** CREDITS ENGINEERING SCIENCE

**18** CREDITS PROJECT WORK / INTERNSHIP

**12** CREDITS* OTHER ELECTIVES & AEC

**12** CREDITS PROFESSIONAL ELECTIVES

**12** CREDITS HUMANITIES & SOCIAL SCIENCE

**160** CREDITS TOTAL

*ABILITY ENHANCEMENT COURSES (AEC), UNIVERSAL HUMAN VALUES (UHV), INDIAN KNOWLEDGE SYSTEM (IKS), YOGA.

**17**
Centers of Excellence

**11**
Centers of Competence

**212**
Publications On Web Of Science

**669**
Publications Scopus (2023 - 24)

**1093**
Citations

**70**
Patents Filed

**39**
Patents Granted

**61**
Published Patents

**11**
Skill Based Laboratories Across Four Semesters

MOUS: 90+WITH INSDUSTRIES / ACADEMIC INSTITUTIONS IN INDIA & ABROAD

EXECUTED MORE THAN RS.40 CRORES WORTH SPONSORED RESEARCH PROJECTS & CONSULTANCY WORKS SINCE 3 YEARS

RV College of Engineering®

# Undergraduate Programs


Bachelor of Engineering (B.E) in

## Industrial Engineering and Management

Scheme and Syllabus of V & VI Semester (2022 Scheme)

B.E. Programs : AS, BT, CH, CS, CS - AI, CS - CD, CS - CY, CV, EC, EE, EI, ET, IM, IS, ME.
M. Tech (13) MCA, M.Sc. (Engg.)

2024

# INDUSTRIAL ENGINEERING & MANAGEMENT

## DEPARTMENT VISION

Imparting innovation and value-based education in Industrial Engineering and Management for steering organizations to global standards with an emphasis on sustainable and inclusive development.

## DEPARTMENT MISSION

1. To impart scientific knowledge, engineering and managerial skills for driving organizations to global excellence.
2. To promote a culture of training, consultancy, research and entrepreneurship interventions among the students.
3. To institute collaborative academic and research exchange programs with national and globally renowned academia, industries and other organizations.
4. To establish and nurture centers of excellence in the niche areas of Industrial and Systems Engineering.

## PROGRAM EDUCATIONAL OBJECTIVES

| | |
|---|---|
| PEO1 | Conceive, design, implement and operate integrated systems, focus on appropriate measures of performance at strategic, tactical and operational levels. |
| PEO2 | Develop competency to adapt to changing roles for achieving organizational excellence. |
| PEO3 | Design and develop sustainable technologies and solutions for betterment of society. |
| PEO4 | Pursue entrepreneurial venture with a focus on creativity and innovation for developing newer products, processes and systems. |

## PROGRAM SPECIFIC OUTCOMES

| | |
|---|---|
| PSO1 | Design, develop, implement and improve integrated systems that include people, Materials, information, equipment and energy. |
| PSO2 | Apply statistical and simulation tools, optimization and meta heuristics techniques for analysis of various systems leading to better decision making. |
| PSO3 | Demonstrate the engineering relationships between the management tasks of planning, Organization, leadership, control, and the human element in various sectors of economy. |

## LEAD SOCIETY

Institute of Industrial Engineers (IIE)

RV College of Engineering®
Mysore Road, RV Vidyaniketan Post,
Bengaluru - 560059, Karnataka, India

*Go, change the world®*

## Bachelor of Engineering in

# INDUSTRIAL ENGINEERING AND MANAGEMENT

| V SEMESTER | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** | **Credit Allocation** | | | | **BoS** | **Category** | **Max Marks CIE** | | **SEE Duration (H)** | **Max Marks SEE** | |
| | | | **L** | **T** | **P** | **Total** | | | **Theory** | **Lab** | | **Theory** | **Lab** |
| 1. | HS351TA | Entrepreneurship and Intellectual Property Rights | 3 | 0 | 0 | 3 | HSS | Theory | **100** | **----** | **3** | **100** | **----** |
| 2. | IM352IA | Operations Management | 3 | 0 | 1 | 4 | IM | Theory + Practice | **100** | **50** | **3** | **100** | **50** |
| 3. | IM353IA | Quality Assurance | 3 | 0 | 1 | 4 | IM | Theory + Practice | **100** | **50** | **3** | **100** | **50** |
| 4. | IM254TA | Finance Accounting and Costing | 3 | 1 | 0 | 4 | IM | Theory | **100** | **----** | **3** | **100** | **----** |
| 5. | IM355TBX | Category: Professional Core Elective-I **(Group-B)** | 3 | 0 | 0 | 3 | IM | Theory | **100** | **----** | **3** | **100** | **----** |
| 6. | IM256TCX | Category: Professional Core Elective-II **(Group C)** | 2 | 0 | 0 | 2 | IM | NPTEL | **----** | **----** | **2** | **50** | **----** |
| | | | | | | **20** | | | | | | | |

| GROUP-B | | |
|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** |
| 1 | IM355TBA | Discrete Event System Simulation |
| 2 | IM355TBB | Enterprise Information Systems |
| 3 | IM355TBC | Non-Conventional Manufacturing Processes |
| 4 | IM355TBD | Advanced Decision Modelling |
| 5 | IM355TBE | Theory of Machines |

| GROUP-C (NPTEL) | | |
|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** |
| 1 | IM256TCA | Business Fundamentals for Entrepreneurs (Part 1: Internal Operations) |
| 2 | IM256TCB | Organizational Behavior: Individual Dynamics |
| 3 | IM256TCC | Retail Management |
| 4 | IM256TCD | Integrated Marketing Management |
| 5 | IM256TCE | Database Management Systems |

## INDEX



**Category: Professional Core Elective-I (Group-B)**



**V Sem: Category: Professional Core- Elective-II (Group -C)**

| Sl. No. | Course Code | Course Title |
|---|---|---|
| 1 | IM256TCA | Business Fundamentals for Entrepreneurs (Part 1: Internal Operations) |
| 2 | IM256TCB | Organizational Behavior: Individual Dynamics |
| 3 | IM256TCC | Retail Management |
| 4 | IM256TCD | Integrated Marketing Management |
| 5 | IM256TCE | Database Management Systems |

## Bachelor of Engineering in

# INDUSTRIAL ENGINEERING AND MANAGEMENT

**VI SEMESTER**

| Sl. No. | Course Code | Course Title | Credit Allocation | | | | BoS | Category | Max Marks CIE | | SEE Duration (H) | Max Marks SEE | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | | | Theory | Lab | | Theory | Lab |
| 1. | HS261TA | Principles of Management and Economics | 3 | 0 | 0 | 3 | HSS | Theory | **100** | **----** | **3** | **100** | **----** |
| 2. | IM362IA | Supply Chain Management | 3 | 0 | 1 | 4 | IM | Theory + Lab | **100** | **50** | **3** | **100** | **50** |
| 3. | IM363IA | Ergonomics | 3 | 0 | 1 | 4 | IM | Theory + Lab | **100** | **50** | **3** | **100** | **50** |
| 4. | IM364TA | Human Resource Management & Analytics | 3 | 1 | 0 | 4 | IM | Theory | **100** | **----** | **3** | **100** | **----** |
| 5. | IM365TDX | Category: Professional Core Elective-III (Group – D) | 3 | 0 | 0 | 3 | IM | Theory | **100** | **----** | **3** | **100** | **----** |
| 6. | XX266TEX | Institutional Electives – I (Group E) | 3 | 0 | 0 | 3 | Resp Bos | Theory | **100** | **----** | **3** | **100** | **----** |
| 7. | IM367P | Interdisciplinary Project | 0 | 0 | 1 | 3 | IM | Project | **----** | **100** | **3** | **----** | **100** |
| | | | | | | **24** | | | | | | | |

**GROUP-D**

| Sl. No. | Course Code | Course Title |
|---|---|---|
| 1 | IM365TDA | Facilities planning and Design |
| 2 | IM365TDB | Service Operations Management |
| 3 | IM365TDC | Additive Manufacturing |
| 4 | IM365TDD | Design of Experiments |
| 5 | IM365TDE | Principles Of Fluid Mechanics and Thermodynamics |

## INDEX



**Category: Professional Core -Elective-I (Group-D)**



**Institutional Electives – I (Group E)**

| Semester: V | | | | | | |
|---|---|---|---|---|---|---|
| **ENTREPRENEURSHIP & INTELLECTUAL PROPERTY RIGHTS**<br>**Category: Professional Core**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **HS351TA** | | **CIE** | **:** | **100 Marks** |
| **Credits: L: T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **42L** | | **SEE Duration** | **:** | **03 Hours** |

| UNIT-I | 08 hrs |
|---|---|
| **Introduction to Entrepreneurship:** Definition and Scope of Entrepreneurship, Importance of Entrepreneurship in Engineering Innovation and Economic Growth, Techniques for Identifying Entrepreneurial Opportunities, Types of Entrepreneurs: Innovative, Imitative, Fabian, Characteristics and Traits of Successful Entrepreneurs.<br>**Role in economic development-** Emerging Trends in Entrepreneurship, Entrepreneur and Entrepreneurship, characteristics of Entrepreneur, Myths about Entrepreneurship, Entrepreneur vs Intrapreneur, Role of Entrepreneurial Teams<br>**Activities:** Case study on Entrepreneurship in Indian Scenario, Ideation Workshops and Hackathons, | |
| **UNIT-II** | **08 hrs** |
| **Entrepreneurial Opportunity Evaluation:** Identifying Market Opportunities and Trends, Integration of Engineering Principles in Ideation Process, Cross-Disciplinary Collaboration for Technological Innovation, Assessing Market Feasibility and Demand Analysis, Evaluating Technical Feasibility: Prototype Development, Proof of Concept, Financial Feasibility Analysis: Cost Estimation, Revenue Projection, Break-Even Analysis.<br>**Business Planning and Strategy Development:** Elements of a Business Plan, Executive Summary, Company Description, Market Analysis, writing a Business Plan: Structure and Components, Strategic Planning: Vision, Mission, Goals, Objectives, SWOC Analysis, Competitive Strategy: Porter's Generic Strategies, Differentiation, Cost Leadership, Focus Strategy, Growth Strategies: Organic Growth, Mergers and Acquisitions, Strategic Alliances<br>**Activities:** Writing a Business Plan on given templates, Developing Business Models and Prototypes Based on Generated Ideas | |
| **UNIT-III** | **08 hrs** |
| **Entrepreneurial Marketing and Sales:** Basics of Marketing: Product, Price, Place, Promotion (4Ps), Market Segmentation, Targeting, and Positioning (STP), Branding and Product Development Strategies, Creating a Unique Value Proposition (UVP) Digital Marketing: Social Media Marketing, Content Marketing, SEO, SEM, Sales Techniques and Customer Relationship Management (CRM).<br>**Entrepreneurial Finance and Resource Management:** Sources of Financing: Equity Financing, Debt Financing, Venture Capital, Angel Investors, Crowdfunding, Financial Management: Budgeting, Cash Flow Management, Financial Statements Analysis, Risk Management and Insurance, Human Resource Management: Recruitment, Training, Performance Evaluation, Legal and Ethical Issues in Entrepreneurship: Intellectual Property Rights, Contracts, Corporate Governance<br>**Activities:** Case Studies and Practical Applications | |
| **UNIT-IV** | **09 hrs** |
| **Introduction to IP :** Types of Intellectual Property<br>**Patents:** Introduction, Scope and salient features of patent; patentable and non-patentable inventions, Patent Procedure - Overview, Transfer of Patent Rights; protection of traditional knowledge, Infringement of patents and remedy, Case studies, Patent Search and Patent Drafting, Commercialization and Valuation of IP.<br>**Trade Marks:** Concept, function and different kinds and forms of Trademarks, Registrable and non-registrable marks. Registration of Trade Mark; Deceptive similarity; Transfer of Trade Mark, ECO Label, Passing off, Infringement of Trade Mark with Case studies and Remedies. | |

| UNIT-V | 09 hrs |
|---|---|
| **Trade Secrets**: Definition, Significance, Tools to protect Trade secrets in India.<br>**Industrial Design:** Introduction of Industrial Designs Features of Industrial, Design. Procedure for obtaining Design Protection, Revocation, Infringement and Remedies, Case studies.<br>**Copy Right:** Introduction, Nature and scope, Rights conferred by copy right, Copy right protection, transfer of copy rights, right of broad casting organizations and performer's rights, Exceptions of Copy Right, Infringement of Copy Right with case studies. | |

| **Course Outcomes: After completing the course, the students will be able to** | |
|---|---|
| **CO1** | Understand the concepts of entrepreneurship and cultivate essential attributes to become an entrepreneur or Intrapreneur and demonstrate skills such as problem solving, team building, creativity and leadership. |
| **CO2** | Comprehend the process of opportunity identification of market potential and customers while developing a compelling value proposition solutions. |
| **CO3** | Analyse and refine business models to ensure sustainability and profitability and build a validated MVP of their practice venture idea and prepare business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture. |
| **CO4** | Apply insights into the strategies and methods employed to attain a range of benefits from these IPs and deliver an investible pitch deck of their practice venture to attract stakeholders |
| **CO5** | Knowledge and competence related exposure to the various Legal issues pertaining to Intellectual Property Rights with the utility in engineering perspectives. |

| **Reference Books** | |
|---|---|
| **1.** | Donald F. Kuratko ,"Entrepreneurship: Theory, Process, and Practice", South-Western Pub publishers, 10th edition, 2016,978-ISBN-13: 1305576247 |
| **2.** | Eric Ries, "The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses", Crown Currency Publishers,1st Edition, 2011, ISBN-13: 978-0307887894. |
| **3.** | Dr B L Wadehra, Law Relating to Intellectual Property, universa Law publishers 05th edition, ISBN : 9789350350300 . |
| **4** | Intellectual Property Rights: Unleashing Knowledge Economy, Prabuddha Ganguly, 1st Edition, 2001, Tata McGraw Hill Publishing Company Ltd., New Delhi, ISBN: 0074638602. |

| **RUBRIC FOR SEMESTER END EXAMINATION (THEORY)** | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| Semester: V | | | | | | |
|---|---|---|---|---|---|---|
| **OPERATIONS MANAGEMENT**<br>**Category: Professional Core**<br>**(Theory+ Practice)** | | | | | | |
| **Course Code** | **:** | **IM352IA** | | **CIE** | **:** | **100 + 50 Marks** |
| **Credits: L:T:P** | **:** | **3:0:1** | | **SEE** | **:** | **100 + 50 Marks** |
| **Total Hours** | **:** | **45L + 30P** | | **SEE Duration** | **:** | **03 + 03 Hours** |

| **UNIT-I** | **09 Hrs** |
|---|---|
| **Using operations to create value:** Role of operations in an organization, a process view, a supply chain view, operations strategy, competitive priorities and capabilities, fourth Industrial revolution, decision making models. | |
| **UNIT-II** | **09 Hrs** |
| **Process strategy:** Process structure in services, process structure in manufacturing, process strategy decisions, strategic fit, strategies for change.<br>**Planning capacity:** Planning long term capacity, planning timing and sizing strategies, a systematic approach to long term capacity decisions. | |
| **UNIT-III** | **09 Hrs** |
| **Forecasting Demand:** The role of forecasting, characteristics of forecasts, components of a forecast and forecasting methods, basic approach to demand forecasting, time series, measures of forecast error, selecting the best smoothing constant, role of IT in forecasting, risk management in forecasting, big data and the forecasting process. | |
| **UNIT-IV** | **09 Hrs** |
| **Managing process constraints:** the theory of constraints, managing bottlenecks in service and manufacturing processes, applying the theory of constraints to product mix decisions, managing constraints in line processes<br>**Efficient resource planning:** Material requirements planning, master production scheduling, MRP explosion, enterprise resource planning, resource planning for service providers. | |
| **UNIT-V** | **09 Hrs** |
| **Scheduling:** Introduction, Single machine Scheduling, Shortest Processing time (SPT), Rule to minimize mean flow time, earlier due date (EDD), Rule to minimize, Maximum lateness. Minimizing makespan,<br>**Flow shop scheduling:** Johnson's Rule, CDS Heuristic.<br>**Job shop scheduling:** Types of schedules, schedule generation. Two jobs and M machines scheduling, bottleneck scheduling. | |
| **OPERATIONS MANAGEMENT LABORATORY** | |
| – Break-Even Analysis<br>– Demand Forecasting<br>– Capacity planning<br>– Aggregate Planning using Linear Programming<br>– Production planning and scheduling<br>– Analyzing dependent demand inventory situations and generating reports using MRP Module.<br>– Preparation of Bill of Materials.<br>– MRP Run- Generation of planned order release report.<br>– Creation of Purchase order for the item.<br>– Creation of Production order for the item | |

| **Course Outcomes: After completing the course, the students will be able to** | |
|---|---|
| CO1 | Explain the concept and scope of operations management in a business context |
| CO2 | Recognize the role of Operations management among various business functions and its role in the organizations' strategic planning and gaining competitive advantage |
| CO3 | Analyze and assess the appropriateness and applicability of a range of operations management systems/models in decision making. |
| CO4 | Evaluate a selection of frameworks used in the design and delivery of operations |

| **Reference Books** | |
|---|---|
| 1. | Lee J Karjewski and Larry P Ritzman, Manoj Malhotra, Operations Management – Processes and Supply Chain, Pearson Education Asia, 13th Edn, 2021, ISBN-13: 9780136860631 |
| 2. | R. Paneerselvam, Production and Operations Management, PHI, 3rd Edn, 2012, ISBN-13: 978-8120345553 |
| 3. | B. Mahadevan, Operations Management – Theory and Practice, PHI, 2015, 3rd Edn, ISBN-13: 978-9332547520 |
| 4. | Sunil Chopra & Peter Meindl, "Supply Chain Management - Strategy, Planning & Operation" Pearson Education Asia, 2006, 3rd Edition. ISBN-13: 978-0131730427 |

| **RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION** | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50 Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**. | **40** |
| 4. | **LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (20 Marks),lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (20 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50 MARKS | **50** |
| | **MAXIMUM MARKS FOR THE CIE** | **150** |

| **RUBRIC FOR SEMESTER END EXAMINATION (THEORY)** | | |
|---|---|---|
| **Q.NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type of questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of THREE Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| **RUBRIC FOR SEMESTER END EXAMINATION (LAB)** | | |
|---|---|---|
| **Q.NO.** | **CONTENTS** | **MARKS** |
| 1 | Write Up | 10 |
| 2 | Conduction of the Experiments | 20 |
| 3 | Viva | 20 |
| | **TOTAL** | **50** |

| Semester: V | | | | | | |
|---|---|---|---|---|---|---|
| **QUALITY ASSURANCE**<br>**Category: Professional Core**<br>**(Theory+ Practice)** | | | | | | |
| **Course Code** | **:** | **IM353IA** | | **CIE** | **:** | **100 + 50 Marks** |
| **Credits: L:T:P** | **:** | **3:0:1** | | **SEE** | **:** | **100 + 50 Marks** |
| **Total Hours** | **:** | **42L + 30P** | | **SEE Duration** | **:** | **03 + 03 Hours** |

| **UNIT-I** | **08 Hrs** |
|---|---|
| **Introduction:** Dimensions of Quality, Statistical Methods for Quality, Quality costs.Quality assurance, ISO 9000, 14000 standards, Quality 4.0.<br>**Statistical Process Control:** Chance and assignable causes of variation. Statistical basisof control charts, Basic principles of control charts, choice of control limits, sample size and sampling frequency, rational sub groups, statistical basis of control charts. Analysis of patterns of control charts. | |
| **UNIT-II** | **09 Hrs** |
| **Control Charts for Variable and Attribute Data:** Controls charts for mean and Range, Control charts for mean and standard deviation. Brief discussion on – Pre control, Control charts for individual measurements, Moving-range charts, Sloping control charts, Group control charts.<br>Controls chart for fraction non- conforming (p, np, 100p charts), Control chart for non- conformities (c and u charts).<br>**Process capability** – methods of estimating process capability, Process capability indices- $c_p$ and $c_{pk}$, | |
| **UNIT-III** | **09 Hrs** |
| **Advanced Control Charts:** Control charts for Individual measurements, Cumulative sum, Exponentially weighted moving average, Group control charts.<br>**Acceptance Sampling:** Concept of acceptance sampling, economics of inspection, Acceptance sampling plans – Single, Double and Multiple Sampling. Operating Characteristic curves – construction and use. Determination of Average Outgoing Quality (AOQ), Average Outgoing Quality Level, Average Total Inspection, Production Risk and Consumer Risk, Published Sampling Plans. | |
| **UNIT-IV** | **08 Hrs** |
| **Experimental Design for Process Improvement:** General model of a process, Examples of designed experiments in process improvement, Principles of experimentation, Guidelines for designing experiments, Completely randomized designs (CRD), Randomized block designs (RBD), Factorial experiments – $2^2$ design. | |
| **UNIT-V** | **08 Hrs** |
| **Reliability And Life Testing**: Failure models of components, definition of reliability, MTBF, Failure rate, common failure rate curve, types of failure, reliability evaluation in simple cases of exponential failures in series, parallel and series-parallel device configurations. | |

| **Course Outcomes: After completing the course, the students will be able to** | |
|---|---|
| CO1. | Explain the DMAIC process and fundamentals of quality control and improvement. |
| CO2. | Apply modern statistical methods for process quality control and improvement. |
| CO3. | Examine the data and draw inference about the process. |
| CO4. | Evaluate processes and select statistical tools and techniques for quality control & improvement. |

| **Reference Books** | |
|---|---|
| **1.** | "Statistical Quality Control : A Modern Introduction", D C Montgomery, 6th Edition, 2009, John Wiley and Sons, ISBN 978-81-265-2506-5. |
| **2.** | "Statistical Quality Control", Grant and Leavenworth, 7th Edition, 2008, McGraw Hill, ISBN – 0-07-043555-3. |
| **3.** | An Introduction to Reliability and Maintainability Engineering, Charles E. Ebeling, 1st Edition, 1997, McGraw-Hill International Editions, ISBN0070188521 |
| **4.** | Quality Planning & Analysis, Joseph M. Juran; Gryna, Frank M., Jr., 3rd Edition, 2009, Tata McGraw Hill, ISBN – 9780070331839. |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50 Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**. | **40** |
| 4. | **LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (20 Marks),lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (20 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50 MARKS | **50** |
| | **MAXIMUM MARKS FOR THE CIE** | **150** |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q.NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type of questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of THREE Sub-divisions only) | |
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| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| RUBRIC FOR SEMESTER END EXAMINATION (LAB) | | |
|---|---|---|
| **Q.NO.** | **CONTENTS** | **MARKS** |
| 1 | Write Up | 10 |
| 2 | Conduction of the Experiments | 20 |
| 3 | Viva | 20 |
| | **TOTAL** | **50** |

| Semester: V | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FINANCIAL ACCOUNTING AND COSTING**<br>**Category: Professional Core Elective**<br>**(Theory)** | | | | | | | |
| **Course Code** | **:** | **IM254TA** | | **CIE** | **:** | **100 Marks** | |
| **Credits: L:T:P** | **:** | **3:1:0** | | **SEE** | **:** | **100 Marks** | |
| **Total Hours** | **:** | **42L + 24T** | | **SEE Duration** | **:** | **03 Hours** | |
| **UNIT-I** | | | | | | | **09 Hrs** |
| **Introduction:** Financial Accounting objectives, accounting cycle, Generally Accepted Accounting Practices (GAAP), International Financial Reporting Standards (IFRS), Concepts of Debit and Credit, Assets and Liabilities, Objectives of costing. Budgeting and types. | | | | | | | |
| **UNIT-II** | | | | | | | **09 Hrs** |
| **Accounting Process**: Bookkeeping: single entry vs double-entry accounting, Recording of cash and bank transactions- preparation of Journal, preparation of Ledger accounts, preparation of trial balance-usefulness and interpretation. | | | | | | | |
| **UNIT-III** | | | | | | | **08 Hrs** |
| **Financial Statements:** Preparation of Trading account, Profit & Loss account and Balance Sheet (with simple adjustments). | | | | | | | |
| **UNIT-IV** | | | | | | | **08 Hrs** |
| **Costing:** Elements of costing, Financial accounting vs Cost accounting, Preparation of cost sheet. Types: Job Costing**,** Batch Costing, Process Costing, Cost accumulation in process costing. | | | | | | | |
| **UNIT-V** | | | | | | | **08 Hrs** |
| **Standard Costing**: Components of standard cost, Material cost variance, labor cost variance, overhead cost variance. | | | | | | | |

| **Course Outcomes: After completing the course, the students will be able to** | |
|---|---|
| **CO1:** | Elucidate the fundamental principles and procedures of financial accounting and costing. |
| **CO2:** | Record, Summarize and Report financial transactions using different steps of accounting cycle. |
| **CO3:** | Prepare and interpret financial statements to understand the financial health of organizations. |
| CO4: | Illustrate a thorough understanding of fundamental cost concepts and application of different cost measurement and control techniques. |

| **Reference Books** | |
|---|---|
| 1. | Fundamentals of Financial Management, Prasanna Chandra, 7th Edition, 2020, McGraw-Hill Education (India), ISBN – 13:978-93-89811-26-1 |
| 2. | Financial Accounting, P.C. Tulsian& Bharat Tulsian, 2nd Edition, 2016, S. Chand & CompanyLtd., ISBN : 978-93-525-3333-6 |
| 3. | Financial Management, M. Y. Khan, P. K. Jain, 8th edition, 2019, McGraw-Hill Education (India), ISBN –13:978-93 – 5316 – 218-4 |
| 4. | Financial Accounting, Dr. S N Maheshwari&Dr.Suneel K Maheshwari, CA Sharad k Maheshwari,6th Edition, 2018, Vikas Publishing house Pvt Ltd., ISBN : 978-93-5271-853-5 |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| Semester: V | | | | | | |
|---|---|---|---|---|---|---|
| **DISCRETE EVENT SYSTEM SIMULATION**<br>**Category: Professional Core Elective**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **IM355TBA** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **42L** | | **SEE Duration** | **:** | **03 Hours** |

| **UNIT-I** | **09 Hrs** |
|---|---|
| **Introduction to Simulation:** Simulation, Advantages, Disadvantages, Areas of application, System environment, components of a system, Model of a system, types of models, steps in a simulation study. | |
| **UNIT – II** | **09 Hrs** |
| **Simulation Examples:** Simulation of Queuing systems, Simulation of Inventory System, Other simulation examples.<br>**Analysis of Simulation Data**<br>**Input Modelling**: Data collection, Identification and distribution with data, parameter estimation, Goodness of fit tests, Selection of input models without data. | |
| **UNIT –III** | **09 Hrs** |
| **Random Numbers:** Properties, Generations methods, Tests for Random number- Frequency test, Runs test, Autocorrelation test.<br>**Random Variate Generation:** Inverse transform technique-exponential distribution. Uniform distribution, weibull distribution, Generating approximate normal variates, acceptance –rejection technique for Poisson distribution, gamma distribution. | |
| **UNIT –IV** | **09 Hrs** |
| **Output Analysis – Types of Simulations with Respect to Output Analysis,** Stochastic Nature of output data, Measures of Performance and their estimation, Output analysis of terminating simulation, Output analysis of steady state simulations. | |
| **UNIT –V** | **06 Hrs** |
| **Verification and Validation of Model –** Model Building, Verification, Calibration and Validation of Models.<br>**Simulation Software:** Selection of Simulation Software, Simulation packages, Trend in Simulation Software.<br>Developing simple models using Simulation packages (ARENA / PROMODEL) | |

| **Course Outcomes: After completing the course, the students will be able to** | |
|---|---|
| **CO1:** | Describe the role of important elements of discrete event simulation and modeling paradigm |
| **CO2:** | Conceptualize real world situations related to systems development decisions, originating from source requir ements and goals |
| **CO3:** | Develop skills to apply simulation to construct and execute goal-driven system models |
| **CO4:** | Interpret the model and apply the results to resolve critical issues in a real-world environment |

| **Reference Books** | |
|---|---|
| **1.** | Discrete Event System Simulation, Jerry Banks, John S Carson, II, Berry L Nelson, David M Nicol, 4th Edition, 2007, Pearson Education, Asia, ISBN: 81-203-2832-9. |
| **2.** | Simulation Modelling & Analysis, Averill M Law, W David Kelton, 5th Edition, 2014, McGraw Hill International Editions – Industrial Engineering series, ISBN: 978-0073401324. |
| **3.** | Systems Simulation with Digital Computer, Narsingh Deo, 3rd Edition, 2004, PHI Publication (EEE), ISBN : 0-87692-028-8. |
| **4.** | Discrete-Event Simulation: Modeling, Programming, and Analysis, George S. Fishman, 1st Edition, 2013, Springer Science & Business Media, ISBN :1475735529, 9781475735529 |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| Semester: V | | | | | | |
|---|---|---|---|---|---|---|
| **ENTERPRISE INFORMATION SYSTEMS**<br>**Category: Professional Core Elective**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **IM355TBB** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **42L** | | **SEE Duration** | **:** | **03 Hours** |

| **UNIT-I** | **07 Hrs** |
|---|---|
| Introduction to Enterprise Systems, Overview of Enterprise Information Systems (EIS), Key components: ERP, CRM, and SCM, Role of EIS in business decision-making, Introduction to digital transformation. | |
| **UNIT-II** | |
| Business Process and Automation, Business Process Overview, Introduction to Automation in Business Processes, Basic concepts of RPA (Robotic Process Automation), Simplified approach to Business Process Reengineering | **08 Hrs** |
| **UNIT-III** | |
| Data Management and Analysis Basics of Data Storage and Warehousing, Introduction to Data Analytics in EIS, Basic concepts of Business Intelligence (BI) tools, Use of data for decision-making | **08 Hrs** |
| **UNIT-IV** | |
| Enterprise Information Systems and Supply chain: Magnitude of EIS in SCM, Web enable EIS/ERP and its impact on SCM, EIS Vs SCM, product Life cycle management. | **07 Hrs** |
| **UNIT-V** | |
| Trends in Enterprise Systems, Basic overview of Cloud-based EIS, Introduction to Cybersecurity in EIS, Simplified future trends in EIS (e.g., AI basics, IoT), Overview of Agile project management in EIS | **06 Hrs** |

| **Course Outcomes: After completing the course, the students will be able to** | |
|---|---|
| **CO1** | Understand the role of enterprise information system analytics in decision making. |
| **CO2** | Explain the technologies for data warehousing data mining and data visualization. And its use in organizations. |
| **CO3** | Apply information-gathering techniques to document the requirements for an information system solution |
| **CO4** | Develop an understanding of investigative methods for building and designing computer based information systems and Realize the trends in enterprise system and the supportive technologies. |

| **Reference Books** | |
|---|---|
| **1.** | Enterprise Information Systems: Contemporary Trends and Issues, David L. Olson and Subodh Kesharwani, 2009 Retrieved 20 August 20, New York: World Scientific, ISBN 9814273163. |
| **2.** | Enterprise Information Systems: Concepts, Methodologies, Tools and Applications, Information Resources Management Association (USA), 1st Edition, 2011, Idea Group Inc. ISBN 978-1-61692852-0. |
| **3.** | Enterprise Information Systems: A Pattern - Based Approach, Cheryl L. Dunn, 3rd Edition, 2005, McGraw-Hill, ISBN: 9780071111201 |
| **4.** | Software Project Management, Hughes, B. and Mike Cotterell, M. 5th Edition, 2009, McGraw-Hill, ISBN:1070-1389 |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
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| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| Semester: V | | | | | | |
|---|---|---|---|---|---|---|
| **NON – CONVENTIONAL MANUFACTURING PROCESSES**<br>**Category: Professional Core Elective**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **IM355TBC** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **42L** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **07 Hrs** |
|---|---|
| **Introduction:** Unconventional machining Process – Need – classification – Brief overview | |
| **Unit – II** | **10Hrs** |
| **Mechanical Energy Based Processes:** Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR-Variation in techniques used – Applications. | |
| **Unit –III** | **10 Hrs** |
| **Electrical Energy Based Processes:** Electric Discharge Machining (EDM)- working Principle-equipments-Process Parameters – Surface Finish and MRR- electrode / Tool – Power and control Circuits – Tool Wear – Dielectric –Flushing – Wire cut EDM – Applications | |
| **Unit –IV** | **10 Hrs** |
| **Chemical And Electro-Chemical Energy Based Processes**: Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchants maskant techniques of applying maskants-Process Parameters – Surface finish and MRR, Applications. Principles of ECM-equipments-Surface Roughness and MRR-Electrical circuit – Process Parameters-ECG and ECH - Applications. | |
| **Unit –V** | **05 Hrs** |
| **Thermal Energy Based Processes**: Laser Beam machining and drilling (LBM), plasma arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications. | |

| **Course Outcomes: After completing the course, the students will be able to** | |
|---|---|
| CO1 | Explain advanced machining processes, mechanism of Mechanical machining processes, its applications and limitations. |
| CO2 | Explain the methodologies and stages involved non conventional manufacturing processes |
| CO3 | Interpret Thermal Metal Removal Processes, characteristics of spark eroded surface & machine tool selection. |
| CO4 | Analyze the Metal Removal Processes, characteristics of different non conventional machining process. |

| **Reference Books** | |
|---|---|
| **1** | Vijay.K. Jain “Advanced Machining Processes” Allied Publishers Pvt. Ltd., New Delhi, 2021 |
| **2** | Pandey P.C. and Shan H.S. “Modern Machining Processes” Tata McGraw-Hill, New Delhi,2018. |
| **3** | Benedict. G.F. “Nontraditional Manufacturing Processes”, Marcel Dekker Inc., New York, 2014. |
| **4** | Paul De Garmo, J.T.Black, and Ronald.A.Kohser, “Material and Processes in Manufacturing Prentice Hall of India Pvt. Ltd., 8thEdition, New Delhi , 2008. |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
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| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| Semester: V | | | | | | |
|---|---|---|---|---|---|---|
| **ADVANCED DECISION MODELLING**<br>**Category: Professional Core Elective**<br>**(THEORY)** | | | | | | |
| **Course Code** | **:** | **IM355TBD** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **42L** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **09 Hrs** |
|---|---|
| **Queuing Models:** Introduction, The Structure of a Queuing System, Performance Measures of a Queuing System, Probability Distributions in Queuing Systems, Classification of Queuing Models, Single-Server Queuing Models (M/M/1) and Problems | |
| **Unit – II** | **09 Hrs** |
| **Markov Chains**: Introduction, Characteristics of a Markov Chain, Applications of Markov Analysis, State and Transition Probabilities, Multi-Period Transition Probabilities, Steady-State (Equilibrium) Conditions, Absorbing States and Accounts Receivable Application | |
| **Unit –III** | **09 Hrs** |
| **Inventory Control Models:** Introduction, The Meaning of Inventory Control, Functional Role of Inventory, Reasons for Carrying Inventory, Factors Involved in Inventory Problem Analysis, Inventory Model Building, Single Item Inventory Control Models without Shortages, Single Item Inventory Control Models with Shortages | |
| **Unit –IV** | **08 Hrs** |
| **Replacement and Maintenance Models:** Introduction, Types of Failure, Replacement of Items whose Efficiency Deteriorates with Time, Replacement of Items that Completely Fail, Other Replacement Problems. | |
| **Unit –V** | **07 Hrs** |
| **Sequencing Problems:** Introduction, Notations, Terminology and Assumptions, Processing n Jobs Through Two Machines, Processing n Jobs Through Three Machines, Processing n Jobs Through m Machines, Processing Two Jobs Through m Machines | |

| **Course Outcomes:** After completing the course, the students will be able to | |
|---|---|
| **CO1:** | Formulate a stochastic problem. |
| **CO2:** | Choose an adequate modeling technique for particular stochastic problems. |
| **CO3:** | Solve real-world stochastic problems with the aid of appropriate tools. |
| **CO4:** | Analyze the solution of stochastic problems. |

| **Reference Books** | |
|---|---|
| **1.** | Introduction to Operations Research, F. S. Hillier and G. J. Lieberman, Bodhibrata Nag, Preetam Basu, 9th Edition, 2012, McGraw-Hill, New Delhi, India. |
| **2.** | Operations Research: Principles and Practice, A. Ravindran, D. Phillips, and J. Solberg, 2nd Edition, JohnWiley & Sons, 1987, ISBN: 978-0-471-08608-6. |
| **3.** | Introduction to Probability Models: Operations Research, W.L. Winston, Volume II, 4th Edition, Cengage Learning, 2003, ISBN-10 : 053440572X. |
| **4.** | Operations Research: An Introduction, H.A. Taha, 9th Edition, Prentice Hall, 2010. |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
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| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
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| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| Semester: V | | | | | | |
|---|---|---|---|---|---|---|
| **THEORY OF MACHINES**<br>**Category: Professional Core Elective**<br>**(Theory)** | | | | | | |
| **Subject Code** | **:** | **IM355TBE** | | **CIE Marks** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE Marks** | **:** | **100 Marks** |
| **Total Hours** | **:** | **42L** | | **SEE** | **:** | **03 Hours** |

| **Unit – I** | **08 Hrs** |
|---|---|
| Introduction: Kinematic Link, Kinematic pair, Types of Kinematic pair, Kinematic chain, Kinematic representation of a machine. Expansion of pairs, Inversions of mechanism, Four bar chain, Slider crank mechanism, Double slider crank chain. Concepts of binary, ternary and quaternary links. | |
| **Unit – II** | **08 Hrs** |
| Velocity and Acceleration Analysis of Mechanisms (Graphical Method): Velocity and acceleration analysis of four bar mechanism, slider crank mechanism. Angular velocity and angular acceleration of links, velocity of rubbing. Determination of linear and angular velocity using instantaneous center method. | |
| **Unit – III** | **08 Hrs** |
| Governors: Types of governors; force analysis of Porter and Hartnell governors. Controlling force, stability, sensitiveness, isochronism, effort and power.<br>Gyroscope: Vectorial representation of angular motion, gyroscopic couple. Effect of gyroscopic couple on ship, plane disc, aero plane, stability of two wheelers | |
| **Unit – IV** | **08 Hrs** |
| Cams: Types of Cams, Types of Followers. Displacement, Velocity & Acceleration Time Curves for Cam Profiles. Disc Cam with Reciprocating Follower Having Knife- Edge, Roller & Flat-Face Follower, Disc Cam With Oscillating Roller Follower. Follower Motions including, SHM, Uniform Velocity, Uniform Acceleration & Retardation and Cycloidal Motion. | |
| **Unit – V** | **10 Hrs** |
| Gears: Gear terminology, classification of gears, law of gearing, velocities of sliding in the mating teeth of the gear wheels, forms of teeth, effect of center distance variation on the velocity ratio for involute profile tooth gears, properties of involute profile toothed gears in mesh. Numerical Problems. | |

| **Course Outcomes:** After completing the course, the students will be able to | |
|---|---|
| **CO1:** | Understand the principles of kinematic pairs, chains and their classification, DOF and inversions. |
| **CO2:** | Analyze the planar mechanisms for position, velocity and acceleration and steering gear mechanism. |
| **CO3:** | Asses various concepts of mechanisms and working principles of power elements and design related problems effectively. |
| **CO4:** | Utilize analytical, mathematical and graphical aspects of kinematics of Machines for effective design. |

| **Reference Books:** | |
|---|---|
| **1.** | Sadhu Singh, Theory of Machines, Pearson Education (Singapore) Ptd. Ltd., Indian Branch, New Delhi, 2019, ISBN: 0-07–460320–5 |
| **2.** | Shigley, J.V. and Uicker, J.J., Theory of Machines & Mechanisms, McGraw Hill International, 2nd Edition, 1995, ISBN: 9780195155983. |
| **3.** | Rattan S.S, Theory of Machines, Tata McGraw-Hill Publishing Company, 2014 |
| **4.** | Ballaney, Theory of Machines & Mechanisms, Khanna Publishers, 23rd Edition, 2003, ISBN: 817409122-X |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
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| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
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| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
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| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
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| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| Semester VI | | | | | | |
|---|---|---|---|---|---|---|
| **PRINCIPLES OF MANAGEMENT & ECONOMICS**<br>**Category: Professional Core**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **HS261TA** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **45 Hrs** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **06 Hrs** |
|---|---|
| Introduction to Management: Management Functions – POSDCORB – an overview, Management levels & Skills, Management History - Classical Approach: Scientific Management, Administrative Theory, Quantitative Approach: Operations Research, Behavioral Approach: Hawthorne Studies, Contemporary Approach: Systems Theory, Contingency Theory. Caselets / Case studies | |
| **Unit-II** | **10 Hrs** |
| **Foundations of Planning:** Types of Goals & Plans, Approaches to Setting Goals & Plans, Strategic Management Process, Corporate strategies – types of corporate strategies, BCG matrix, Competitive Strategies – Porters Five force Model, types of Competitive Strategies. **Caselets / Case studies**<br>**Organizational Structure & Design:** Overview of Designing Organizational Structure - Work Specialization, Departmentalization, Chain of Command, Span of Control, Centralization & Decentralization, Formalization, Mechanistic & Organic Structures. **Caselets / Case studies** | |
| **Unit-III** | **10 Hrs** |
| **Motivation:** Early Theories of Motivation - Maslow's Hierarchy of Needs Theory, McGregor's Theory X & Theory Y, Herzberg's Two Factor Theory. Contemporary Theories of Motivation: Adam's Equitytheory, Vroom's Expectancy Theory. **Caselets / Case studies**<br>**Leadership:** Behavioral Theories: Blake & Mouton's Managerial Grid, Contingency Theories of Leadership: Hersey & Blanchard's Situational Leadership, Contemporary Views of Leadership: Transactional & Transformational Leadership. **Caselets / Case studies** | |
| **Unit-IV** | **10 Hrs** |
| **Introduction to Economics:** Microeconomics and Macroeconomics, Circular flow model of economics, An Overview of Economic Systems.<br>**Essentials of Microeconomics:** Demand, Supply, and Equilibrium in Markets for Goods and Services, Price Elasticity of Demand and Price Elasticity of Supply, Elasticity and Pricing, Numericals on determining price elasticity of demand and supply. Changes in Income and Prices Affecting Consumption Choices, Monopolistic Competition, Oligopoly. | |
| **Unit-V** | **09 Hrs** |
| **Macroeconomic Indicators:** Prices and inflation, Consumer Price Index, Exchange rate, Labor Market, Money and banks, Interest rate. Gross Domestic product (GDP) - components of GDP, Measures of GDP: Outcome Method, Income method and Expenditure method, Numericals on GDP Calculations, ESG an overview.<br>**Macroeconomic models**- The classical growth theory, Keynesian cross model, IS-LM-model, The AS-AD model, The complete Keynesian model, The neo-classical synthesis. National Budgeting process in India | |

| **Course Outcomes: After completing the course, the students will be able to** | |
|---|---|
| **CO1** | Elucidate the principles of management theory & recognize the characteristics of an organization. |
| **CO2** | Demonstrate the importance of key performance areas in strategic management and design appropriate organizational structures and possess an ability to conceive various organizational dynamics. |
| **CO3** | Compare and contrast early and contemporary theories of motivation and select and implement the right leadership practices in organizations that would enable systems orientation. |
| **CO4** | Demonstrate an understanding on the usage and application of basic economic principles. |
| **CO5** | Appreciate the various measures of macro-economic performance and interpret the prevailing economic health of the nation. |

| **Reference Books** | |
|---|---|
| 1. | Management, Stephen Robbins, Mary Coulter &NeharikaVohra, 15th Edition, 2021, Pearson Education Publications, ISBN: 13: 978-0-13-558185-8 |
| 2. | Management, James Stoner, Edward Freeman & Daniel Gilbert Jr, 6th Edition, 2009, PHI, ISBN: 81-203-0981-2. |
| 3. | Principles of Microeconomics, Steven A. Greenlaw, David Shapiro, 2nd Edition, 2017, ISBN:978-1-947172-34-0 |
| 4. | Macroeconomics: Theory and Policy, Dwivedi D.N, 5th Edition, 2021, McGraw Hill Education; ISBN : 9789353163334 |

| **RUBRIC FOR SEMESTER END EXAMINATION (THEORY)** | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| **RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)** | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| Semester VI | | | | | | |
|---|---|---|---|---|---|---|
| **SUPPLY CHAIN MANAGEMENT**<br>**Category: Professional Core**<br>**(Theory & Practice)** | | | | | | |
| **Course Code** | **:** | **IM362IA** | | **CIE** | **:** | **100 + 50 Marks** |
| **Credits: L:T:P** | **:** | **3:0:1** | | **SEE** | **:** | **100 + 50 Marks** |
| **Total Hours** | **:** | **45L + 30P** | | **SEE Duration** | **:** | **03 + 03 Hours** |

| **UNIT-I** | **09 Hrs** |
|---|---|
| **Building a Strategic Frame Work to Analyse Supply Chains:** Definition and Objective of Supply Chain, The importance of Supply Chain Decisions, Decision Phases in a Supply Chain, Process View of Supply Chains. Competitive and Supply Chain Strategies, Achieving Strategic fit, Expanding Strategic Scope. Drivers of Supply Chain Performance, Frame work for Structuring Drivers, Facilities, Inventory, Transportation, Information, Sourcing, Pricing, Infrastructure, International Logistics. | |
| **UNIT – II** | **09Hrs** |
| **Designing The Supply Chain Network:** The Role of Distribution in the Supply Chains, Factors influencing Distribution Network design, Design Options for a Distribution Network, Online sales and the Distribution network, Distribution Networks in practice. Factors influencing network design decisions, Framework for Network design decisions, The impact of uncertainty on network design, The impact of Globalization on Supply Chain networks, Risk Management in Global Supply Chains, Discounted cash flow analysis, Evaluating Network Design Decisions **Problems**. | |
| **UNIT –III** | **09Hrs** |
| **Planning and Managing Inventories in a Supply Chain:** The Role of Cycle inventory in a Supply Chain, Economies of Scale to Exploit Fixed costs, Managing Multi-echelon Cycle Inventory. The Role of Safety Inventory in a Supply Chain, Determining appropriate level of Safety inventory, Impact of supply Uncertainty on Safety inventory, Impact of aggregation on safety inventory, impact of replenishment policies on safety inventory, Managing Safety Inventory in a Multi-echelon Supply Chain, The Role of IT in inventory management. **Problems** | |
| **Unit –IV** | **09Hrs** |
| **Designing And Planning Transportation Networks:** The role of transportation in a Supply chain, Modes of transportation and their performance characteristics, Transportation infrastructure and policies, Design options for a transportation network, Trade-offs in transportation design, Tailored transportation, The role of IT in transportation, **Problems.**<br>**Sourcing Decisions In A Supply Chain:** The role of sourcing in a supply chain, in-house or outsource, Third- and Fourth-party logistics providers, Total cost of Ownership, Supplier selection-Auctions and Negotiations, Sharing Risk and Reward in the Supply chain. | |
| **UNIT –V** | **09 Hrs** |
| **Digital Supply Chain:** The role of IT in a supply chain, The supply chain IT framework, The supply chain macro processes, Lack of Supply Chain co-ordination and the Bullwhip effect, managerial levers to achieve coordination, continuous replenishment and vendor-managed inventories, collaborative planning, forecasting and replenishment (CPFR). | |

| **SUPPLY CHAIN MANAGEMENT LABORATORY**<br>**Part – I** | |
|---|---|
| 1. | Exercises on designing supply chain networks: Facility location models, Network optimization models. |
| 2. | Planning supply chain inventory and sensitivity analysis: Cycle inventory, Safety inventory and Product availability, Inventory aggregation. |

| **Part – II** | |
|---|---|
| 3. | Exercises on transportation design: Transportation cost and inventory cost trade off, Customer response and transportation cost trade off, Routing and scheduling. |
| 4. | Exercises on Designing Marketing Campaign, Customer Service and Customer Order Processing. |
| 5. | Demonstration Exercises on the beer game, illustrating bullwhip effect; Risk Pool Game; Auctions |

| Course Outcomes: After completing the course, the students will be able to | |
|---|---|
| **CO1:** | Understand supply chain concepts, systemic and strategic role of SCM in global competitive environment. |
| **CO2:** | Evaluate alternative supply and distribution network structures using optimization models. |
| **CO3:** | Develop optimal sourcing and inventory policies in the supply chain context. |
| **CO4:** | Select appropriate information technology frameworks for managing supply chain processes. |

| Reference Books | |
|---|---|
| **1.** | Supply Chain Management – Strategy, Planning & Operation, Sunil Chopra, Peter Meindl & D V Kalra, 6th Edition, 2016, Pearson Education Asia; ISBN: 978-0-13-274395-2. |
| **2.** | Supply Chain Management – Creating Linkages for Faster Business Turnaround, Sarika Kulkarni & Ashok Sharma, 1st Edition, 2004, TATA Mc Graw Hill, ISBN: 0-07-058135–5 |
| **3.** | Designing & Managing the Supply Chain – Concepts Strategies and Case Studies, David Simchi Levi, Philip Kaminsky, Edith Simchi Levi & Ravi Shankar, 3rd Edition, 2008, Mc Graw Hill, ISBN: 978- 0-07-066698-6 |
| **4.** | Modelling the Supply Chain, Jeremy F Shapiro, 2nd Edition, 2009, Cengage Learning, ISBN 0-495-12609-8. |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50 Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**. | **40** |
| 4. | **LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (20 Marks),lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (20 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50 MARKS | **50** |
| | **MAXIMUM MARKS FOR THE CIE** | **150** |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q.NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type of questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of THREE Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| RUBRIC FOR SEMESTER END EXAMINATION (LAB) | | |
|---|---|---|
| **Q.NO.** | **CONTENTS** | **MARKS** |
| 1 | Write Up | 10 |
| 2 | Conduction of the Experiments | 20 |
| 3 | Viva | 20 |
| | **TOTAL** | **50** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **ERGONOMICS**<br>**Category: Professional Core**<br>**(THEORY & PRACTICE)** | | | | | | |
| **Course Code** | **:** | **IM363IA** | | **CIE** | **:** | **100 + 50 Marks** |
| **Credits: L:T:P** | **:** | **3:0:1** | | **SEE** | **:** | **100 + 50 Marks** |
| **Total Hours** | **:** | **42L+ 30P** | | **SEE Duration** | **:** | **03 + 03 Hours** |

| **UNIT-I** | **08 Hrs** |
|---|---|
| **Introduction**: Human Factors Engineering, Goals and Process of Human Factors Engineering, Scope of Human Factors Engineering , Systems Thinking, Scientific Base of Human Factors Engineering<br>**Design Methods:** Human factors in design and evaluation, Understanding users, context and tasks, How to perform task, Iterative design an refinement, Evaluation. | |
| **UNIT-II** | **09 Hrs** |
| **Engineering Anthropometry and workspace design:** Human variability and statistics**,** Anthropometric data, Principles of work space design, Design for standing and sitting work.<br>**Biomechanics of work:** The musculoskeletal system, Biomechanical model, Low back problems, NIOSH lifting guide, Cumulative Trauma disorder. | |
| **UNIT-III** | **09 Hrs** |
| **Displays and Controls:** Types of displays and tasks, fifteen principles of display design, labels and icons, monitoring displays and integrative displays, Navigation displays and maps**,** Types of controls and tasks, Information theory, fifteen principles of discrete control, discrete and continuous controls. | |
| **UNIT-IV** | **09 Hrs** |
| **Design for individual differences:** design for people with functional limitations, design for aging, design for children, design for all | |
| **UNIT-V** | **07 Hrs** |
| **Cognitive Ergonomics:** Cognitive environment, Information processing model of cognition, selective attention and perception, working memory, long term memory, Divided attention and time sharing<br>**Human Computer Interaction:** Matching interaction style to users and tasks, Interaction styles, Theories of interface and interaction, Fifteen principles of HCI design, | |

| **ERGONOMICS LABORATORY** |
|---|
| • Experiments on fatigue measurement using bio-medical parameter.<br>• Experiments on Measurement of anthropometric data.<br>• Experiments on evaluation workstation.<br>• Experiments on Measurement of local muscle activity using EMG.<br>• Experiments on virtual evaluation workstation. |

| **Course Outcomes: After completing the course, the students will be able to** | |
|---|---|
| **CO1:** | Explain the fundamental principles of ergonomics, including anthropometry, biomechanics, and human factors |
| **CO2:** | Apply ergonomic principles to the design and evaluation of workspaces, products, and interfaces and develop skills in conducting ergonomic assessments. |
| **CO3:** | Analyze ergonomic risks in different settings and identify factors contributing to work-related musculoskeletal disorders (WMSDs). |
| **CO4:** | Evaluate the effectiveness of ergonomic interventions and assess ergonomic improvements in terms of their impact on worker health and performance. |

| **Reference Books** | |
|---|---|
| **1.** | Mark S. Sanders and Ernest J Mc McCormick; Human Factors in Engineering and Design; McGraw-Hill and Co. Singapore, 7th Edition, 1992, ISBN: 0-07-112826-3. |
| **2.** | R S Bridger, Introduction to Ergonomics, Taylor & Francis, 2nd Edition, 2003, ISBN: 0415273781. |
| **3.** | Gavriel. Salvendy-Editor, Handbook of Human Factors and Ergonomics, Wiley, Hoboken, New Jersey, USA, 3rd Edition, 2006, ISBN: 0471116904. |
| **4.** | Chandler Allen Phillips, Human Factors Engineering, John Wiley and Sons, New York, 2000 |

| **RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION** | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50 Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**. | **40** |
| 4. | **LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (20 Marks),lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (20 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50 MARKS | **50** |
| | **MAXIMUM MARKS FOR THE CIE** | **150** |

| **RUBRIC FOR SEMESTER END EXAMINATION (THEORY)** | | |
|---|---|---|
| **Q.NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type of questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of THREE Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| **RUBRIC FOR SEMESTER END EXAMINATION (LAB)** | | |
|---|---|---|
| **Q.NO.** | **CONTENTS** | **MARKS** |
| 1 | Write Up | 10 |
| 2 | Conduction of the Experiments | 20 |
| 3 | Viva | 20 |
| | **TOTAL** | **50** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **HUMAN RESOURCE MANAGEMENT & ANALYTICS**<br>**Category: Professional Core Elective**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **IM364TA** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:1:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **45L + 24T** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **09 Hrs** |
|---|---|
| **Introduction to Human Resource Management:** Objectives of HRM, Importance of HRM, Line & Staff aspects of HRM, Duties & Responsibilities of HRM and Competencies of HRM.<br>**Job Analysis & Talent Management:** Talent Management Process, Basics of Job Analysis, Methods for collecting Job Analysis Information and Writing Job Descriptions & Specifications | |
| **Unit – II** | **09 Hrs** |
| **Personnel Planning & Recruiting:** Workforce Planning & Forecasting, Recruitment Process and Internal & External Sources of Candidates.<br>**Employee Testing, Selection & Interviewing:** Basics of Testing & Selecting Employees, Types of Tests, Work Samples & Simulations, Background Investigation & Other Selection Methods, Basic Types of Interviews. | |
| **Unit –III** | **09 Hrs** |
| **Training & Development:** Orienting & Onboarding New Employees, Training Process, Implementing Training Program, Implementing Management Development Programs and Evaluating Training Process.<br>**Performance Management & Appraisal:** Basics of Performance Management & Appraisal, Techniques for Appraising Performance, Managing Appraisal Interview, Talent Management & Employee Appraisal | |
| **Unit –IV** | **09 Hrs** |
| **HR Analytics**: Introduction, Alignment of HR Analytics with Business Goals and Strategies, Strategies and Business-aligned HR Analytics, Applications of HR and Predictive Analytics, HR Analytics Framework and Models. HR Decision-making.<br>**HR Business Process and HR Analytics**: Introduction, Statistical Modelling for HR Research, HR Research Tools and Techniques, Data Analysis, HRIS for HR Decision-making, HR, Recruitment, Training and Development Metrics, HR Scorecard & Dashboards. | |
| **Unit –V** | **09 Hrs** |
| **HR Analytics and Data**: Introduction, Big Data for Human Resources, Transforming HR Data into HR Information, Process of Data Collection for HR Analytics, Data Collection for Effective HR Measurement, HR Reporting, HR Report Visualization, Root Cause Analysis, Datafication of Human Resources.<br>**HR Analytics and Predictive Modelling**: Introduction, Different Phases of HR Analytics or HR Predictive Modelling and examples, Data and Information for HR Predictive Analysis, Software Solutions, Predictive Analytics Tools and Techniques. | |

| **Course Outcomes: After completing the course, the students will be able to** | |
|---|---|
| **CO1** | Provide students with an understanding of HRM fundamentals, job analysis techniques, and talent management strategies essential for effective workforce planning and development. |
| **CO2** | Understand and Demonstrate the processes of planning, recruitment, employee selection, and interviewing techniques in organizations. |
| **CO3** | Analyzing the techniques for training and development and evaluate the performance appraisal measures in present-day organizations. |
| **CO4** | Equip students with foundational knowledge and skills in using data and analytics for informed decision-making in Human Resources. |

| Reference Books | |
|---|---|
| **1** | Human Resource Management, Gary Dessler & Biju Varkkey, 17th Edition, 2023 Pearson, ISBN-13: 9780137930654 |
| **2** | HR Analytics: Understanding Theories and Applications, Dipak Kumar Bhattacharyya, SAGE Publications, 2017, ISBN:9789386062710 |
| **3** | Human Resource Management: Text and Cases, Aswathappa, K,2013, McGraw Hill Education, isbn: 978125902682 |
| **4** | Predictive HR Analytics: Mastering the HR Metric, Dr Martin R. Edwards, Kirsten Edwards, 2019 Kogan Page, ISBN:9780749484453 |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **FACILITIES PLANNING AND DESIGN**<br>**Category: Professional Core -Elective-III**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **IM365TDA** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **42L** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **08 Hrs** |
|---|---|
| **Introduction:** Facilities planning defined, significance of facilities planning, objectives of facilities planning, facilities planning process, strategic planning process, developing facilities planning strategies, examples of inadequate planning.<br>**Plant Location and Layout:** Factors influencing plant location, Theories of plant location. Objectives of plant layout, Principles of plant layout, types of plant layout, their merits and demerits, numerical on plant location. | |
| **Unit – II** | **08 Hrs** |
| **Materials Handling:** Introduction, scope and definition of material handling, material handling principle, designing material handling systems, unit load design, material handling equipment, estimating material handling costs, safety considerations. | |
| **Unit –III** | **08 Hrs** |
| **Computer Aided Layout:** Introduction, CRAFT, COFAD, PLANET, CORELAP, ALDEP. Numerical on CRAFT / ALDEP.<br>**Warehouse Operations:** Introduction, Mission of a warehouse, functions in the warehouse, receiving & shipping operations, dock locations, storage operations, order picking operations. | |
| **Unit –IV** | **08 Hrs** |
| **Designing of Material flow:** Factors for consideration in planning material flow. Designing of Layout corresponding to typical types of Flow: Straight Line Flow / U Flow / S flow, Numerical on material flow. Examples on hospitals, super & hyper markets, airports, petrol stations, hotels, IT & ITES sector. | |
| **Unit –V** | **10 Hrs** |
| **Facilities Design for Manufacturing Systems:** Introduction, fixed automation systems, flexible manufacturing systems, single-stage multi-machine systems, reduction of work-in-process, Just-In-Time Manufacturing, facilities planning trends. | |

| **Course Outcomes: After completing the course, the students will be able to know** | |
|---|---|
| **CO1:** | Understand the factors influencing decisions related to plant locations, layout and material handling. |
| **CO2:** | Recognize the influence of planning process and strategies and their effect on facility location planning. |
| **CO3:** | Develop different layout plans and their operations on warehouse. |
| **CO4:** | Evaluate different flow systems of a facility. |

| **Reference Books** | |
|---|---|
| **1.** | Facilities Planning, James A Tompkins, John A White, Yavuz A Bozer, J M A Tanchoco, 4th Edition, 2010, John Wiley & Sons INC, ISBN- 978-0-470-44404-7. |
| **2.** | Plant Layout and Material Handling, James M Apple, 3rd Edition, January 1991, Krieger Pub Co., ISBN-13: 978-0894645457. |
| **3.** | Facility layout and Location, Francies, R.L. and White, J.A, 2nd Edition, 1998, Prentice Hall of India, ISBN: 8120314603. |
| **4.** | Facilities Design, Sunderesh Heragu, 4th edition, 2016, CRC Press, ISBN: 978-1-4987-3290-1 |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **SERVICE OPERATIONS MANAGEMENT**<br>**Category: Professional Core Elective-III**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **IM365TDB** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **42L** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **08 Hrs** |
|---|---|
| **Introduction to service operations management:** Introduction, what is service operations management? The challenges facing service operations managers, different types of services, different types of service processes, judging the success of a service operation | |
| **Unit – II** | **08 Hrs** |
| **The service concept:** the service concept, the service concept defined, the service concept as a strategic tool, focused and unfocussed service operations<br>**Customers and relationships:** customers and customer segmentation, customer retention, managing customer relationships | |
| **Unit –III** | **09 Hrs** |
| **Customer expectations and satisfaction:** customer satisfaction, service quality and confidence, customer expectations, defining expectations-service quality factors, finding expectations and assessing satisfaction, managing perceptions<br>**Managing supply relationships:** types of supply relationships, managing service supply chains, managing through intermediaries, supply partnerships, service level agreements | |
| **Unit –IV** | **08 Hrs** |
| **Service processes:** service processes and their importance, understanding the nature of service processes, engineering service processes, controlling service processes, repositioning service processes<br>**Service people:** understanding the pressures on service providers, managing and motivating service providers, managing customers | |
| **Unit –V** | **09 Hrs** |
| **Resource utilization:** capacity management, operations planning and control, managing bottlenecks and queues, managing the coping zone, improving resource utilization<br>**Performance measurement:** the purpose of Performance measurement, a balance of measures, Interlinking, targets and rewards, benchmarking | |

| **Course Outcomes:** After completing the course, the students will be able to | |
|---|---|
| **CO1** | Develop an understanding of the terminology and responsibilities that relate to Service Operations Management. |
| **CO2** | Formulate and describe the function of the Service Operations Management discipline in various sectors of the economy through case study. |
| **CO3** | Obtain a set of basic tools and skills used in solving problems traditionally associated with operating the service operations system. |
| **CO4** | Explore the interface of Service Operations Management with the other management functions, such as marketing, procurement & sourcing, outsourced good & services and customers. |

| **Reference Books** | |
|---|---|
| 1. | Service Operations Management, Improving Service Delivery, Robert Johnston, Graham Clark, 2nd Edition, 2008, Pearson, ISBN:*8131715205* |
| 2. | Service Operations Management, Richard Metters, King-Metters, Steve Walton, 13th Edition, 2002, South-Western, ISBN: 978-0324135565 |
| 3. | Service Operations Management: The Total Experience, David W. Parker, 13th Edition, 2012, Edward Elgar Pub, ISBN-978-1781007860 |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **ADDITIVE MANUFACTURING**<br>**Category: Professional Core - Elective -III**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **IM365TDC** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **42 L** | | **SEE Duration** | **:** | **03 Hours** |

| **UNIT-I** | **08 Hrs** |
|---|---|
| **Introduction:** Definition of Prototype, Types of prototype, Need for the compression in product development, History of RP systems, classification of RP systems, Process Chain of RP. | |
| **UNIT-II** | **08 Hrs** |
| Liquid Based Rapid Prototyping System: Stereo lithography Systems - Principle, process specification & materials, advantages and disadvantages.<br>Rapid Freeze Prototyping: Principle, process specification & materials, advantages and disadvantages. | |
| **UNIT-III** | **08 Hrs** |
| Solid Based Rapid Prototyping System: Fused Deposition Modeling (FDM): Principle, Process specification & materials, advantages and disadvantages.<br>Laminated Object Manufacturing (LOM): Principle, LOM specification & materials, advantages and disadvantages.<br>3D System's Multi-Jet Modelling System (MJM): Principle, process specification & advantages and disadvantages. | |
| **UNIT-IV** | **10 Hrs** |
| Powder Based Rapid Prototyping System: Selective Laser Sintering (SLS): Principle of operation, process parameters, advantages and disadvantages.<br>Laser Engineering Net Shaping (LENS): Principle of operation, process parameters, advantages and disadvantages.<br>3-D Printer: Principle of operation, process parameters, advantages and disadvantages. | |
| **UNIT-V** | **08 Hrs** |
| Rapid Prototyping Data Formats & Applications: Data Formats, STL Format, STL file problems, consequences of building valid and invalid tessellated models, STL file repair. Applications: Material Relationship, finishing processes, Design, Manufacturing and Tooling, automotive Industry, Jeweler Industry, Coin Industry, Tableware Industry, Arts and architecture. | |

| **Course Outcomes: After completing the course, the students will be able to** | |
|---|---|
| CO1 | Explain the basic principles and methodology of various additive manufacturing processes that are used for the production of mechanical parts and products. |
| CO2 | Compare and contrast the advantages and limitations of different additive manufacturing processes |
| CO3 | Solve the problems on processing time and economics of processing of material with respect to a additive manufacturing process. |
| CO4 | Apply the design concept of various additive manufacturing processes when a specific product has to be manufactured. |

| **Reference Books** | |
|---|---|
| **1.** | Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2015. |
| **2.** | C.K.Chua,K.F.Leong C.S Lim "Rapid Prototyping Principles and Applications" Cambridge University Press India Pvt. Ltd. 3rd Edition 2010. ISBN:13:978-81-7596-778-6. |
| **3.** | Pham D.T & Dinjoy S.S "Rapid Manufacturing" Verlog London 2001 |
| **4.** | Terry Wohler's "Wohler's Report 2000" Wohler's Association 2000 |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **DESIGN OF EXPERIMENTS**<br>**Category: Professional Core Elective-III**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **IM365TDD** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **42 L** | | **SEE Duration** | **:** | **03 Hours** |

| **UNIT – I** | **08 Hrs** |
|---|---|
| **Introduction:** Strategy of experimentation, applications, Basic principles, Terminology, Guidelines, History of statistical design.<br>**Principles of quality engineering** – Tools used in robust design, Applications and benefits, Quality loss function, Quadratic loss function, Noise factors, Optimization of product & process design, Role of various quality control activities. | |
| **UNIT – II** | **09 Hrs** |
| **Factorial Experimentation-** The $2^2$ design, The $2^3$ design, The general $2^k$ design, A single replicate of the $2^k$ design, The $3^2$ design. Problems. | |
| **UNIT – III** | **09 Hrs** |
| **Blocking and Confounding in the $2^k$ Factorial Design:** Blocking a replicated $2^k$ factorial design, Confounding in the $2^k$ factorial design, Confounding the $2^k$ factorial design in 2 & 4 blocks. Problems.<br>**Fractional Factorial Designs:** The one – half fraction & one – quarter fraction of the $2^k$ design, Resolution III, IV & V designs. Problems. | |
| **UNIT – IV** | **10 Hrs** |
| **Constructing Orthogonal Arrays**: Counting degrees or freedom, selecting a standard orthogonal array, dummy level technique, and compound factor method. Linear graphs and interaction assignment, modification of linear graphs, column merging method, branching design. Strategy for constructing an orthogonal array. Problems. | |
| **UNIT – V** | **06 Hrs** |
| **Steps In Robust Design** Case study discussion illustrating steps in Robust Design.<br>**Signal-To-Noise Ratio**: Evaluation of sensitivity to noise. S/N ratios for static problems, S/N ratios for dynamic problems.<br>**Advanced Techniques:** Taguchi Inner and Outer Arrays, Shainin Techniques. | |

| **Course Outcomes:** After going through this course the student will be able to: | |
|---|---|
| **CO1:** | Explain principles and concepts of design of experiments and quality engineering. |
| **CO2:** | Illustrate quality engineering and robust design concepts. |
| **CO3:** | Develop factorial, fractional factorial and orthogonal array designs for product and process optimization |
| **CO4:** | Conduct experiments and analyse data for product and process improvements. |

| **Reference Books:** | |
|---|---|
| **1.** | Design and Analysis of Experiments, D.C. Montgomery, 5th Edition, 2006, Wiley India, ISBN – 812651048-X. |
| **2.** | Quality Engineering Using Robust Design, Madhav S. Phadke, 1989, Prentice Hall PTR, Englewood Cliffs, New Jersey 07632, ISBN: 0137451679. |
| **3.** | Designing for Quality – an Introduction Best of Taghuchi and Western Methods or Statistical Experimental Design, Robert H. Lochner, Joseph E. Matar, 1st Edition, 1990, Chapman and Hall, ISBN – 0412400200 |
| **4.** | Taguchi Techniques for Quality Engineering: Loss Function, Orthogonal Experiments, Parameter and Tolerance Design, Philip J. Ross, 2nd Edition, 1996, McGraw-Hill, ISBN: 0070539588 |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **PRINCIPLES OF FLUID MECHANICS AND THERMODYNAMICS**<br>**Category: Professional Core -Elective-III**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **IM365TDE** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **42L** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **08 Hrs** |
|---|---|
| **Introduction, Basic Concepts & Properties of Fluid:** Definition of fluid, density, Specific weight, specific volume, specific gravity, viscosity, surface tension, capillarity compressibility, bulk modulus, vapour pressure, cavitation, classification of fluids, No-slip condition, definition of fluid pressure,<br>pascal's law, hydrostatic law, pressure measurements using simple and u-tube differential manometers. Simple numerical | |
| **Unit – II** | **08 Hrs** |
| Dynamics of Fluid Flow: Derivation of Euler's equation of motion, Bernoulli equation for real fluids, applications of Bernoulli equation-venturimeter, orifice meter, pitot-tube. Simple numerical<br>Flow through Pipes: Introduction, loss of energy in pipes, Darcy-weisbach formula, minor energy losses due to sudden enlargement, sudden contraction (No derivation), entrance to a pipe and exit of a pipe, concept of hydraulic gradient and total energy line. Simple numerical | |
| **Unit –III** | **08 Hrs** |
| **Basic Concepts of Thermodynamics:** System, control volume, properties, processes, cycles, thermodynamic equilibrium, Quasi-static process, temperature, zeroth law of thermodynamics, thermometers and thermometric properties, temperature scales, Numerical.<br>**First Law of Thermodynamics:** Closed system undergoing a cycle, change of state, energy – a property of system, enthalpy and specific heats, PMMM1, Flow processes- energy analysis of steady flow systems. Examples- Turbine, compressor, nozzle-Numerical. | |
| **Unit –IV** | **09 Hrs** |
| **Second law of thermodynamics:** Thermal energy reservoirs, heat engine-thermal efficiency, pump-coefficient of performance, statements, equivalence of two statements, PMMM2, carnot cycle, reversible and irreversible processes, Numerical. | |
| **Unit –V** | **09 Hrs** |
| **Work and Heat Transfer:** Work transfer, pdv-work or displacement work, path and point functions, pdv-work in various Quasi-static processes, Other types of work transfers- electrical work, shaft work,<br>paddle wheel work or stirring work, flow work, heat transfer, similarities and dissimilarities between heat and work transfers. Simple numericals. | |

| **Course Outcomes: After completing the course, the students will be able to:-** | |
|---|---|
| **CO1** | Explain the properties of fluid in engineering design. |
| **CO2** | Evaluate measures resulting from the first law of thermodynamics on closed systems. |
| **CO3** | Apply the second law of thermodynamics for control volumes undergoing steady state flow processes. |
| **CO4** | Formulate and solve complex problems in fluid mechanics and thermodynamics using analytical and computational methods. |

| **Reference Books** | |
|---|---|
| 1. | Fluid Mechanics – Fundamentals & Application, Yunus A Cencgal and John M Cimbala, 2nd Edition, 2006, Tata McGraw Hill publications, ISBN: 978-0-07-070034-5. |
| 2 | A Textbook of Fluid Mechanics, Dr. R.K.Bansal, 1st Edition, 2008, Laxmi Publications, ISBN8131802949, 9788131802946 |
| 3 | Thermodynamics - An Engineering Approach, Yunus A Cencgal and Michael A. Boles, 5th Edition, 2006, Tata McGraw Hill publications, ISBN: 0072884959. |
| 4 | Engineering Thermodynamics, Nag P K, Tata McGraw Hill, 4th Edition, 2011,ISBN-13:978-0- 07-026062-7: ISBN-10:0-07-026062-1 |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| Semester: V | | | | | | |
|---|---|---|---|---|---|---|
| **FUNDAMENTALS OF AEROSPACE ENGINEERING**<br>**Category: Institutional Electives-I GROUP-E**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **AS266TEA** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **45L** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **09 Hrs** |
|---|---|
| **Basics of Flight Vehicles:** History of aviation, International Standard atmosphere (ISA), Temperature, pressure and altitude relationships, Simple Problems on Standard Atmospheric Properties, Classification of aircrafts, Anatomy of an aircraft & Helicopters, Basic components and their functions. | |
| **Unit – II** | **10 Hrs** |
| **Aircraft Aerodynamics:** Bernoulli's theorem, Centre of Pressure, Lift and Drag, Types of Drag, Aerodynamic Coefficients, Aerodynamic Centre, Wing Planform Geometry, Airfoil Nomenclature, Basic Aerodynamic characteristics of Airfoil, Simple Numericals on Lift and Drag. | |
| **Unit –III** | **12 Hrs** |
| **Aerospace Propulsion:** Introduction, Turbine Engines: Brayton Cycle, Operation of Turbojet, Turboprop, Turbofan, Turboshaft, RAMJET and SCRAMJET Engines, Rocket Engines: Principles of operation of Solid, Liquid, Hybrid, Nuclear and Electric Rockets.<br>**Introduction to Space Mechanics:** Basic Orbital Mechanics-Types of Trajectories, Escape and Orbital Velocities, Kepler's Laws of Planetary Motion, Simple Numericals. | |
| **Unit –IV** | **06 Hrs** |
| **Aerospace Structures and Materials:** General types of construction-Monocoque, Semi-Monocoque & Geodesic, Structure of Wing and Fuselage, Metallic and Composite Materials. | |
| **Unit –V** | **08 Hrs** |
| **Aircraft Systems & Instruments:** Instrument Displays, Basic Air data systems & Pitot Probes- Mach meter, Air speed indicator, Vertical speed indicator, Altimeter.<br>**Basics of Aircraft Systems:** Hydraulic and pneumatic systems, Electrical System, Aircraft Fuel System, Environmental Control System. | |

| **Course Outcomes:** At the end of this course the student will be able to : | |
|---|---|
| **CO1:** | Identify the fundamental nuances of Aerospace Engineering and appreciate their significance on the Flight Vehicles design and performance |
| **CO2:** | Interpret the design parameters that influence the design of the Aerospace Vehicles systems and its sub-systems |
| **CO3:** | Evaluate critically the design strategy involved in the development of Aerospace vehicles |
| **CO4:** | Categorically appraise the operation of the Aerospace Vehicles for different operating conditions |

| **Reference Books** | |
|---|---|
| **1** | Introduction to Flight, John D. Anderson, 7th Edition, 2011, McGraw-Hill Education, ISBN 9780071086059. |
| **2** | Fundamentals of Aerodynamics, Anderson J .D, 5th Edition, 2011, McGraw-Hill International Edition, New York ISBN:9780073398105. |
| **3** | Rocket Propulsion Elements, Sutton G.P., 8th Edition, 2011, John Wiley, New York, ISBN: 1118174208, 9781118174203. |
| **4** | Aircraft structural Analysis, T.H.G Megson, 2010, Butterworth-Heinemann Publications, ISBN: 978-1-85617-932-4 |
| **5** | Ian Moir, Allan Seabridge, "Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration", John Wiley & Sons, 3rd edition, 2011, ISBN: 9781119965206 |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**. | **40** |
| **MAXIMUM MARKS FOR THE CIE THEORY** | | **100** |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | **20** |
| | **PART B**<br>(Maximum of THREE Sub-divisions only) | |
| 2 | Unit 1: (Compulsory) | **16** |
| 3 & 4 | Unit 2: Question 3 or 4 | **16** |
| 5 & 6 | Unit 3: Question 5 or 6 | **16** |
| 7 & 8 | Unit 4: Question 7 or 8 | **16** |
| 9 & 10 | Unit 5: Question 9 or 10 | **16** |
| **TOTAL** | | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **BIOINFORMATICS**<br>**Category: Institutional Electives-I GROUP-E**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **BT266TEB** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **45 Hrs** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **09 Hrs** |
|---|---|
| **Introduction to tools and databases:** Introduction to Bioinformatics, Goals, Scope, Applications, Sequence databases, Structure databases, Special databases – genome and microarray, Applications of these databases, examples, Database similarity search: Unique requirements of database searching, Heuristic Database Searching, Basic Local Alignment Search Tool (BLAST), FASTA, Comparison of FASTA and BLAST, Database Searching with Smith-Waterman Method | |
| **Unit – II** | **09 Hrs** |
| **Sequence Analysis:** Types of Sequence alignment -Pairwise and Multiple sequence alignment, Alignment algorithms, Scoring matrices, Statistical significance of sequence alignment. Multiple Sequence Alignment: Scoring function, Exhaustive algorithms, Heuristic algorithms, Profiles and Hidden Markov Models: Position-Specific scoring matrices, Profiles, Markov Model and Hidden Markov Model, Scoring matrices – BLOSSUM and PAM<br>**Molecular Phylogenetics:** Introduction, Terminology, Forms of Tree Representation. Phylogenetic Tree Construction Methods - Distance-Based, Character-Based Methods and Phylogenetic Tree evaluation. | |
| **Unit –III** | **09 Hrs** |
| **Introduction to Next-Generation Sequencing (NGS) analysis**: Sanger sequencing principles - history and landmarks, of Sequencing Technology Platforms, A survey of next-generation sequencing technologies, A review of DNA enrichment technologies, Base calling algorithms, Base quality, phred values, Reads quality checks, Interpretations from quality checks. Adapter and primer contamination. Processing reads using clipping of reads-Advantages and disadvantages of processing of reads, automation in NGS analysis and advantages (shell scripting) | |
| **Unit –IV** | **09 Hrs** |
| **Structural analysis & Systems Biology:** Gene prediction programs – ab initio and homology-based approaches. ORFs for gene prediction. Detection of functional sites and codon bias in the DNA. Predicting RNA secondary structure, Protein structure basics, structure visualization, comparison and classification. Protein structure predictive methods using protein sequence, Protein identity based on composition. Structure prediction - Prediction of secondary structure, tertiary structure prediction methods, Scope, Applications. Concepts, implementation of systems biology, Mass spectrometry and Systems biology, Flux Balance analysis. | |
| **Unit –V** | **09 Hrs** |
| **Drug Screening:** Introduction to Computer-aided drug discovery, target selection, ligand preparation and enumeration, molecular docking, post-docking processing, molecular dynamics simulations, applications and test cases, AI/ML in Drug discovery | |

| **Course Outcomes:** After completing the course, the students will be able to:- | |
|---|---|
| **CO1** | Gain proficiency in utilizing a range of bioinformatics tools and databases for comprehensive sequence and structural analysis. |
| **CO2** | Investigate and apply innovative sequencing technologies and analytical methods to solve complex biological questions and advance research in genomics and molecular biology. |
| **CO3** | Demonstrate expertise in NGS technologies, including performing data quality assessments, read processing, and managing large-scale data. |
| **CO4** | Apply bioinformatics tools for modeling and simulating biological processes, with a focus on gene prediction using both ab initio and homology-based approaches. |

| **Reference Books** | |
|---|---|
| 1 | Xiong J. Essential bioinformatics. Cambridge University Press; 2006 Mar 13. |
| 2. | Buehler LK, Rashidi HH, editors. Bioinformatics basics: applications in biological science and medicine. CRC Press; 2005 Jun 23. |
| 3. | Ghosh Z, Mallick BM. Bioinformatics principles and Applications. Oxford University Press; 2018 Jun 13. |
| 4. | Low L, Tammi MT. Introduction to next generation sequencing technologies. Bioinformatics. WORLD SCIENTIFIC. 2017 Jul 26:1-21. |
| 5. | Bioinformatics: Sequence and Genome Analysis; D W Mount; 2014; CSHL Press; 2nd edn; ISBN: 9780879697129. |
| 6. | Computational Systems Biology; A Kriete and R Eils; 2006; Academic Press; Illustrated edn; ISBN: 978-01-208-87866. |

| **RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)** | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| **MAXIMUM MARKS FOR THE CIE THEORY** | | **100** |

| **RUBRIC FOR SEMESTER END EXAMINATION (THEORY)** | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B** | |
| (Maximum of TWO Sub-divisions only; wherein one sub division will be a caselet in the related topics) | | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| **TOTAL** | | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **INDUSTRIAL SAFETY ENGINEERING**<br>**Category: Institutional Electives-I GROUP-E**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **CH266TEC** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **45L** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **08 Hrs** |
|---|---|
| **Introduction Safety:**<br>Introduction to industrial safety engineering, major industrial accidents, safety and health issues, key concepts and terminologies, Hazard theory, Hazard triangle, Hazard actuation, Actuation transition, Causal factors, problems on OSHA | |
| **Unit – II** | **08 Hrs** |
| **Risk assessment and control:** Risk assessment, Risk perception, acceptable risk, problems on net present value, internal rate of return, payback period concepts including real life examples.<br>**Hazard Identification Methods:** Preliminary Hazard List (PHL), worksheets, case study. Preliminary Hazard Analysis (PHA), Fault tree and Event tree analysis. Design and development of fault tree and event tree for high pressure reactor system. | |
| **Unit –III** | **08 Hrs** |
| **Hazard analysis:** Hazard and Operability Study (HAZOP): Guide words, HAZOP matrix, Procedure, HAZOP studies on reactors, heat exchanger, design of HAZOP table, Failure Modes and Effects Analysis (FMEA) concept, methodology, problems of FMEA, examples. | |
| **Unit –IV** | **08 Hrs** |
| **Risk analysis on capital budgeting:** Risk adjusted discount rate (RADAR) method, certainty equivalent approach, scenario analysis, probability distribution, quantification of risk using statistical parameters and associated problems. | |
| **Unit –V** | **08 Hrs** |
| **Safety in process industries and case studies: Personnel Protection Equipment (PPE):** Safety glasses, face shields, welding helmets, absorptive lenses, hard hats, types of hand PPE, types of foot PPE, types of body PPE. Bhopal gas tragedy, Chernobyl nuclear disaster, Chemical plant explosion and fire. | |

| **Course Outcomes: After completing the course, the students will be able to:-** | |
|---|---|
| CO1 | Understand the risk assessment techniques used in process industry |
| CO2 | Interpret the various risk assessment tools. |
| CO3 | Use hazard identification tools for safety management. |
| CO4 | Analyze tools and safety procedures for protection in process industries. |

| **Reference Books** | |
|---|---|
| 1. | Functional Safety in the Process Industry: A Handbook of practical Guidance in the application of IEC61511 and ANSI/ISA-84, Kirkcaldy K.J.D Chauhan, 2012, North corolina,Lulu publication, ISBN:1291187235. |
| 2. | Safety Instrumented Systems Verification Practical probabilistic calculations, Goble and William M., 2005, Pensulvania ISA publication, ISBN:155617909X. |
| 3. | Industrial safety and risk Management, Laird Wilson and Doug Mc Cutche, 1st Edition, 2003,The University of alberta press,Canada, ISBN: 0888643942. |
| 4. | ndustrial Safety, Health and Environment Management Systems, R K Jain, Sunil S Rao, 4th Edition, 2005, Khanna Publishers, New Delhi, ISBN: 8174092102. |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **ROBOTIC PROCESS AUTOMATION**<br>**Category: Institutional Electives-I GROUP-E**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **CS266TED** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Duration** | **:** | **45 L** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit – I** | **8 Hrs** |
|---|---|
| **RPA Concepts**: RPA Basics, History of Automation, what is RPA? RPA vs Automation, Processes & Flowcharts, Programming Constructs in RPA, What Processes can be Automated? Types of Bots, Workloads that can be automated.<br>**RPA Advanced Concepts**: Standardization of processes, Setting up the Centre of Excellence, RPA Development methodologies, Difference from SDLC, RPA journey, RPA business case, RPA Team, Process Design Document/Solution Design Document, Industries best suited for RPA, Risks & Challenges with RPA, RPA and emerging ecosystem. | |
| **Unit – II** | **7 Hrs** |
| **RPA Tool Introduction:** Introduction to UiPath - the User Interface, Types of Variables, Variables in UiPath, Managing Arguments, The Arguments Panel, Namespaces; Control flow statements in UiPath, Sequences and Flowcharts, Control Flow Activities<br>Data Manipulation Introduction, Data Manipulation Operations, Types of data storing variables, Text Manipulation, main string methods.<br>**UiPath Recording:** Basic, Desktop and Web Recording, Image and Native Citrix Recording, Input/output methods, Types of OCR, Data Scraping, Advanced Scraping techniques. | |
| **Unit – III** | **7 Hrs** |
| **Advanced Automation Concepts:** Selectors, Types of Selectors (Full, partial, dynamic), Defining and Assessing Selectors, Customization, Debugging.<br>Image, Text & Advanced Citrix Automation – Introduction, Keyboard based automation, Information Retrieval, Best Practices Excel Data Tables & PDF, Data Tables in RPA, Excel and Data Table, Extracting Data from Data Table, Anchors, Using anchors in PDF | |
| **Unit – IV** | **7 Hrs** |
| **Email Automation, Exceptions and Deploying Bots:** Introduction to Email Automation, Key concepts of email, email protocols, email automation in UiPath, email as input and output.<br>Debugging and Exception Handling, Types of exception, Debugging Tools, Strategies for solving issues, Catching errors. Overview of orchestration Server, orchestrator functionalities, Connecting Bot to orchestrator | |
| **Unit – V** | **7 Hrs** |
| **Hyper automation**: Components and application of Hyper automation, Automation versus hyper automation, Benefits and challenges of hyper automation, use cases, Phases (Integration, Discover, Orchestration and Governance), Trends in Hyper automation (low-code/no-code platform, HaaS) | |

| **Course Outcomes:** After completing the course, the students will be able to | |
|---|---|
| **CO1** | Understand RPA principles, its features and applications |
| **CO2** | Demonstrate proficiency in handling variables and decision making inside a workflow and data manipulation techniques |
| **CO3** | Gain insights into recording, Email Automation and exception handling and orchestrator. |
| **CO4** | Analyze the trends in automation and chose business strategy to design a real-world automation workflow. |

| **Reference Books:** | |
|---|---|
| **1.** | Alok Mani Tripathi, "Learning Robotic Process Automation, Publisher: Packt Publishing, Release Date: March 2018 ISBN: 9781788470940 |
| **2.** | PASCAL BORNET, Intelligent automation: Welcome to the world of hyperautomation, World Scientific Publishing Company, ISBN-13: 978-9811235481 December 2020 |
| **3.** | UiPath pdf manuals |
| **4.** | https://www.uipath.com/rpa/robotic-process-automation |
| **5.** | https://www.ibm.com/topics/hyperautomation |
| **6.** | https://www.pega.com/hyperautomation |

| # | COMPONENTS | MARKS |
|---|---|---|
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| **RUBRIC FOR SEMESTER END EXAMINATION (THEORY)** | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B** (Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **INTELLIGENT TRANSPORT SYSTEMS**<br>**Category: Institutional Electives-I GROUP-E**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **CV266TEE** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **45L** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **08 Hrs** |
|---|---|
| Introduction to Intelligent Transportation Systems **(**ITS): Historical background, Urbanisation, Motorisation, Transport system characteristics, Transport problems and issues, Challenges and opportunities in ITS: ITS-Today and tomorrow, ITS training and education needs, Role and importance of ITS in context of Indian Transport system and opportunity for sector growth of ITS. | |
| **Unit – II** | **08 Hrs** |
| ITS Architecture: introduction, Functionalities required for User service, Logical architecture, Physical architecture, Equipment and Market packages, Need of ITS Architecture to solve problems in Urban area. Technology building blocks for ITS: Introduction, Data acquisition, Communication tools, Data analysis and Traveller information. Various detection, Identification and collection methods for ITS. | |
| **Unit –III** | **08 Hrs** |
| Traffic management system components and ITS: Introduction, objectives, traffic management measures, ITS for traffic management, Development of traffic management system, Traffic Management Centre, Advance Traffic Management System, Advanced Traveller Information System, Advance Vehicle Control Systems, Advance Public Transport System, Commercial Vehicle Operations, ITS For Intermodal Freight Transport. | |
| **Unit –IV** | **08 Hrs** |
| ITS Evaluation – Project selection at the planning level, Deployment Tracking, Impact Assessment, Benefits by ITS components, Evaluation Guidelines. ITS for Law Enforcement: Introduction, Enhance and support the enforcement traffic rules and regulations, ITS Funding options. | |
| **Unit –V** | **08 Hrs** |
| ITS Standards-Standard development process, National ITS architecture and standards, ITS standards application areas, National Transportation Communications for ITS Protocol, Standards testing. ITS for smart cities and Case studies. | |

| **Course Outcomes:** After completing the course, the students will be able to:- | |
|---|---|
| **CO1** | Identify and apply ITS applications at different levels |
| **CO2** | Illustrate ITS architecture for planning process |
| **CO3** | Examine the significance of ITS for various levels |
| **CO4** | Compose the importance of ITS in implementations |

| **Reference Books** | |
|---|---|
| 1. | Pradip Kumar Sarkar and Amit Kumar Jain, "Intelligent Transport Systems", PHI Learning Private Limited, Delhi,2018, ISBN-9789387472068 |
| 2. | Choudury M A and Sadek A, "Fundamentals of Intelligent Transportation Systems Planning" Artech House publishers (31 March 2003); ISBN-10: 1580531601 |
| 3. | Bob Williams, "Intelligent transportation systems standards", Artech House, London, 2008. ISBN-13: 978-1-59693-291-3 |
| 4. | Asier Perallos, Unai Hernandez-Jayo, Enrique Onieva, Ignacio Julio García Zuazola "Intelligent Transport Systems: Technologies and Applications" Wiley Publishing ©2015, ISBN:1118894782 9781118894781, |
| 5 | R.P Roess, E.S. Prassas, W.R. McShane. Traffic Engineering, Pearson Educational International, Third Edition, 2004, ISBN-13: 978-0-13-459971-7. |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **INTEGRATED HEALTH MONITORING OF STRUCTURES**<br>**Category: Institutional Electives-I GROUP-E**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **CV266TEF** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **42L** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **08 Hrs** |
|---|---|
| **Structural Health**: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance, Importance of maintenance<br>**Structural Health Monitoring**: Concepts, Various Measures, Analysis of behavior of structures using remote structural health monitoring, Structural Safety in Alteration. | |
| **Unit – II** | **08 Hrs** |
| **Materials:** Piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique, Sensor technologies used in SHM<br>**Structural Audit**: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures, SHM using Artificial Intelligence | |
| **Unit –III** | **08 Hrs** |
| **Static Field Testing:** Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement. | |
| **Unit –IV** | **08 Hrs** |
| **Dynamic Field Testing:** Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring. | |
| **Unit –V** | **08 Hrs** |
| **Remote Structural Health Monitoring**: Introduction, Hardware for Remote Data Acquisition Systems, Advantages, Case studies on conventional and Remote structural health monitoring<br>**Case studies:** Structural Health Monitoring of Bridges, Buildings, Dams, Applications of SHM in offshore Structures- Methods used for non-destructive evaluation (NDE) and health monitoring of structural components | |

| **Course Outcomes: After completing the course, the students will be able to:-** | |
|---|---|
| **CO1** | Diagnose the distress in the structure understanding the causes and factors. |
| **CO2** | Understand safety aspects, components and materials used in Structural Health Monitoring. |
| **CO3** | Assess the health of structure using static field methods and dynamic field tests. |
| **CO4** | Analyse behavior of structures using remote structural health monitoring |

| **Reference Books** | |
|---|---|
| 1 | Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes,2006, John Wiley and Sons, ISBN: 978-1905209019 |
| 2 | Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, 2007,John Wiley and Sons, ISBN:9780470033135 |
| 3 | Structural Health Monitoring and Intelligent Infrastructure, J. P. Ou, H. Li and Z. D. Duan, Vol1,2006,Taylor and Francis Group, London, UK. ISBN: **978-0415396523** |
| 4 | Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, 2007,Academic Press Inc, ISBN: 9780128101612 |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **ADVANCED ENERGY STORAGE FOR E-MOBILITY**<br>**Category: Institutional Electives-I GROUP-E**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **CM266TEG** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **45L** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **07 Hrs** |
|---|---|
| **Energy storage in electric vehicles**<br>Introduction to E-mobility, background of alternative energy sources and sustainability. Types of electric vehicles and their salient features along with their energy requirement. Fundamentals of advanced battery technology. Battery characteristics. Specification of advanced battery for e mobility. | |
| **Unit – II** | **08 Hrs** |
| **Advanced lithium-ion batteries**<br>Basic concepts of lithium batteries. Types of advanced cathode and anode materials employed in lithium batteries. Construction, working and future applications of lithium cobalt oxide, lithium iron phosphate, Lithium air, lithium sulfur and lithium polymer batteries with their advancement in vehicle electrification. | |
| **Unit –III** | **09 Hrs** |
| **Non lithium batteries for e mobility**<br>Limitations of lithium batteries. Overview of non-lithium battery technology. Construction and working of advanced non-Lithium batteries such as Lead acid, Nickel Metal Hydride, Redox flow, Zebra, Sodium and Magnesium batteries. Electrode materials and electrolyte considerations in non lithium batteries. Performance comparison with lithium-ion batteries. Battery requirement in charging infrastructure. | |
| **Unit –IV** | **09 Hrs** |
| **Chemistry of alternative storage devices**<br>Introduction to super capacitor. Construction, working and applications of supercapacitors along with the materials used in electrodes. Types of advanced supercapacitors. Application of supercapacitors in regenerative braking. Advancement in battery-supercapacitor hybrid, Battery-fuel cell hybrid, and Battery-solar cell hybrid electric vehicles with their advantages and limitations. | |
| **Unit –V** | **09 Hrs** |
| **Battery management and recycling:**<br>Battery management systems (BMS): Fundamentals of battery management systems and controls, State-of-charge (SoC), state-of-health (SoH) and Cell balancing techniques.<br>Battery Thermal Management: Passive and active cooling systems. Safety mechanisms, thermal runaway and thermal management.<br>Battery recycling: Economic aspects, environmental safety and process of recycling of advanced batteries. | |

| **Course Outcomes: After completing the course, the students will be able to** | |
|---|---|
| CO1: | Implement the fundamentals of chemistry in advanced energy storage and conversion devices. |
| CO2: | Apply the chemistry knowledge used for hybridization of various energy storage and conversion devices. |
| CO3: | Analyze the different battery system for achieving maximum energy storage for vehicle electrification |
| CO4: | Evaluation of efficiency of a battery with respect to cost, environmental safety, material, energy consumption and recycling. |

| **Reference Books** | |
|---|---|
| 1 | Battery reference book, T. R. Crompton., 3rd edition, NEWNES Reed Educational and Professional Publishing Ltd 2000, ISBN: 07506 4625 X. |
| 2 | Batteries for Electric Vehicles, D. A. J. Rand, R. Woods, and R. M. Dell, Society of Automotive Engineers, Warrendale PA, 2003. ISBN 10: 0768001277. |
| 3 | Lithium Batteries, Science and Technology, GA. Nazri and G. Pistoa, Kluwer Academic Publisher, 2003, ISBN 978-0-387-92675-9. |
| 4 | Battery Technology Handbook, H. A. Kiehne, Marcel Dekker, NYC, 2003. ISBN: 0824742494 9780824742492. |
| 5 | Electric Vehicle Technology Explained, James Larminie and John Lowry. 2nd Edition, Wiley, ISBN-13: 978-1118505429. |
| 6 | Electric Vehicle Technology and Design, Antoni Gandia. CRC Press, ISBN-13: 978-1138551912. |
| 7 | Sustainable Transportation: Problems and Solutions. William R. Black, The Guilford Press, ISBN-13: 978-1462532072. |

| **RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)** | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
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| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| **RUBRIC FOR SEMESTER END EXAMINATION (THEORY)** | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
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| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **HUMAN MACHINE INTERFACE (HMI)**<br>**Category: Institutional Electives-I GROUP-E**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **EC266TEH** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **45L** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **09 Hrs** |
|---|---|
| **Foundations of HMI:** The Human: History of User Interface Designing, I/O channels, Hardware, Software andOperating environments, The Psychopathology of everyday Things, Psychology of everyday actions, Reasoning and problem solving. The computer: Devices, Memory, Processing and networks. Interaction: Models, frameworks, Ergonomics, styles, elements, interactivity, Paradigms.<br>**Introduction to HMI and Domains**: Automotive, Industrial, CE, Medical, ECUs within car and their functionalities. Interaction between ECUs. Communication protocols for ECUs(CAN, LIN, Most, FlexRay,Ethernet etc) | |
| **Unit – II** | **09 Hrs** |
| **Automotive Human-Machine Interfaces:** Automotive infotainment system - Evolution road map, Feature sets,System architecture, Trends, Human factors and ergonomics in automotive design, Automotive User Experience (UX) Design Principles, In-Vehicle Information Systems (IVIS), Driver-Assistance Systems (DAS) Interfaces, HMI design for adaptive cruise control, Voice and Gesture Recognition in Automotive HMIs, Touchscreen Interfaces and Controls, Usability Testing and Evaluation in Automotive HMIs, Safety Considerations and Regulations in Automotive HMIs, Emerging Technologies in Automotive HMIs, Human-Machine Interfaces forAutonomous Vehicles | |
| **Unit –III** | **09 Hrs** |
| **UX and Guidelines:** Introduction to UX design - stages, theory, Design thinking, UX Study, Interaction concepts,Graphic design tools - Adobe Photoshop, Adobe XD, Blender, GIMP, Asset Design - Overview, Guidelines and norms, 2D/3D rendering, OpenGL, OSG. | |
| **Unit –IV** | **09 Hrs** |
| **HMI User Interface**: User-centered HMI development process, Basics of Web-Server.Web-basedHMI: Basics of TwinCAT and HTML, CSS, JavaScript.<br>**HMI on Mobile**: Four Principles of Mobile UI Design, Benefits of Mobile HMIs, Mobile HMI DevelopmentSuites. | |
| **Unit –V** | **09 Hrs** |
| **HMI Control Systems**: Introduction to Voice-Based HMI, Gesture-Based HMI, Sensor-Based UI controls.<br>**Haptics in Automotive HMI**: Kinesthetic Feedback Systems, Tactile Feedback Systems, Haptics in MultimodalHMI, Automotive Use-Cases<br>**HMI Testing**: Limitations of Traditional Test Solutions, Case - Study: Bosch's HMI validation tool - GraphicsTest Systems (GTS).<br>**UI analytics**: Usage patterns, Debugging, Performance Profiling, Use Cases. | |

| **Course Outcomes: After completing the course, the students will be able to:-** | |
|---|---|
| **CO1** | Understanding the application of HMIs in various domain. |
| **CO2** | Comparison of various communication protocols used in HMI development. |
| **CO3** | Apply and analyse the car multimedia system free software and hardware evolution. |
| **CO4** | Design and evaluate the graphic tools and advanced techniques for creating car dashboard multimedia systems. |

| Reference Books | |
|---|---|
| 1. | Touch based HMI; Principles and Applications, Shuo gao, Shuo Yan, Hang Zhao, Arokia Nathan, Springer Nature Switzerland AG, 1st Edition. |
| 2. | Unity 2020 by Example: A Project based guide to building 2D, 3D augmented reality and Virtual reality games from sratch, Robert Wells, Packt Publishing ltd, 2020. |
| 3. | GUI Design and Android Apps, Ryan Cohen, Tao Wang, Apress, Berkley, CA,2014. |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**. | **40** |
| **MAXIMUM MARKS FOR THE CIE** | | **100** |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B** (Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1: (Compulsory) | 16 |
| 3 & 4 | Unit 2: Question 3 or 4 | 16 |
| 5 & 6 | Unit 3: Question 5 or 6 | 16 |
| 7 & 8 | Unit 4: Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **ENERGY AUDITING & STANDARDS**<br>**Category: Institutional Electives-I GROUP-E**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **EE266TEJ** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **45 L** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **06 Hrs** |
|---|---|
| **Types of Energy Audit and Energy-Audit Methodology:** Definition of Energy Audit, Place of Audit, Energy – Audit Methodology, Financial Analysis, Sensitivity Analysis, Project Financing Options, Energy Monitoring and Training.<br>**Survey Instrumentation:** Electrical Measurement, Thermal Measurement, Light Measurement, Speed Measurement, Data Logger and Data Acquisition System,<br>**Energy Audit of a Power Plant:** Indian Power Plant Scenario, Benefit of Audit, Types of Power Plants, Energy Audit of Power Plant. | |
| **Unit – II** | **10 Hrs** |
| **Electrical-Load Management:** Electrical Basics, Electrical Load Management, VariableFrequency Drives, Harmonics and its Effects, Electricity Tariff, Power Factor, Transmission and Distribution Losses.<br>**Energy Audit of Motors:** Classification of Motors, Parameters related to Motors, Efficiency of a Motor, Energy Conservation in Motors, BEE Star Rating and Labelling.<br>**Energy Audit of Pumps, Blowers and Cooling Towers:** Pumps, Fans and Blowers, Cooling Towers | |
| **Unit –III** | **09 Hrs** |
| **Communication & Standards:**<br>**Wireless technologies:** WPANs, LAN, Wireless metropolitan area network, cellular network, satellite communication, Zigbee, Bluetooth, LAN, NAN<br>**Wireline communication:** Phone line technology, powerline technology, coaxial cable technology; Optical communication, TCP/IP networks | |
| **Unit –IV** | **09 Hrs** |
| **Energy Audit of Boilers:** Classification of Boilers, Parts of Boiler, Efficiency of a Boiler, Role of excess Air in Boiler Efficiency, Energy Saving Methods.<br>**Energy Audit of Furnaces:** Parts of a Furnace, classification of Furnaces, Energy saving Measures in Furnaces, Furnace Efficiency<br>**Energy Audit of Steam-Distribution Systems :** S team as Heating Fluid, Steam Basics, Requirement of Steam, Pressure, Piping, Losses in Steam Distribution Systems, Energy Conservation Methods | |
| **Unit-V** | **09 Hrs** |
| **Energy Audit of Lighting Systems:** Fundamentals of Lighting, Different Lighting Systems, Ballasts, Fixtures (Luminaries), Reflectors, Lenses and Louvres, Lighting Control Systems, Lighting System Audit, Energy Saving Opportunities.<br>**Energy Audit Applied to Buildings:** Energy – Saving Measures in New Buildings, Water Audit, Method of Audit, General Energy – Savings Tips Applicable to New as well as Existing Buildings. | |

| **Course Outcomes: After completing the course, the students will be able to: -** | |
|---|---|
| **CO 1** | Explain the need for energy audit, prepare a flow for audit and identify the instruments needed. |
| **CO 2** | Design and perform the energy audit process for electrical systems. |
| **CO 3** | Design and perform the energy audit process for mechanical systems |
| **CO 4** | Propose energy management scheme for a building |

| **Reference Books** | |
|---|---|
| 1. | Handbook of energy audit, Sonal Desai, Kindle Edition, 2015, McGraw Hill Education, ISBN: 9339221346, 9789339221348. |
| 2. | Energy management handbook, Wayne C Turner and Steve Doty, 6th Edition, 2015, CRC Press, ISBN: 0-88173-542-6. |
| 3. | Energy management, Sanjeev Singh and Umesh Rathore, 1st Edition, 2016, Katson Books, ISBN 10: 9350141019, ISBN 13: 9789350141014. |
| 4. | Energy audit of building systems, Moncef Krarti, 2nd Edition, 2010, CRC Press ISBN: 9781439828717 |

| **RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)** | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| **RUBRIC FOR SEMESTER END EXAMINATION (THEORY)** | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **BIOMEDICAL INSTRUMENTATION**<br>**Category: Institutional Electives-I GROUP-E**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **EI266TEK** | | **CIE** | : | **100 Marks** |
| **Credits: L:T:P** | **:** | **03:00:00** | | **SEE** | : | **100 Marks** |
| **Total Hours** | **:** | **45L** | | **SEE Duration** | : | **03 Hours** |

| **Unit-I** | **09 Hrs** |
|---|---|
| **Fundamentals:** Sources of Biomedical signals, Basic medical instrumentation system, General constraints in design of medical instrumentation systems.<br>**Bioelectric Signals and Electrodes**: Origin of bioelectric signals, Types of bioelectric signals, Recording electrodes, Electrode-tissue interface, Polarization, Skin contact impedance, Silver-silver chloride electrodes, Electrodes for ECG, EEG, EMG, Microelectrodes. | |
| **Unit – II** | **09 Hrs** |
| **Electrocardiograph:** Electrical activity of heart, Genesis and characteristics of Electrocardiograph (ECG), Block diagram description of an Electrocardiograph, ECG lead systems, Multi-channel ECG machine.<br>**Electroencephalograph:** Genesis of EEG, Block diagram description of an EEG, 10-20 Electrode system, Computerized analysis of EEG. | |
| **Unit –III** | **09 Hrs** |
| **Patient Monitoring System:** Bedside monitors, Central Monitors, Measurement of Heart Rate, Average Heart Rate meter, Instantaneous heart rate meter, Measurement of pulse rate, Blood Pressure measurement, Direct and indirect method, Automatic blood pressure measuring apparatus using Korotkoff's method.<br>**Oximeters:** Oximetry, ear oximeter, pulse oximeter, skin reflectance oximeter and intravascular oximeter. | |
| **Unit –IV** | **09 Hrs** |
| **Blood Flow Meters:** Electromagnetic blood flow meter, Types of electromagnetic blood flow meters, Ultrasonic blood flow meters, NMR blood flow meters, Laser Doppler blood flow meters.<br>**Cardiac Pacemakers and Defibrillators:** Need for Cardiac pacemaker, External Pacemaker, Implantable Pacemaker, Types of Implantable Pacemaker, Ventricular Synchronous Demand Pacemaker and Programmable<br>Pacemaker. Need for a defibrillator, DC defibrillator, Defibrillator electrodes, DC defibrillator with synchronizer. | |
| **Unit –V** | **09 Hrs** |
| **Advances in Radiological Imaging:** X-rays-principles of generation, Conventional X-ray radiography, Fluoroscopy, Angiography, Digital radiography, Digital subtraction angiography (DSA). Basic principle of computed tomography, magnetic resonance imaging system and Ultrasonic imaging system. | |

| **Course Outcomes: After completing the course, the students will be able to:-** | |
|---|---|
| **CO1** | Understand the sources of biomedical signals and basic biomedical instruments. |
| **CO2** | Apply concepts for the design of biomedical devices |
| **CO3** | Analyze the methods of acquisition and signal conditioning to be applied to the physiological parameters. |
| **CO4** | Develop instrumentation for measuring and monitoring biomedical parameters. |

| **Reference Books** | |
|---|---|
| 1. | Handbook of Biomedical Instrumentation, R. S. Khandpur,3rd Edition, Reprint 2016, Tata McGraw-Hill, ISBN: 9780070473553. |
| 2. | Biomedical Instrumentation and Measurements, Leslie Cromwell & others, 2nd Edition, Reprint 2015, ISBN: 9780130771315. |
| 3. | Medical instrumentation: Application and Design, J. G. Webster, 3rd Edition, Reprint 2015, Wiley Publications, ISBN: 9788126511068. |

| | |
|---|---|
| 4. | Principles of Medical Imaging, K.Kirk Shung, Michael B. Smith and Banjamin Tsui, Academic Press, 2016, ISBN: 978-0126409703. |

| **RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)** | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **Two tests will be conducted**. Each test will be evaluated for **50 Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**). Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**. | **40** |
| **MAXIMUM MARKS FOR THE CIE THEORY** | | **100** |

| **RUBRIC FOR SEMESTER END EXAMINATION (THEORY)** | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1: (Compulsory) | 16 |
| 3 & 4 | Unit 2: Question 3 or 4 | 16 |
| 5 & 6 | Unit 3: Question 5 or 6 | 16 |
| 7 & 8 | Unit 4: Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **TELECOMMUNICATION SYSTEMS**<br>**Category: Institutional Electives-I GROUP-E**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **ET266TEM** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **45 L** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **8 Hrs** |
|---|---|
| **Introduction to Electronic Communication:** The Significance of Human Communication, Communication Systems, Types of Electronic Communication, Modulation and Multiplexing, Electromagnetic Spectrum, Bandwidth, A Survey of Communication Applications.<br>**The Fundamentals of Electronics:** Gain, Attenuation, and Decibels.<br>**Radio Receivers:** Super heterodyne receiver. | |
| **Unit – II** | **10 Hrs** |
| **Modulation Schemes: Analog Modulation:** AM, FM and PM- brief review.<br>**Digital Modulation:** PCM, Line Codes, ASK, FSK, PSK & QAM (Architecture).<br>**Wideband Modulation:** Spread spectrum, FHSS, DSSS.<br>**Multiple Access:** FDMA, TDMA, CDMA. | |
| **Unit –III** | **10 Hrs** |
| **Satellite Communication:** Satellite Orbits, Satellite Communication Systems, Satellite Subsystems, Ground Stations, Satellite Applications, Global Positioning System. | |
| **Unit –IV** | **9 Hrs** |
| **Optical Communication:** Optical Principles, Optical Communication Systems, Fiber-Optic Cables, Optical Transmitters and Receivers, Wavelength-Division Multiplexing, Passive Optical Networks. | |
| **Unit –V** | **8 Hrs** |
| **Cell Phone Technologies:** Cellular concepts, Frequency allocation, Frequency reuse, Internet Telephony.<br>**Wireless Technologies:** Wireless LAN, PANs and Bluetooth, Zig Bee, Mesh Wireless Networks, WiMax, and Wireless Metropolitan Area Networks. | |

| **Course Outcomes: After completing the course, the students will be able to :-** | |
|---|---|
| **CO1** | Describe the basics of communication systems. |
| **CO2** | Analyze the importance of modulation and multiple access schemes for communication systems. |
| **CO3** | Analyze the operational concept of cell phone and other wireless technologies. |
| **CO4** | Justify the use of different components and sub-system in advanced communication systems. |

| **Reference Books** | |
|---|---|
| 1. | Principles of Electronic Communication Systems, Louis E. Frenzel, 4th Edition, 2016, Tata McGraw Hill, ISBN: 978-0-07-337385-0. |
| 2. | Electronic Communication Systems, George Kennedy,3rd Edition, 2008, Tata McGraw Hill, ISBN: 0-02-800592-9. |
| 3. | Introduction to Telecommunications, Anu A. Gokhale, 2nd Edition, 2008, Cengage Learning ISBN: 981-240-081-8 |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| **MAXIMUM MARKS FOR THE CIE THEORY** | | **100** |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| **PART B**<br>(Maximum of TWO Sub-divisions only) | | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| **TOTAL** | | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **MOBILE COMMUNICATION NETWORKS AND STANDARDS**<br>**Category: Institutional Electives-I GROUP-E**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **ET266TEN** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **45 L** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **9 Hrs** |
|---|---|
| **Principle of Cellular Communication:** Cellular Terminology, Cell Structure and Cluster, Frequency Reuse Concept, Cluster size and System Capacity, Method of Locating Co-channel cells, Frequency Reuse distance, Co-channel Interference and Signal Quality, Co-channel interference Reduction Methods. | |
| **Unit – II** | **9 Hrs** |
| **Basic Cellular system:** Consideration of components of a cellular system- A basic cellular system connected to PSTN, Main parts of a basic cellular system, Operation of a Cellular system, Performance criteria- Voice quality, Trunking and Grade of Service, Spectral Efficiency of FDMA and TDMA systems | |
| **Unit –III** | **9 Hrs** |
| **Second generation Cellular Technology: GSM:** GSM Network Architecture, Identifiers used in GSM System, GSM channels, Authentication and Security in GSM, GSM Call Procedure, GSM Hand-off Procedures. | |
| **Unit –IV** | **9 Hrs** |
| **3G Digital Cellular Technology: GPRS:** GPRS technology, GPRS NetworkArchitecture, GPRS signalling, Mobility Management in GPRS. **UMTS:** UMTS Network Architecture, UMTS Interfaces, UMTS Air Interface Specifications, UMTS Channels**.** | |
| **Unit –V** | **9 Hrs** |
| **Wireless Personal Area Networks:** Network architecture, components, Bluetooth, Zigbee, Applications. **Wireless Local Area networks:** Network Architecture, Standards, Applications. Wireless Metropolitan Area Networks: IEEE 802.16 standards, advantages, WMAN Network architecture, Protocol stack | |

| **Course Outcomes: After completing the course, the students will be able to :-** | |
|---|---|
| **CO1** | Describe the concepts and terminologies for Cellular Communication. |
| **CO2** | Analyze the Architecture, Hand-off and Security aspects in 2G and 3G Networks. |
| **CO3** | Compare the performance features of 2G and 3G Cellular Technologies. |
| **CO4** | Analyze and Compare the architectures of various Wireless technologies and standards. |

| **Reference Books** | |
|---|---|
| 1. | Wireless Communications, T.L. Singal, 2nd Reprint 2011,Tata McGraw Hill Education Private Limited, ISBN: 978-0-07-068178-1 |
| 2. | Wireless and Mobile Networks Concepts and Protocols, Dr.Sunil Kumar SManvi, 2010, Willey India Pvt. Ltd., ISBN: 978-81-265-2069-5. |
| 3. | Wireless Communication, Upena Dalal, 1st Edition, 2009, Oxford higher Education, ISBN-13:978-0-19-806066-6. |
| 4 | Wireless Communications Principles and practice, Theodore S Rappaport, 2nd Edition, Pearson, ISBN 97881-317-3186-4 |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| **MAXIMUM MARKS FOR THE CIE THEORY** | | **100** |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| **TOTAL** | | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **MOBILE APPLICATION DEVELOPMENT**<br>**Category: Institutional Electives-I GROUP-E**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **IS266TEO** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **45L** | | **SEE Duration** | **:** | **03 Hours** |

**Prerequisite: -** Programming in Java.

| **Unit-I** | **09 Hrs** |
|---|---|
| **Introduction:**<br>Smart phone operating systems and smart phones applications. Introduction to Android, Installing Android Studio, creating an Android app project, deploying the app to the emulator and a device. UI Design: Building a layout with UI elements, Layouts, Views and Resources, Text and Scrolling Views.<br>Activities and Intents, The Activity Lifecycle, Managing State, Activities and Implicit Intents, The Android Studio Debugger, Testing the Android app, The Android Support Library. | |
| **Unit–II** | **09 Hrs** |
| **User experience**:<br>User interaction, User Input Controls, Menus, Screen Navigation, Recycler View, Delightful user experience, Drawables, Styles, and Themes, Material Design, Testing app UI, Testing the User Interface | |
| **Unit–III** | **09 Hrs** |
| **Working in the background:**<br>Async Task and Async Task Loader, Connect to the Internet, Broadcast Receivers and Services. Scheduling and optimizing background tasks – Notifications, Scheduling Alarms, and Transferring Data Efficiently | |
| **Unit–IV** | **09 Hrs** |
| **All about data:**<br>Preferences and Settings, Storing Data, Shared Preferences. Storing data using SQLite, SQLite Database. Sharing data with content providers.<br>Advanced Android Programming: Internet, Entertainment and Services. Displaying web pages and maps, communicating with SMS and emails, Sensors. | |
| **Unit–V** | **09 Hrs** |
| **Hardware Support & devices:**<br>Permissions and Libraries, Performance and Security. Fire base and AdMob, Publish and Polish, Multiple Form Factors, Using Google Services. | |

| **Course Outcomes: After completing the course, the students will be able to** | |
|---|---|
| **CO1:** | Comprehend the basic features of android platform and the application development process. Acquire familiarity with basic building blocks of Android application and its architecture. |
| **CO2:** | Apply and explore the basic framework, usage of SDK to build Android applications incorporating Android features in developing mobile applications. |
| **CO3:** | Demonstrate proficiency in coding on a mobile programming platform using advanced Android technologies, handle security issues, rich graphics interfaces, using debugging and troubleshooting tools. |
| **CO4:** | Create innovative applications, understand the economics and features of the app marketplace by offering<br>the applications for download. |

| Reference Books | |
|---|---|
| **1** | Android Programming, Phillips, Stewart, Hardy and Marsicano, Big Nerd Ranch Guide, 2nd Edition, 2015, ISBN-13 978-0134171494 |
| **2** | Android Studio Development Essentials- Android6, Neil Smyth,2015, Create space Independent Publishing Platform, ISBN:9781519722089 |
| **3** | Android Programming–Pushing the limits, Eric Hellman, 2013, Wiley, ISBN-13:978-1118717370 |
| **4** | Professional Android 2 Application Development, Reto Meier, Wiley India Pvt. Ltd, 1st Edition, 2012, ISBN-13:9788126525898 |
| **5** | BeginningAndroid3, Mark Murphy, A press Springer India Pvt Ltd, 1stEdition, 2011, ISBN-13:978-1-4302-3297-1 |
| **6** | AndroidDeveloperTraining-https://developers.google.com/training/android/<br>AndroidTestingSupportLibrary-https://google.github.io/android-testing-support-library/ |

| **RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)** | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50 Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| **RUBRIC FOR SEMESTER END EXAMINATION (THEORY)** | | |
|---|---|---|
| **Q.NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **ELEMENTS OF FINANCIAL MANAGEMENT**<br>**Category: Institutional Electives-I GROUP-E**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **IM266TEQ** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **45L** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **06 Hrs** |
|---|---|
| **Financial Management-An overview:** Financial Decisions in a firm, Goals of a firm, Fundamental principle of finance, Organization of finance function and its relation to other functions, Regulatory framework.<br>**The financial System:** Functions, Assets, Markets, Market returns, Intermediaries, regulatory framework, Growth and trends in Indian financial system. | |
| **Unit – II** | **10 Hrs** |
| **Financial statements, Taxes and cash flow:** Balance sheet, statement of profit and loss, items in annual report, manipulation of bottom line, Profits vs Cash flows, Taxes. **(Conceptual treatment only)**<br>**Time Value of Money:** Future value of a single amount, future value of an annuity, present value of a single amount, present value of an annuity.<br>**Valuation of securities:** Basic valuation model, bond valuation, equity valuation-dividend capitalization approach and other approaches. | |
| **Unit –III** | **10 Hrs** |
| **Risk and Return:** Risk and Return of single assets and portfolios, measurement of market risk, relationship between risk and return, implications.<br>**Techniques of Capital Budgeting:** Capital budgeting process, project classification, investment criteria, Net present value, Benefit-Cost ratio, Internal Rate of return, Payback period, Accounting rate of return. **(Conceptual and Numerical treatment)** | |
| **Unit –IV** | **10 Hrs** |
| **Long term finance:** Sources- Equity capital, Internal accruals, preference capital, term loans, debentures. Raising long term finance- Venture capital, Initial Public Offer, Follow on Public Offer, Rights Issue, Private Placement, Term Loans, Investment Banking<br>**Securities Market:** Primary market vs Secondary market, Trading and Settlements, Stock market quotations and Indices, Govt. securities market, Corporate debt market. | |
| **Unit –V** | **09 Hrs** |
| **Working Capital – Policy and Financing:** Factors influencing working capital requirements, Current assets financing policy, operating cycle and cash cycle. Accruals, trade credit, banks, public deposits, inter-corporate deposits, short term loans, right debentures, commercial paper, Factoring<br>**(Conceptual treatment only)** | |

| **Course Outcomes: After completing the course, the students will be able to:-** | |
|---|---|
| **CO1** | Explain the features and elements of a financial system. |
| **CO2** | Recognize the relevance basic principles of financial management in decision making. |
| **CO3** | Describe the processes and techniques of capital budgeting and working capital financing by organizations. |
| **CO4** | Demonstrate an understanding of various sources of finance. |

| **Reference Books:** | |
|---|---|
| 1. | Fundamentals of Financial Management, Prasanna Chandra, 6th Edition, 2018, McGraw Hill Education(India) Pvt. Ltd, ISBN: 978-93-392-0313-9, 93-392-0313-5 |
| 2. | Financial Management ,I M Pandey, 12th edn, 2021, Pearson, ISBN-939057725X, 978-9390577255 |
| 3. | Financial Management-Text, Problems and Cases, Khan M Y & Jain P K, 8th Edition, 2018, McGraw Hill Education(India) Pvt. Ltd, ISBN: 9353162181 , 9789353162184 |

| | |
|---|---|
| 4. | Fundamentals of Financial Management, Eugene F Brigham, Joel F Houston, 8th Edition, 2014, Cengage Learning, ISBN : 9781285065137, 1285065131. |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50 Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q.NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **OPTIMIZATION TECHNIQUES**<br>**Category: Institutional Electives-I GROUP-E**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **IM266TER** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **45L** | | **SEE Duration** | **:** | **03 Hours** |

| **UNIT – I** | **08 Hrs** |
|---|---|
| **Introduction:** OR Methodology, Definition of OR, Application of OR to Engineering and Managerial problems, Features of OR models, Limitations of OR.<br>**Linear Programming:** Definition, Mathematical Formulation, Standard Form, Solution Space, Types of solution – Feasible, Basic Feasible, Degenerate, Solution through Graphical Method. Problems on Product Mix, Blending, Marketing, Finance, Agriculture and Personnel.<br>**Simplex methods:** Variants of Simplex Algorithm – Use of Artificial Variables. | |
| **UNIT – II** | **09 Hrs** |
| **Simplex Algorithm:** How to Convert an LP to Standard Form, Preview of the Simplex Algorithm, Direction of Unboundedness, Why Does an LP Have an Optimal basic feasible solution, The Simplex Algorithm, Using the Simplex Algorithm to Solve Minimization Problems, Alternative Optimal Solutions, Degeneracy and the Convergence of the Simplex Algorithm, The Big M Method, The Two-Phase Simplex Method. | |
| **UNIT – III** | **09 Hrs** |
| **Transportation Problem:** Formulation of Transportation Model, Basic Feasible Solution using North-West corner, Least Cost, Vogel's Approximation Method, Optimality Methods, Unbalanced Transportation Problem, Degeneracy in Transportation Problems, Variants in Transportation Problems.<br>**Assignment Problem:** Formulation of the Assignment problem, solution method of assignment problem-Hungarian Method, Variants in assignment problem, Travelling Salesman Problem (TSP). | |
| **UNIT – IV** | **08 Hrs** |
| **Project Management Using Network Analysis:** Network construction, CPM & PERT, Determination of critical path and duration, floats. Crashing of Network. Usage of software tools to demonstrate N/W flow problems | |
| **UNIT – V** | **08 Hrs** |
| **Game Theory**: Introduction, Two person Zero Sum game, Pure strategies, Games without saddle point - Arithmetic method, Graphical Method, The rules of dominance | |

| **Course Outcomes: After going through this course the student will be able to** | |
|---|---|
| **CO1** | Understand the characteristics of different types of decision – making environments and the appropriate decision making approaches and tools to be used in each type. |
| **CO2** | Build and solve Transportation Models and Assignment Models. |
| **CO3** | Design new simple models, like: CPM, PERT to improve decision –making and develop critical thinking and objective analysis of decision problems. |
| **CO4** | Implement practical cases, by using TORA, WinQSB, Excel, GAMS. |

| **Reference Books:** | |
|---|---|
| 1. | Operation Research An Introduction, Taha H A, 10th Global Edition, 2017, Pearson Education Limited, ISBN 13: 978-1-292-16554-7 |
| 2. | Principles of Operations Research – Theory and Practice, Philips, Ravindran and Solberg, 2nd Edition, 2007, John Wiley & Sons (Asia) Pvt Ltd, ISBN 13: 978-8126512560 |
| 3. | Introduction to Operation Research, Hiller, Liberman, Nag, Basu, 10th Edition, 2017, McGraw Hill Education, ISBN 13: 978-9339221850 |
| 4. | Operations Research Theory and Application, J K Sharma, 6th Edition, 2009, Trinity Press, ISBN : 978-93-85935-14-5 |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50 Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q.NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **AUTOMOTIVE MECHATRONICS**<br>**Category: Institutional Electives-I GROUP-E**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **ME266TES** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **45 L** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **09 Hrs** |
|---|---|
| **Automobile Engines**<br>Classifications of Internal Combustion Engines**.** Engine nomenclature and mechanics. Mixture formation – External, internal, quality and quantity control – homogeneous and stratified injection. Thermodynamic principles of Otto and Diesel cycle. Characteristics – pressure curve and energy yield, engine speed, torque, and power | |
| **Unit-II** | **10 Hrs** |
| **Engine Auxiliary Systems:**<br>Turbocharger, Intercooler, Exhaust manifold, 3-way catalytic convertor, Exhaust Gas Recirculation system.<br>**Common Rail Fuel Injection system**- Low pressure and high pressure fuel systems, Return line, Quantity control valve and Injectors. | |
| **Unit-III** | **10 Hrs** |
| **Vehicular Auxiliary Systems:**<br>Vehicle frame and body classification- Hatchback, Sedan, SUV, Coupe, Roadster. Adaptive Brakes - Disc and drum brakes, Antilock Braking Systems, ESP, TCS. Wheels and Tyres- Toe-In, Toe-Out, Caster and Camber angle. Classification of tyres, Radial, Tubeless.<br>**Supplemental Restraint System**: Active and passive safety, Vehicle structure, Gas generator and air bags, Belt Tensioner, Acceleration sensor, Rollover sensor, Seat occupancy recognition. | |
| **Unit-IV** | **09 Hrs** |
| **EV Technology**: Types of EV's, ICE vs EV torque output, Architecture and Working of EV's.<br>Battery Thermal Management System, Regenerative braking, Safety system and Impacts of EV on the environment. | |
| **Unit-V** | **07 Hrs** |
| **Telematics in vehicles** – Radio Transmission, Exchange of information, signal path & properties, Concept of radio waves.<br>**Sensors:** Oxygen sensors, Crankshaft/Cam shaft Sensor, Boost Pressure Sensor, Coolant Temperature Sensor, Hot Film Air Mass flow Sensor, Throttle Position Sensor, Rain/Light sensor | |

| **Course Outcomes: After completing the course, the students will be able to** | |
|---|---|
| **CO1:** | Describe the functions of Mechatronic systems in a modern automobile |
| **CO2:** | Evaluate the performance of an engine by its parameters |
| **CO3:** | Analyse the automotive exhaust pollutants as per emission norms |
| **CO4:** | Demonstrate communication of control modules using a On-Board Diagnostic kit |

| **Reference Books** | |
|---|---|
| **1.** | Automotive Technology – A systems approach, Jack Erjavec, 5th Edition, Delamr Cengage Learning, ISBN-13: 978-1428311497 |
| **2.** | Automotive Engineering Fundamentals, Richard Stone and Jeffrey K. Ball, 2004, SAE International, ISBN: 0768009871 |
| **3.** | Bosch Automotive Handbook, Robert Bosch, 9th Edition, 2004, ISBN: 9780768081527 |
| **4.** | Understanding Automotive Electronics, William B Ribbens, 5th Edition, Butterworth–Heinemann, ISBN 0-7506-7008-8 |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding up to 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**)** **ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1: (Compulsory) | 16 |
| 3 & 4 | Unit 2: (Internal Choice) | 16 |
| 5 & 6 | Unit 3: (Internal Choice) | 16 |
| 7 & 8 | Unit 4: (Internal Choice) | 16 |
| 9 & 10 | Unit 5: (Internal Choice) | 16 |
| | **TOTAL** | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **MATHEMATICAL MODELLING**<br>**Category: Institutional Electives-I GROUP-E**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **MA266TEU** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **45L** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **09 Hrs** |
|---|---|
| **Introduction to Mathematical Modelling:**<br>Basic concepts, steps involved in modelling, classification of models, assorted simple mathematical models from diverse fields. | |
| **Unit – II** | **09 Hrs** |
| **Mathematically Modelling Discrete Processes:**<br>Difference equations - first and second order, Introduction to Difference equations, Introduction to discrete models-simple examples, Mathematical modelling through difference equations in economics, finance, population dynamics, genetics and other real world problems. | |
| **Unit –III** | **09 Hrs** |
| **Markov modelling:**<br>Mathematical foundations of Markov chains, application of Markov Modelling to problems. | |
| **Unit –IV** | **09 Hrs** |
| **Modelling through graphs:**<br>Graph theory concepts, Modelling situations through different types of graphs. | |
| **Unit –V** | **09 Hrs** |
| **Variational Problem and Dynamic Programming:**<br>Optimization principles and techniques, Mathematical models of variational problem and dynamic programming, Problems with applications. | |

| **Course Outcomes: After completing the course, the students will be able to** | |
|---|---|
| **CO1:** | Apply the knowledge and skills of discrete and continuous models to understand various types of analysis. |
| **CO2:** | Analyze the appropriate mathematical model to solve the real world problem and to optimize the solution. |
| **CO3:** | Distinguish the overall knowledge gained to demonstrate the problems arising in many practical situations. |
| **CO4:** | Apply the knowledge and skills of discrete and continuous models to understand various types of analysis. |

| **Reference Books** | |
|---|---|
| **1** | Mathematical Modeling, J. N. Kapur, 1st Edition, 1998, New Age International, New Delhi, ISBN: 81-224-0006-X. |
| **2** | Mathematical Modeling: Models, Analysis and Applications, Sandip Banerjee, 2014, Chapman and Hall/CRC Textbook, ISBN 9781439854518. |
| **3** | Case studies in mathematical modeling, D. J. G. James and J. J. Mcdonald, 1981, Stanly Thames, Cheltonham, ISBN: 0470271779, 9780470271773. |
| **4** | Modeling with difference equations, D. N. Burghes, M. S. Borrie, Ellis Harwood, 1981, ISBN 13: 9780853122869. |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only; wherein one sub division will be a caselet in the related topics) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **MATHEMATICS FOR QUANTUM COMPUTING**<br>**Category: Institutional Electives-I GROUP-E**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **MA266TEV** | | **CIE** | **:** | **100 Marks** |
| **Credits: L: T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **45L** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **09 Hrs** |
|---|---|
| **Introduction to Quantum Computing:**<br>Quantum superposition, Qubits, Linear algebra for quantum computing, Inner products and Tensor products of vector spaces, Quantum states in Hilbert space, The Bloch sphere, Generalized measurements, No-cloning theorem. | |
| **Unit – II** | **09 Hrs** |
| **Quantum Gates:**<br>Universal set of gates, quantum circuits, Dirac formalism, superposition of states, entanglement Bits and Qubits. Qubit operations, Hadamard Gate, CNOT Gate, Phase Gate, Z-Y decomposition, Quantum Circuit Composition, Basic Quantum circuits. | |
| **Unit –III** | **09 Hrs** |
| **Quantum Algorithm - I:**<br>Deutsch Algorithm, Deutsch-Jozsa Algorithm, Bernstein-Vazarani Algorithm, Simon periodicity algorithm, Phase estimation algorithm, Quantum Fourier transform. | |
| **Unit –IV** | **09 Hrs** |
| **Quantum Algorithm - II:**<br>Grover search algorithm, Shor quantum factoring algorithm, Harrow-Hassidim-Lloyd (HHL) algorithm for solving linear system problems. | |
| **Unit –V** | **09 Hrs** |
| **Applications of Quantum Computing:**<br>Application to: order-finding, discrete logarithm, quantum counting, Boolean satisfiability problems(SAT), graph theory problems. | |

| **Course Outcomes: After completing the course, the students will be able to** | |
|---|---|
| **CO1:** | Explore the fundamental concepts of quantum computing. |
| **CO2:** | Apply the knowledge and skills of quantum computing to understand various types of problems arising in various fields engineering |
| **CO3:** | Analyze the appropriate quantum algorithm to solve the real-world problem and to optimize the solution. |
| **CO4:** | Distinguish the overall knowledge gained to demonstrate the problems arising in many practical situations. |

| **Reference Books** | |
|---|---|
| **1** | An introduction to Quantum Computing, Phillip Kaye, Raymond Laflamme, 2007, Oxford University press. |
| **2** | Quantum Computing for Everyone, Chris Bernhardt, 2020, The MIT Press, Cambridge. |
| **3** | Quantum Computation and Quantum Information, M. A. Nielsen & I. Chuang, 2013, Cambridge University Press. |
| **4** | Quantum Computing for the quantum curious, Cirian Hughes et. al., 2021, Springer, ISBN 978-3-030-61600-7. |
| **5** | Concise guide to quantum computing, Sergei Kurgalin, Sergei Borzunov, 2021, Springer, ISBN 978-3-030-65051-3, ISBN 978-3-030-65052-0 (eBook). |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only; wherein one sub division will be a caselet in the related topics) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **APPLIED PSYCHOLOGY FOR ENGINEERS**<br>**Category: Institutional Electives-I GROUP-E**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **HS266TEW** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **45 Hrs** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **08 Hrs** |
|---|---|
| **Introduction to Psychology**: Definition and goals of Psychology: Role of a Psychologist in the Society: Today's Perspectives (Branches of psychology- Clinical, Industrial). Psychodynamic, Behavioristic, Cognitive, Humanistic, Psychological Research and Methods to study Human Behavior: Experimental, Observation, Questionnaire and Clinical Method. | |
| **Unit – II** | **08 Hrs** |
| **Intelligence and Aptitude:** Concept and definition of Intelligence and Aptitude, Nature of Intelligence. Theories of Intelligence – Spearman, Thurston, Guilford Vernon. Characteristics of Intelligence tests, Types of tests. Measurement of Intelligence and Aptitude, Concept of IQ, Measurement of Multiple Intelligence – Fluid and Crystallized Intelligence. | |
| **Unit –III** | **10 Hrs** |
| **Personality**: Concept and definition of personality, Approaches of personality- psychoanalytical, Socio-Cultural, Interpersonal and developmental, Humanistic, Behaviorist, Trait and type approaches. Assessment of Personality: Self- report measures of Personality, Questionnaires, Rating Scales and Projective techniques, its Characteristics, advantages & limitations, examples. Behavioral Assessment. | |
| **Unit –IV** | **10 Hrs** |
| **Learning:** Definition, Conditioning – Classical Conditioning, Basics of Classical Conditioning (Pavlov), the process of Extinction, Discrimination and Generalization. Operant Conditioning (Skinner expt). The basics of operant conditioning, Schedules of reinforcement. Cognitive – Social approaches to learning – Latent Learning, Observational Learning, Trial and Error Method, Insightful Learning. | |
| **Unit –V** | **09 Hrs** |
| **Application of Psychology in Working Environment:** The present scenario of information technology, the role of psychologist in the organization, Selection and Training of Psychology Professionals to work in the field of Information Technology. **Psychological Stress**: a. Stress- Definition, Symptoms of Stress, Extreme products of stress v s Burnout, Work Place Trauma. Causes of Stress – Job related causes of stress.Sources of Frustration, Stress and Job Performance, Stress Vulnerability-Stress threshold, perceived control. Type A and Type B.**Psychological Counseling** - Need for Counseling, Types – Directed, Non- Directed, Participative Counseling. | |

| **Course Outcomes: After completing the course, the students will be able to:-** | |
|---|---|
| **CO1** | Describe the basic theories, principles, and concepts of applied psychology as they relate to behaviors and mental processes. |
| **CO2** | Define learning and compare and contrast the factors that cognitive, behavioral, and Humanistic theorists believe influence the learning process. |
| **CO3** | Develop understanding of psychological attributes such as intelligence, aptitude, creativity, resulting in their enhancement and apply effective strategies for self-management and self-improvement. |
| **CO4** | Apply the theories into their own and others' lives in order to better understand their personalities and experiences. |
| **CO5** | Understand the application of psychology in engineering and technology and develop a route to accomplish goals in their work environment. |

| **Reference Books** | |
|---|---|
| | Understanding Psychology Feldman R. S, IV edition, (1996) McGraw Hill India |
| 2. | Psychology Robert A. Baron, III edition (1995) Prentice Hall India. |
| 3. | Organizational Behaviour , Stephen P Robbins Pearson Education Publications, 13th Edition, ISBN – 81-317 – 1132 – 3 |
| 4. | Organisational Behaviour : Human Behaviour at Work ,John W.Newstrem and Keith Davis. Tata McGraw Hill India, 10th Edition, ISBN 0-07-046504-5 |
| 5 | Psychology-themes and variations , Wayne Weiten, IV edition, Brooks / Cole Publishing Co. |

| **RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)** | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| **RUBRIC FOR SEMESTER END EXAMINATION (THEORY)** | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only; wherein one sub division will be a caselet in the related topics) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **UNIVERSAL HUMAN VALUES - II**<br>**Category: Institutional Electives-I GROUP-E**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **HS266TEY** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **45L** | | **SEE Duration** | **:** | **03 Hours** |

| **Unit-I** | **10 Hrs** |
|---|---|
| Introduction-Basic Human Aspiration, its fulfillment through All-encompassing Resolution. The basic human aspirations and their fulfillment through Right understanding and Resolution, Right understanding and Resolution are the activities of the Self, Self is central to Human Existence; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution. | |
| **Unit – II** | **10 Hrs** |
| Right Understanding (Knowing)- Knower, Known & the Process. The domain of right understanding starts from understanding the human being (the knower, the experiencer and the doer); and extends up to understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct). | |
| **Unit –III** | **08 Hrs** |
| Understanding Existence (including Nature). A comprehensive understanding (knowledge) about the existence, which certainly includes the Nature. The need and the process of inner evolution (through self-exploration, self-awareness and self-evaluation)- particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence). | |
| **Unit –IV** | **08 Hrs** |
| Understanding Human Being. Understanding the human being comprehensively is the first step and the core theme of this course; human being as co-existence of the self and the body, the activities and potentialities of the self, Reasons for harmony/contradiction in the self. | |
| **Unit –V** | **09 Hrs** |
| Understanding Human Conduct, All-encompassing Resolution & Holistic Way of Living. Understanding Human Conduct, Understanding different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavour viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from self to Nature and entire Existence. | |

| **Course Outcomes: After completion of the course the students will be able to** | |
|---|---|
| **CO1** | Understand the basic human aspiration with program of its fulfilment and meaning of resolution in the complete expanse of human living. |
| **CO2** | Understand human being in depth and see how self is central to human being |
| **CO3** | Understand existence in depth and see how coexistence is central to existence |
| **CO4** | Understand human conduct and the holistic way of living leading to human tradition |

| **Reference Books** | |
|---|---|
| 1 | A foundation course in human values and professional ethics, R. R. Gaur, R Asthana, G P Bagaria, 2nd revised Edition, excel books, New Delhi – 2019, ISN 978-93-87034-47-1 |
| 2 | Avartansheel Arthshastra, A Nagraj, Divya Path Sansthan, Amarkantak, India, ISBN 978-8-174-46781-2 |
| 3 | Economy of Performance- a quest for social order based on non – violence, J C Kumarappa, 2010, Sarva-Seva-Sangh-Prakashan, Varanasi, India |
| 4 | Energy and Equity, Ivan Illich, 1974, The Trinity Press, Worcester & Harper Collins, USA, ISBN, 0060803274, 9780060803278 |

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(Maximum of TWO Sub-divisions only) | |
| 2 | Unit 1 : (Compulsory) | 16 |
| 3 & 4 | Unit 2 : Question 3 or 4 | 16 |
| 5 & 6 | Unit 3 : Question 5 or 6 | 16 |
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
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| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**. | **40** |
| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| Semester VI | | | | | | |
|---|---|---|---|---|---|---|
| **INTERDISCIPLINARY PROJECT** | | | | | | |
| **Course Code** | **:** | **IM367P** | | **CIE** | **:** | **50 Marks** |
| **Credits: L:T:P** | **:** | **0:0:3** | | **SEE** | **:** | **50 Marks** |
| **Total Hours** | **:** | **15P** | | **SEE Duration** | **:** | **2 Hours** |

Interdisciplinary Project Guidelines:

1. The project topic, title and synopsis have to be finalized and submitted to their respective internalguide(s) before the beginning of the VI semester.
2. The detailed Synopsis (approved by the department ***Project Review Committee***) has to be submitted during the 1st week after the commencement of VI semester.

Batch Formation:

- Students are free to choose their project partners from any other program.
- Each student in the team must contribute towards the successful completion of the project. The project may be carried out In-house only.
- ***The project work is to be carried out by a team of two to four students.***

Project Topic Selection:

The topics of the project work must be in the ***field of Sustainable Development goals areas or in line with CoE's(Centre of Excellence) identified by the college*** or **List of project areas as given by Faculty. The projects as far as possible should have societal relevance with focus on sustainability.**

Project Evaluation:

Continuous monitoring of project work will be carried out and cumulative evaluation will be done.

- The students are required to meet their guides once in a week to report their progress in project work.
- **Weekly Activity Report** (WAR) has to be maintained in the form of a diary by the project batch and the same has to be discussed with the Guide regularly.
- For CIE assessment the project groups must give a final presentation with the draft copy of the project report.
- The presentation by each group will be for 20-30 minutes and every member of the team needs to justify the contributions to the project.
- The project team is required to submit Hard copies of the detailed Project Report in the prescribed format to the department.
- For CIE 50% weightage should be given to the project guide and 50% weightage to the project evaluation committee.

| **Course Outcomes:** | |
|---|---|
| **1** | Identifying critical thinking and problem-solving abilities by analyzing and addressing interdisciplinary challenges, utilizing creative approaches and innovative solutions. |
| **2** | Exhibit proficiency in conducting comprehensive research, including literature review, data collection, modelling, simulation, and analysis, to address significant technical challenges and propose innovative solutions. |
| **3** | Demonstrate the ability to do effective teamwork, leadership, project management, and communication skills, while adhering to ethical standards and professional responsibility in delivering the project outcomes within time and budget constraints. |
| **4** | Utilize appropriate engineering tools, technologies, and software to design, test, and implement project solutions, ensuring adherence to technical specifications, safety standards, and industry best practices. |

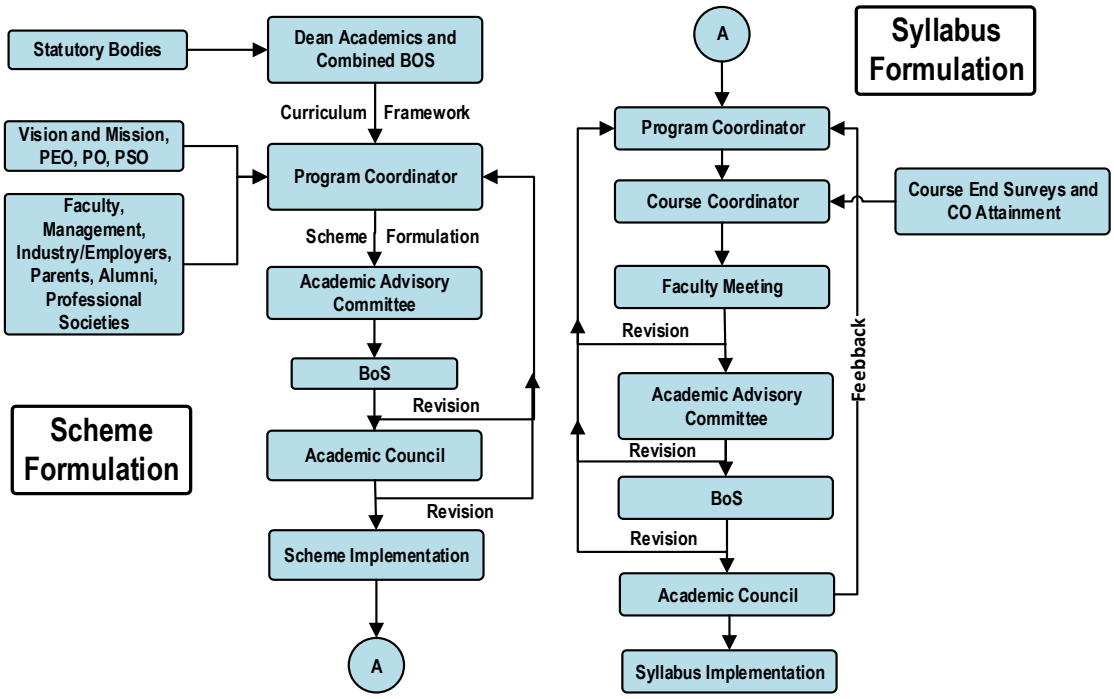
CIE Assessment:
The following are the weightings given for the various stages of the project.

| | | |
|---|---|---|
| 1. | Selection of the topic and formulation of objectives | 10% |
| 2. | Design and Development of Project methodology | 25% |
| 3. | Execution of Project | 25% |
| 4. | Presentation, Demonstration and Results Discussion | 30% |
| 5. | Report Writing & Publication | 10% |

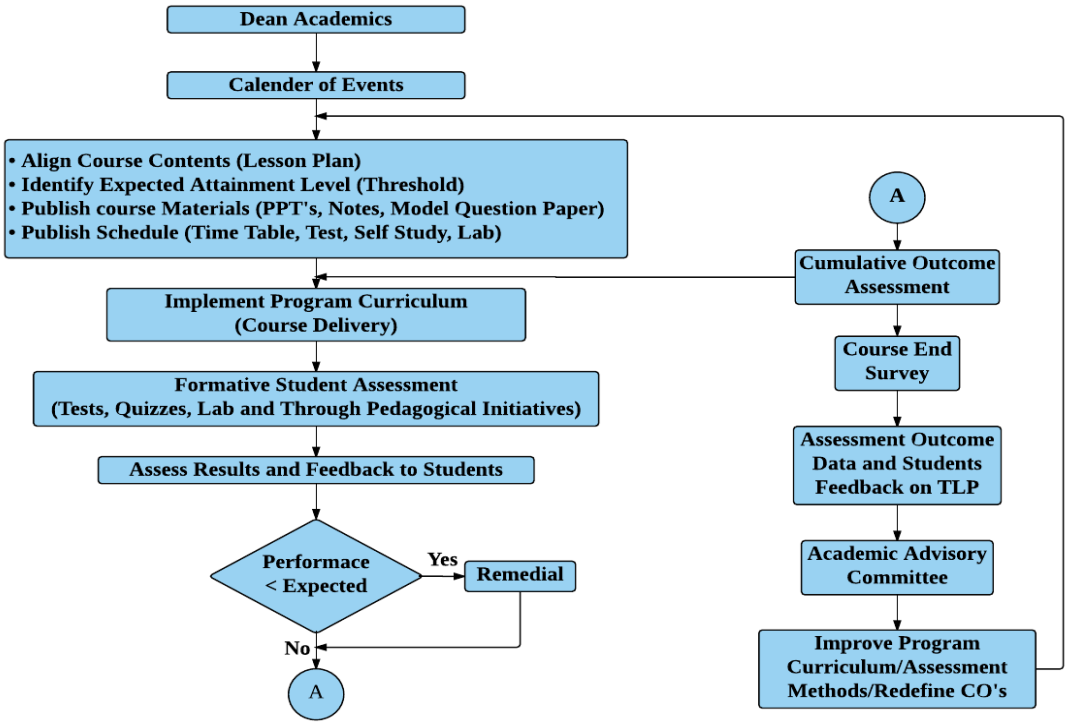
SEE Assessment:
The following are the weightages given during Viva Examination.

| | | |
|---|---|---|
| 1. | Written presentation of synopsis | 10% |
| 2. | Presentation/Demonstration of the project | 30% |
| 3. | Methodology and Experimental Results & Discussion | 30% |
| 4. | Report | 10% |
| 5. | Viva Voce | 20% |

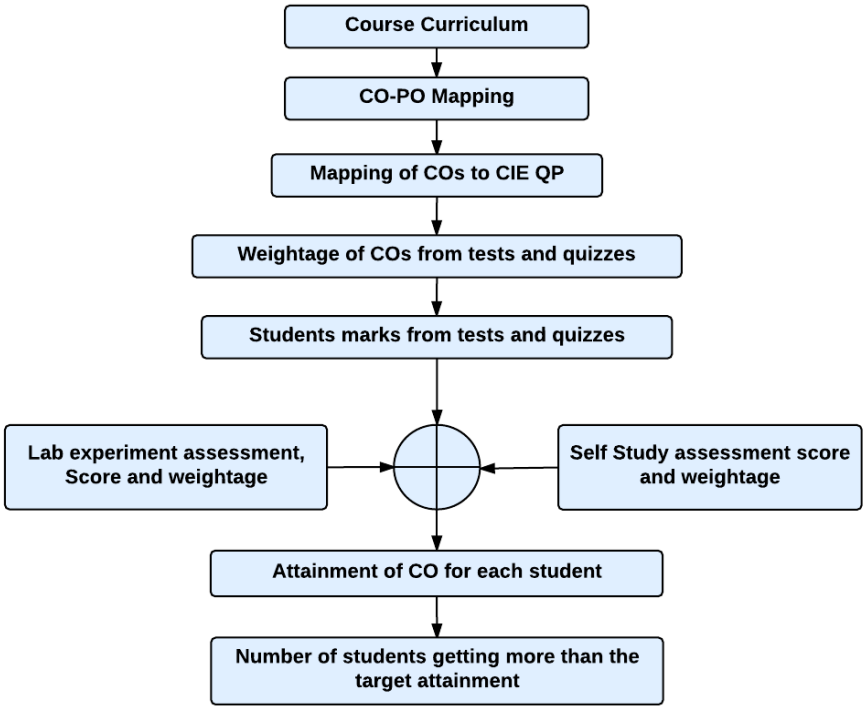
## Curriculum Design Process



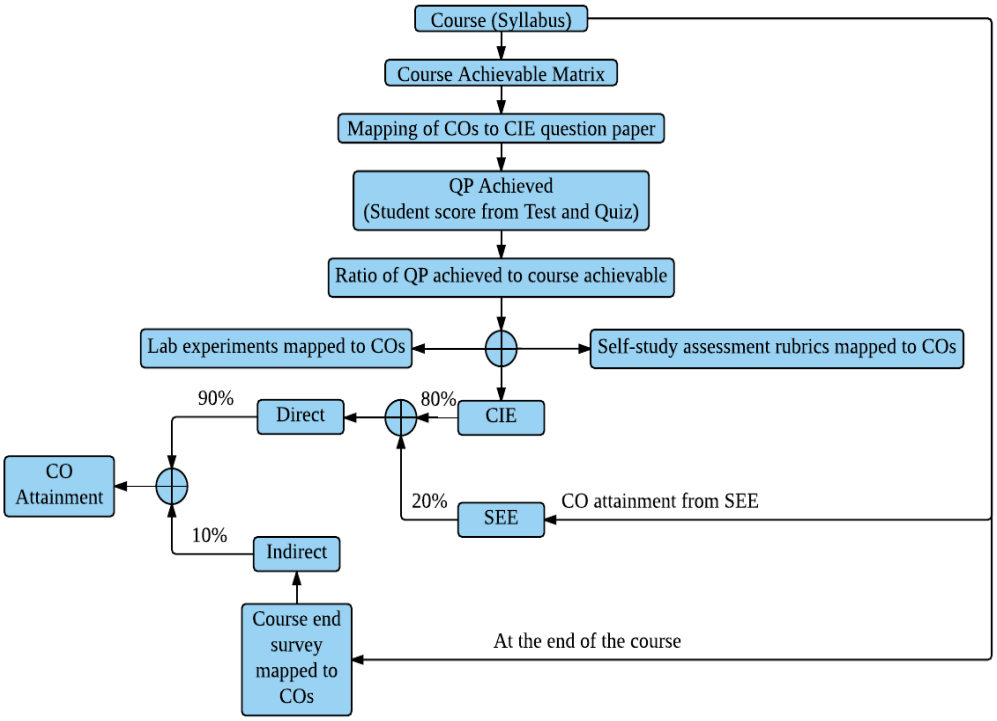

## Academic Planning and Implementation



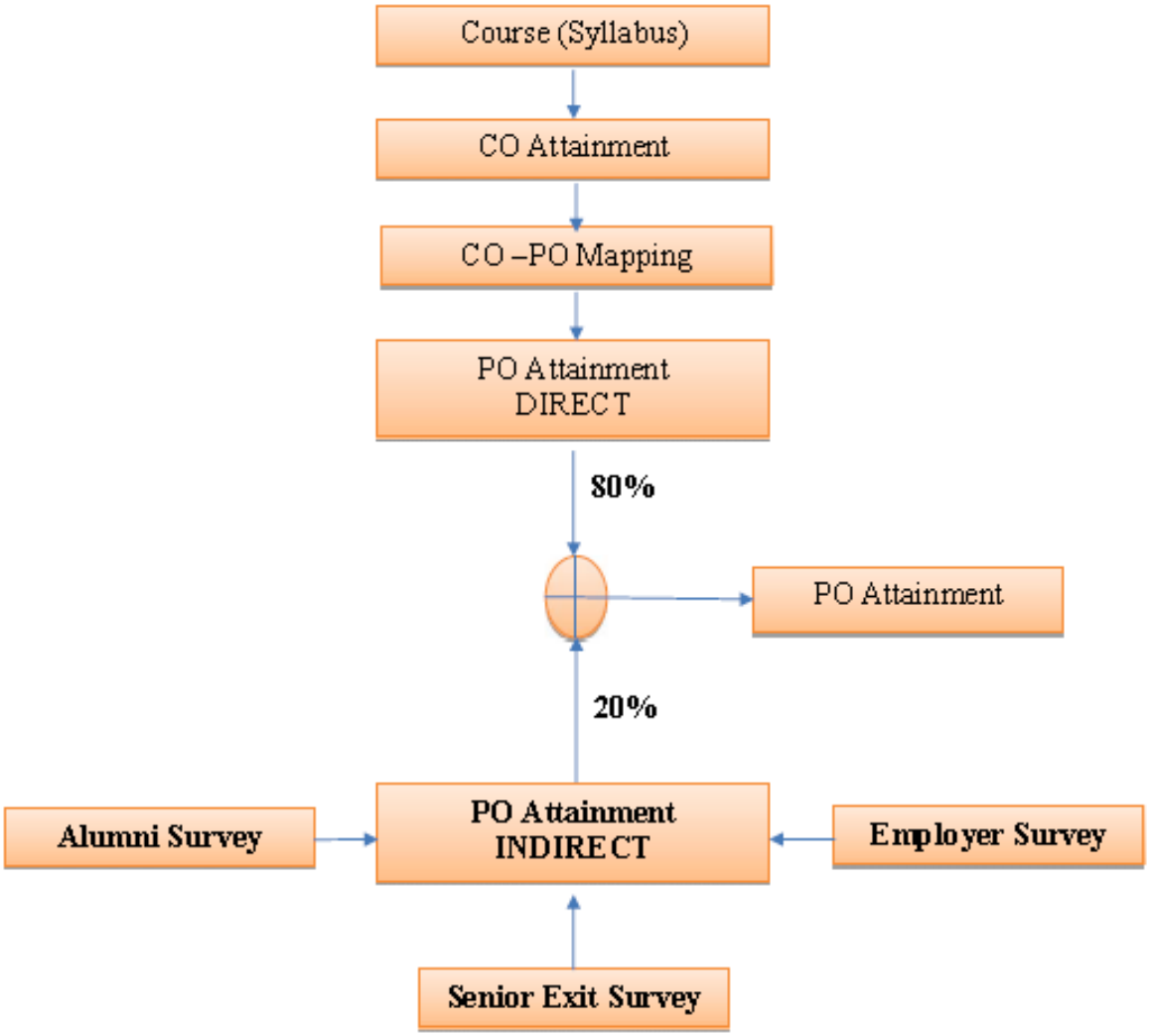
## Process For Course Outcome Attainment




## Final CO Attainment Process



**Program Outcome Attainment Process**



# Knowledge and Attitude Profile (WK)

- **WK1:** A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
- **WK2:** Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.
- **WK3:** A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
- **WK4:** Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
- **WK5:** Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.
- **WK6:** Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
- **WK7:** Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
- **WK8:** Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.
- **WK9:** Ethics, inclusive behaviour and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

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# New Program Outcomes(PO)

- **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, modelling, 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 modelling 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, and 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)

# INNOVATIVE TEAMS OF RVCE

**Ashwa Mobility Foundation (AMF): Designs and fabricates Formula-themed race cars and mobility solutions to address urban transportation issues.**

**Astra Robotics Team: Focuses on designing and building application-specific robots.**

**Coding Club: Helps students gain coding skills and succeed in competitions like GSoC and ACM-ICPC.**

**Entrepreneurship Development Cell (E-Cell): Promotes entrepreneurship through workshops, speaker sessions, and mentoring for startups.**

**Frequency Club Team: Works on software and hardware, emphasizing AI and Machine Learning.**

**Team Garuda: Develops a supermileage urban concept electric car and E-mobility products.**

**Team Jatayu: Builds low-cost UAVs with autonomous capabilities for various tasks.**

**Solar Car Team: Aims to create a solar electric vehicle for sustainable transportation.**

**Team Antariksh: Focuses on space technology and the development of operational rockets.**

**Team Chimera: Builds a Formula Electric Car through R&D in E-Mobility.**

**Helios Racing Team: Designs and tests All-Terrain Vehicles, participating in SAE's BAJA competitions.**

**Team Hydra: Develops autonomous underwater vehicles for tasks like water purification.**

**Team Krushi: Creates low-cost farming equipment to assist farmers in cultivation and harvesting.**

**Team Vyoma: Designs and tests radio-controlled aircraft and UAVs.**

**Team Dhruva: Engages in astronomy-related activities and collaborates on projects with organizations like ICTS and IIA.**

**Ham Club: Promotes Amateur Radio and explores technical innovations in communications,**

Cultural Activity Teams

1. AALAP (Music club)
2. DEBSOC (Debating society)
3. CARV (Dramatics club)
4. FOOTPRINTS (Dance club)
5. QUIZCORP (Quizzing society)
6. ROTARACT (Social welfare club)
7. RAAG (Youth club)
8. EVOKE (Fashion team)
9. f/6.3 (Photography club)
10. CARV ACCESS (Film-making

NSS of RVCE

NCC of RVCE

## VISION

**Leadership in Quality Technical Education, Interdisciplinary Research & Innovation, with a Focus on Sustainable and Inclusive Technology**

## MISSION

- To deliver outcome based Quality education, emphasizing on experientiallearning with the state of the art infrastructure.
- To create a conducive environment for interdisciplinary research and innovation.
- To develop professionals through holistic education focusing on individual growth, discipline, integrity, ethics and social sensitivity.
- To nurture industry-institution collaboration leading to competency enhancement and entrepreneurship.
- To focus on technologies that are sustainable and inclusive, benefiting all sections of the society.

## QUALITY POLICY

Achieving Excellence in Technical Education, Research and Consulting through an Outcome Based Curriculum focusing on Continuous Improvement and Innovation by Benchmarking against the global Best Practices.

## CORE VALUES

**Professionalism, Commitment, Integrity, Team Work, Innovation**