BE SCHEME & SYLLABUS

Third Year (V and VI Semester)

With effect from 2022-23

Mechanical Engineering



ST JOSEPH ENGINEERING COLLEGE

AN AUTONOMOUS INSTITUTION Vamanjoor, Mangaluru - 575028



Service & Excellence

VISION

To be a global premier Institution of professional education and research.

MISSION

- Provide opportunities to deserving students of all communities, the Christian students in particular for quality professional education.
- Design and deliver curricula to meet the national and global changing needs through student-centric learning methodologies.
- Attract, nurture and retain the best faculty and technical manpower.
- Consolidate the state-of-art infrastructure and equipment for teaching and research activities.
- Promote all round personality development of the students through interaction with alumni, academia and industry.
- Strengthen the Educational Social Responsibilities (ESR) of the institution.



ST JOSEPH ENGINEERING COLLEGE

An Autonomous Institution Vamanjoor, Mangaluru - 575028

Affiliated to VTU – Belagavi & Recognized by AICTE New Delhi NBA – Accredited: B.E. (CSE, ECE, EEE, ME and CIV) & PG (MBA and MCA) NAAC – Accredited with A+

B.E. SCHEME & SYLLABUS (With effect from 2022-23)

MECHANICAL ENGINEERING

THIRD YEAR (V and VI Semester)

AUTONOMY AND ACCREDITATION

St Joseph Engineering College (SJEC) is an Autonomous Institute under Visvesvaraya Technological University (VTU), Belagavi, Karnataka State, and is recognized by the All-India Council for Technical Education (AICTE), New Delhi. SJEC is registered under the trust "Diocese of Mangalore, Social Action Department".

The SJEC has been conferred Fresh Autonomous Status from the Academic Year 2021-22. The college was granted autonomy by the University Grants Commission (UGC) under the UGC Scheme for Autonomous Colleges 2018 and conferred by VTU. The UGC Expert Team had visited the college on 28-29 November 2021 and rigorously assessed the college on multiple parameters. The fact that only a handful of engineering colleges in the state have attained Autonomous Status adds to the college's credibility that has been on a constant upswing. Autonomy will make it convenient for the college to design curricula by recognizing the needs of the industry, offering elective courses of choice and conducting the continuous assessment of its students.

At SJEC, the Outcome-Based Education (OBE) system has been implemented since 2011. Owing to OBE practised at the college, SJEC has already been accredited by the National Board of Accreditation (NBA). Five of the UG programs, namely Computer Science & Engineering, Mechanical Engineering, Electronics and Communication Engineering, Electrical & Electronics Engineering and Civil Engineering and two of the PG programs, namely MBA and MCA programs, have accreditation from the NBA.

Also, SJEC has been awarded the prestigious A+ grade by the National Assessment and Accreditation Council (NAAC) for five years. With a Cumulative Grade Point Average (CGPA) of 3.39 on a 4-point scale, SJEC has joined the elite list of colleges accredited with an A+ grade by NAAC in its first cycle. The fact that only a small percentage of the Higher Education Institutions in India have bagged A+ or higher grades by NAAC adds to the college's credibility that has been on a constant upswing.

The college is committed to offering quality education to all its students, and the accreditation by NAAC and NBA reassures this fact. True to its motto of "Service and Excellence", the college's hard work has resulted in getting this recognition, which has endorsed the academic framework and policies that the college has been practising since its inception. The college has been leveraging a flexible choice-based academic model that gives students the freedom to undergo learning in respective disciplines and a transparent and continuous evaluation process that helps in their holistic development.

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ABOUT THE DEPARTMENT

The Department of Mechanical Engineering was established in the year 2002 with the vision of nurturing technically competent and socially responsible Engineering Professionals. Alma mater to more than 1700 Graduate Engineers over the past 17 glorious years; the Mechanical Engineering Department, SJEC, strives to prepare students for careers across a broad range of industries such as automotive, manufacturing, materials and metallurgy, oil and gas, and aeronautical. Mechanical Engineering encompasses learning the application of physical principles of heat, force, conservation of mass and energy, design of mechanisms and machine elements, system design, manufacturing and maintenance of industrial machinery, etc. Thrust is laid on teaching CAD/CAM tools along with latest design tools, to keep the students abreast with modern technologies in the discipline of Mechanical Engineering. The Department offers Undergraduate (B.E.), Post Graduate (M.Sc. in Engineering by Research), and Doctoral (Ph.D.) programme; with an annual intake of 120 candidates for B.E. Course. The Department of Mechanical Engineering at SJEC is one of the few Departments in the region to secure NBA Accreditation since 2013 and the Department has also got permanent affiliation status from VTU Belagavi from 2019-20 to 2024-25.

DEPARTMENT VISION

To be a value-based department committed to excellence in teaching and research, nurturing technically competent and socially responsible engineering professionals

DEPARTMENT MISSION

- Providing state-of-the-art technical knowledge in Mechanical Engineering.
- Promoting research, education and training in frontier areas of Mechanical Engineering.
- Facilitating faculty development through quality improvement programmes.
- Initiating collaboration with industries, research organizations and institutes for internship, joint research and consultancy.
- Instilling social and ethical values in students, staff and faculty through personality development programmes.
- Developing innovation in engineering and technology in order to provide beneficial service to the local community.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. Graduates will engage in designing, manufacturing, testing, operating and/or maintaining systems in the field of Mechanical Engineering and allied industries.

2. Graduates will be able to communicate and perform effectively in both individual and team-based project environments, including multi-disciplinary settings.

3. Graduates will apply knowledge and skills considering ethical practices, societal, economic and environmental factors and/or pursue higher education and research.

4. Graduates will develop the practice of continuously updating themselves with the latest knowledge and information in their field of specialization.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

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

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

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

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

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

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

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

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

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

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

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

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

PROGRAM SPECIFIC OUTCOMES (PSOs)

Graduates of the Mechanical Engineering program are able to

PSO1: Take up research programs on contemporary areas of Mechanical engineering.

PSO2: Gain competence to face various competitive examinations and succeed in seeking the best opportunities in the corporate world and higher studies.

| | V Semester (B.E Mechanical Engineering) | | | | | | | | | | | | |
|------------|---|----------|--|----------------------|----------------------|-------------------|--------------|-----------------------|----------------------|-----------|-----------|--------------------|---------|
| | | | | | | Te Hou | achi rs/W | ng /eek | Examination | | | | |
| SI. No. | Course and Course Code | | Course Title | eaching epartment | aper Setting oard | Theory Lecture | Tutorial | Practical/ Drawing | Duration in hours | CIE Marks | SEE Marks | Fotal Marks | Credits |
| 1 | HSMC | 22MEC51 | Industrial Management and Economics | | | L 2 | Т | Р | 02 | 50 | 50 | 100 | 2 |
| 1 | HSMC IDCC | 22MEC51 | Track area shines (Internets I) | MEC | MEC | 3 | - | | 03 | 50 | 50 | 100 | 3 |
| 2 | IPCC | 22MEC52 | Turbomachines (Integrated) | MEC | MEC | Z | 2 | Z | 03 | 50 | 50 | 100 | 4 |
| 3 | IPCC | 22MEC53 | Theory of Machines (Integrated) | MEC | MEC | 2 | 2 | 2 | 03 | 50 | 50 | 100 | 4 |
| 4 | PCC | 22MEC54 | Control Engineering | MEC | MEC | 2 | 2 | - | 03 | 50 | 50 | 100 | 3 |
| 5 | PCCL | 22MEC55L | CNC Programming and 3D Printing Laboratory | MEC | MEC | - | I | 2 | 03 | 50 | 50 | 100 | 1 |
| 6 | PEC | 22MEC56X | Professional Elective - I | MEC | MEC | 3 | - | - | 03 | 50 | 50 | 100 | 3 |
| 7 | AEC/ SDC | 22RMI57 | Research Methodology and Intellectual Property Rights | MEC | MEC | 2 | - | - | 03 | 50 | 50 | 100 | 2 |
| 8 | AEC/ SDC | 22ETP58 | Emerging Technologies: A Primer | COM | COM | _ | - | 2 | 03 | 100 | - | 100 | 1 |
| | | | | | Total | 14 | 6 | 8 | 24 | 450 | 350 | 800 | 21 |

| | 22MEC56X : Professional Elective I | | | | | | | |
|----------|------------------------------------|----------|-------------------------|--|--|--|--|--|
| 22MEC561 | Mechatronics | 22MEC563 | Supply Chain Management | | | | | |
| 22MEC562 | Sustainable Engineering | 22MEC564 | Energy Engineering | | | | | |

| | VI Semester (B.E Mechanical Engineering) | | | | | | | | | | | | |
|------------|--|------------------|--------------------------------------|----------------------|----------------------|-------------------|-----------------|-----------------------|--------------------|----------|----------|------------|--------|
| | | | | | | T Ho | eachin urs/W | g eek | | Examir | nation | | |
| SI. No. | Course a C | nd Course ode | | eaching epartment | aper Setting oard | Theory Lecture | Tutorial | Practical/ Drawing | uration in ours | IE Marks | EE Marks | otal Marks | redits |
| | | | | ΪŬ | B. B. | L | Т | Р | р Д | C | S | T. | C |
| 1 | IPCC | 22MEC61 | Heat Transfer (Integrated) | MEC | MEC | 2 | 2 | 2 | 03 | 50 | 50 | 100 | 4 |
| 2 | IPCC | 22MEC62 | Mechanical Vibrations (Integrated) | MEC | MEC | 2 | 2 | 2 | 03 | 50 | 50 | 100 | 4 |
| 3 | PCC | 22MEC63 | Machine Design | MEC | MEC | 2 | 2 | - | 03 | 50 | 50 | 100 | 3 |
| 4 | PEC | 22MEC64X | Professional Elective -II | MEC | MEC | 3 | - | - | 03 | 50 | 50 | 100 | 3 |
| 5 | OEC | 22MEC65X | Open Elective -I | MEC | MEC | 3 | - | - | 03 | 50 | 50 | 100 | 3 |
| 6 | PRJ | 22MEC66 | Major Project – Phase I | MEC | MEC | - | - | 4 | 03 | 100 | - | 100 | 2 |
| 7 | HSMC | 22CIV67 | Environmental Studies | CIV | CIV | 1 | - | - | 02 | 50 | 50 | 100 | 1 |
| 8 | AEC/SDC | 22IIP68 | Innovation and Intellectual Property | COM | COM | - | - | 2 | 03 | 100 | - | 100 | 1 |
| Total | | | | | | | | 10 | 23 | 500 | 300 | 800 | 21 |

| | 22MEC64X : Professional Elective II | | | | | | | |
|----------|-------------------------------------|----------|---------------------------------------|--|--|--|--|--|
| 22MEC641 | Operation Research | 22MEC643 | Product Life Cycle Management | | | | | |
| 22MEC642 | Refrigeration and Air Conditioning | 22MEC644 | Design for Manufacturing and Assembly | | | | | |

| | 22MEC65X : Open Elective I | | | | | | |
|----------|-------------------------------|----------|-----------------|--|--|--|--|
| 22MEC651 | Project Management | 22MEC653 | Mechatronics | | | | |
| 22MEC652 | Product Life Cycle Management | 22MEC654 | Modern Mobility | | | | |

V Semester

| INDUSTRIAL MANAGEMENT AND ECONOMICS | | | | | | | |
|-------------------------------------|----------|-------------|---------|--|--|--|--|
| Course Code | 22MEC51 | CIE Marks | 50 | | | | |
| Course Type | Theory | SEE Marks | 50 | | | | |
| (Theory/Practical/Integrated) | Theory | Total Marks | 100 | | | | |
| Teaching Hours/Week (L: T:P) | 3:0:0 | SEE | 3 Hours | | | | |
| Total Hours | 40 hours | Credits | 03 | | | | |

Course Learning Objectives: The objective of the course is

- To help the students to understand the fundamental concepts and principles of management; the basic roles, skills, functions of management, various organizational structures and basic knowledge of marketing.
- To impart knowledge, with respect to concepts, principles and practical applications of Economics, which govern the functioning of a firm/organization under different market conditions.

Module-1 Management & Planning (8 hours)

Management: Introduction - Meaning - nature and characteristics of Management, Scope and Functional areas of management - Management as a science, art of profession - Management & Administration - Roles of Management, Levels of Management, Development of Management Thought- early management approaches – Modern management approaches.

Planning: Nature, importance and purpose of planning process Objectives - Types of plans (Meaning Only) - Decision making Importance of planning - steps in planning & planning premises - Hierarchy of plans.

Module-2 Organizing, Directing & Controlling (8 hours)

Organizing and Staffing: Nature and purpose of organization Principles of organization - Types of organization - Departmentation Committees Centralization Vs Decentralization of authority and responsibility - Span of control - MBO and MBE (Meaning Only) Nature and importance of staffing--Process of Selection & Recruitment (in brief).

Directing & Controlling: Meaning and nature of directing Leadership styles, Motivation Theories, Communication - Meaning and importance - coordination, meaning and importance and Techniques of Co Ordination. Meaning and steps in controlling - Essentials of a sound control system - Methods of establishing control (in brief).

Module-3 Engineering Economics (8 hours)

Introduction: Engineering and economics, Problem solving and decision making, Laws of demand and supply, Difference between Microeconomics & Macroeconomics, equilibrium between demand & supply, elasticity of demand, price elasticity, income elasticity. Law of Returns, Interest and interest factors, simple and compound interest, Cash flow diagrams, personal loans and EMI payment calculation with flexible interest rates, Discussion and problems

Module-4 Present, Future and Annual Worth and Rate of Returns (8 hours)

Basic present worth comparisons, Present worth equivalence, Assets with unequal lives and infinites lives, future worth comparisons, payback comparisons, Equivalent annual worth comparisons, situations for annual worth comparisons. Asset life, Rate of return, minimum acceptable rate of return, IRR anomalies and misconceptions, Cost of capital, comparisons of all present future and annual worth with IRR, product costing, Discussions and problems.

Module-5 Costing and Depreciation (8 hours)

Components of costs, estimation of selling price, marginal cost, first cost, all kinds of overheads, indirect cost estimation with depreciation, mensuration and estimation of material cost, cost estimation of mechanical process, idling time. Product costing (approaches to product costing), causes of depreciation, methods of computing depreciation charges, straight line method, declining balance method, sum of years method, sinking fund method, service output methods, taxation concepts, personal income taxes and corporate taxes, Discussions and problems

| Course Outcomes: At the end of the course the student will be able to: | | | | | | | |
|---|--|--|--|--|--|--|--|
| 22MEC51.1 | Discuss the situations of unethical professional conduct and propose ethical alternatives of management in the engineering arena and describe importance of planning pertains to protection of the public and public interest at global, regional and local level. | | | | | | |
| 22MEC51.2 | Analyse and compare the alignment between theoretical frameworks and practical implementation of management techniques in SMEs. | | | | | | |
| 22MEC51.3 | Apply the basic concepts of engineering economics to demonstrate the understanding of regulations, legislation and standards within the perspective of given syllabus | | | | | | |
| 22MEC51.4 | Select the best economic model from various available alternatives | | | | | | |
| 22MEC51.5 | Apply concepts from technical literature to real-world scenarios and demonstrate adherence to professional conduct standards. | | | | | | |
| 22MEC51.6 | Discuss Decision making, Organizing, Staffing, Directing and Controlling | | | | | | |

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|------------|---|-----------------------------|--------------------------|-----------------------------------|
| Text | books | | | |
| 1 | Engineering Economy | Riggs J.L | McGraw Hill | 4 th edition, 2004 |
| 2 | Principles of Management | Tripathy and Reddy | Tata McGraw Hill | 3 rd edition, 2006 |
| Refer | rence Books | | | |
| 1 | Management Fundamentals Concepts, Applications, Skill Development | Robert N. Lussier | Cengage | 1 st edition, 2012 |
| 2 | Mechanical estimation and costing | T.R. Banga & S.C. Sharma | Khanna Publishers | 17 th edition, 2015 |
| 3 | Engineering Economics | R. Paneer selvam | PHI | 2 nd edition, 2012 |

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/122106031
- https://onlinecourses.nptel.ac.in/noc22_mg104/preview

Course Articulation Matrix

| Course | | | | |] | Progra | m Out | comes | (POs) |) | | | | |
|-------------------|-----|-----|-----|-----|-----|--------|-------|-------|-------|------|------|------|------|------|
| Outcomes (COs) | P01 | P02 | PO3 | P04 | PO5 | P06 | PO7 | PO8 | 909 | PO10 | P011 | P012 | PSO1 | PSO2 |
| 22MEC51.1 | - | - | - | - | - | 3 | - | 1 | 1 | - | - | - | - | - |
| 22MEC51.2 | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - |
| 22MEC51.3 | - | - | - | - | - | 3 | - | - | - | - | - | - | 1 | - |
| 22MEC51.4 | 2 | 2 | - | - | - | - | 1 | - | - | - | - | - | - | - |
| 22MEC51.5 | 3 | 2 | - | - | - | - | - | - | - | - | - | - | - | - |
| 22MEC51.6 | - | - | - | - | - | 3 | - | - | 2 | - | - | - | 1 | - |

| | TURBOMACHINES | | |
|-------------------------------|-------------------------|-------------|---------|
| Course Code: | 22MEC52 | CIE Marks | 50 |
| Course Type | Integrated | SEE Marks | 50 |
| (Theory/Practical/Integrated) | Integrated | Total Marks | 100 |
| Teaching Hours/Week (L:T:P) | 2:2:2 | SEE | 3 Hours |
| Total Hours | 40 hours + 10 lab slots | Credits | 04 |

Course Learning Objectives: The objective of the course is to

- Understand typical design of Turbo machines, their working principle and their application.
- Study the conversion of fluid energy to mechanical energy in a Turbo machine with utilization factor and degree of reaction.
- Analyze various designs of steam turbines and their working principle.
- Analyse the various designs of hydraulic turbines based on the working principle.
- Understand the various aspects in the design of power absorbing machines.

| Module-1 Introduction to | • Turbomachines (8 hours) |
|--------------------------|---------------------------|
|--------------------------|---------------------------|

Definition of turbo machine, parts of turbo machines, Comparison with positive displacement machines, Dimensionless parameters and their significance, Unit and specific quantities, model studies, simple numerical.

Classification of Turbomachines, Basic constructional details, Euler's equation for a Turbo machine and its alternate form, Impulse & Reaction machine - utilization factor, degree of reaction, Relation between degree of reaction and Utilization factor of Turbo machines. Applications of first and second law of thermodynamics to turbomachines.

Module-2 General analysis of Turbomachines (8 hours)

Radial flow Turbomachines: Radial flow Turbines, compressors and pumps – general analysis, velocity triangles, Effect of blade discharge angle on energy transfer and degree of reaction, Numerical.

Axial flow Turbomachines: Axial flow Turbines, pumps and compressors, degree of reaction, velocity triangles, condition for maximum utilization factor, Numerical.

Module-3 Hydraulic Turbines (8 hours)

Impulse type: Various heads and efficiencies, Significance of Specific speed and Unit quantities. Working principle, Velocity triangles, work done, in Pelton wheel and Numerical. **Reaction type:** Working principle, Velocity triangles, work done in Francis turbine and Kaplan turbine. Draft tubes, Cavitation in reaction turbines, Numerical.

Module-4 Steam Turbines (8 hours)

Impulse type: Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, Multi-stage impulse turbine, expression for maximum utilization factor, Numerical using graphical method only.

Reaction type: Parsons's turbine, condition for maximum utilization factor, reaction staging. Numerical using graphical method only.

Module-5 Centrifugal Machines (8 hours)

Centrifugal Pumps: Parts of centrifugal pump, different heads and efficiencies of centrifugal pump, Theoretical head – capacity relationship, Velocity triangles, Minimum speed for starting the flow, Cavitation, Need for priming, Pumps in series and parallel. Concept of slip and slip coefficient, pre-rotation, Numerical.

Centrifugal Fans, Blowers & Compressors: Velocity triangles, work done and degree of reaction, size & speed, vane shape & efficiency. Numerical.

Course Outcomes: At the end of the course the student will be able to:

| 22MEC52.1 | Analyse the energy transfer in Turbomachine with degree of reaction and utilisation factor. |
|-----------|---|
| 22MEC52.2 | Analyse the performance of the radial flow and axial flow turbomachines using velocity triangles. |

| 22MEC52.3 | Compare and evaluate the performance of various types of hydraulic turbines. | | | | | | | | | |
|-----------|---|--|--|--|--|--|--|--|--|--|
| 22MEC52.4 | ompare and evaluate the performance of various types of steam turbines. | | | | | | | | | |
| 22MEC52.5 | Compare and evaluate the performance of centrifugal pumps, blowers and fans. | | | | | | | | | |
| 22MEC52.6 | Conduct experimental investigation of various turbomachines and positive displacement machines. | | | | | | | | | |

| Sl. No | Title of the Book | | Name of the Author/s | Name of the Publisher | Edition and Year |
|-----------|--|----|--|-----------------------------|----------------------------------|
| Text | books | | | | |
| 1 | Turbo machines | | Dr M. S. Govinde Gowda and Dr A. M. Nagaraj | M. M. Publications | 7 th edition, 2018 |
| 2 | Fundamentals of Turbo Machinery | | B.K Venkanna | PHI Publishers | 6 th edition, 2009 |
| Refer | ence Books | | | | |
| 1 | Turbines, Compressors & Fans | | S. M. Yahya | Tata McGraw Hill Co. Ltd | 2 nd edition, 2002 |
| 2 | Fluid Mechanics & Thermodynamics Turbomachines | of | S. L. Dixon | Elsevier | 3 rd edition, 2005 |

Web links/Video Lectures/MOOCs

- https://onlinecourses.nptel.ac.in/noc21_me127 IIT Kanpur
- https://onlinecourses.nptel.ac.in/noc23_me81 IIT Madras

PRACTICAL MODULE

(Conduction)

- 1. Performance test on Pelton turbine and draw main and operating characteristics.
- 2. Performance test on Francis turbine and draw main and operating characteristics.
- 3. Performance test on Kaplan turbine and draw main and operating characteristics.
- 4. Performance test on single stage Reciprocating Pump.
- 5. Performance test on single stage centrifugal pump.
- 6. Performance test on multi-stage centrifugal pump
- 7. Performance test of 4 stroke Single cylinder Diesel engine
- 8. Performance test of 4 stroke Single cylinder Petrol engine

(Demonstration)

1. Demonstration on performance of the blower and air-compressor.

(Open Ended Problem)

2. Virtual lab experiment on impulse/reaction type turbine/pump.

| Course | | Program Outcomes (POs) | | | | | | | | | | | | |
|-------------------|-----|------------------------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| Outcomes (COs) | POI | P02 | PO3 | P04 | PO5 | PO6 | PO7 | PO8 | 909 | PO10 | P011 | P012 | PSO1 | PSO2 |
| 22MEC52.1 | - | 3 | 2 | - | - | - | - | - | 1 | - | - | - | - | - |
| 22MEC52.2 | - | 2 | 3 | - | - | - | - | - | 1 | - | - | - | - | - |
| 22MEC52.3 | - | - | 3 | - | - | - | - | - | 2 | - | - | - | - | - |
| 22MEC52.4 | - | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - |
| 22MEC52.5 | - | - | 3 | - | - | - | - | - | 2 | - | - | - | - | - |
| 22MEC52.6 | - | - | - | 3 | 2 | - | - | - | - | - | - | 3 | - | 2 |

Course Articulation Matrix

| TH | EORY OF MACHINES | | |
|-------------------------------|-------------------------|-------------|---------|
| Course Code | 22MEC53 | CIE Marks | 50 |
| Course Type | Internet d | SEE Marks | 50 |
| (Theory/Practical/Integrated) | Integrated | Total Marks | 100 |
| Teaching Hours/Week (L: T: P) | 2:2:2 | SEE | 3 Hours |
| Total Hours | 40 hours + 10 lab slots | Credits | 04 |

Course Learning Objectives: The objective of the course is

- To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
- To understand undesirable effects of unbalances resulting from prescribed motions in mechanism.
- To understand the principles in mechanisms used for speed control and stability control.
- To familiarize principles of cams, governors and gyroscope.

Module-1 Force Analysis (8 hours)

Static force analysis: Static equilibrium. Equilibrium of two and three force members. Members with two forces and torque. Free body diagrams. Static force analysis of four bar mechanism and slider-crank mechanism with and without friction.

Module-2 Balancing of Masses (8 hours)

Balancing of Rotating Masses: Static and Dynamic Balancing, Balancing of single rotating mass by balancing masses in same plane and in different planes. Balancing of several rotating masses by balancing masses in same plane and in different planes.

Balancing of Reciprocating Masses: Inertia Effect of crank and connecting rod, Single cylinder Engine, Balancing in multi cylinder-inline engine (primary and secondary forces)

Module-3 Gyroscope & Cams (8 hours)

Gyroscope: Gyroscopic couple, Effect of gyroscopic Couple on plane disc, ship, aeroplane, Stability of two wheelers and four wheelers.

Analysis of Cams: Analysis of Tangent cam with roller follower and Circular arc cam operating flat faced and roller followers.

Module-4 Governors (8 hours)

Flywheel: Introduction, turning moment diagrams, Fluctuation of Energy and speed, energy stored in a flywheel, determination of size of flywheels.

Governors: Types of Governors; Force Analysis of Porter and Hartnell Governors. Controlling Force, Stability, Sensitiveness, Isochronism, Effort and Power. Discussion on applications.

Module-5 Friction and Belt Drives (8 hours)

Friction: Types friction, the law of friction, force analysis of the sliding body, screw friction, screw jack, flat pivot bearing, flat collar bearing.

Belt and Chain drive: Types of belts and chains, flat belts; angular velocity, the law of belting, length of open and cross belts, centrifugal tension, and condition for maximum power.

PRACTICAL MODULE

- 1. Balancing of rotating masses
- 2. Determination of equilibrium speed, sensitiveness, power and effort of Porter/Hartnell Governor.
- 3. Determination of Fringe constant of Photo-elastic material using.
 - Circular disc subjected to diametral compression.
 - Pure bending specimen (four-point bending)
- 4. Determination of stress concentration using Photo elasticity for simple components like plate with a hole under tension or bending, circular disk with circular hole under compression, 2D Crane hook.
- 5. Determination of Pressure distribution in Journal bearing
- 6. Determination of Principal Stresses and strains in a member subjected to combined loading using Strain gauge.
- 7. Determination of stresses in Curved beam using strain gauge.

| Course Out | Course Outcomes: At the end of the course the student will be able to: | | | | | | | |
|-------------------|---|--|--|--|--|--|--|--|
| 22MEC53.1 | Examine and evaluate the force, velocity on links of four bar, crank slider mechanism subjected to external forces. | | | | | | | |
| 22MEC53.2 | Solve problems concerning static and dynamic balancing of systems involving rotating and reciprocating masses | | | | | | | |
| 22MEC53.3 | Analyze the effect of gyroscopic couple on rotors, ships, aero planes and automobiles | | | | | | | |
| 22MEC53.4 | Demonstrate the working principle of governors and flywheels | | | | | | | |
| 22MEC53.5 | Comprehend the importance of friction and concept of belt drives in machine design. | | | | | | | |
| 22MEC53.6 | Practically demonstrate the knowledge acquired about rotating masses, governors, bearings and stress in members. | | | | | | | |

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|------------|---|--------------------------------------|--|----------------------------------|
| Text | books | | | |
| 1 | Theory of Machines: Kinematics and Dynamics | Sadhu Singh | Pearson | 3 rd edition, 2019 |
| 2 | Mechanism and Machine Theory | G. Ambekar | Prentice Hall India | 1 st edition, 2009 |
| 3 | Theory of Machines | Jagadish Lal | Dhanpat Rai Publications | 1 st edition, 1994 |
| Refe | rence Books | | | |
| 1 | Theory of Machines | Rattan S.S. | Tata McGraw-Hill Publishing Company | 4 th edition, 2014 |
| 2 | Mechanisms and Machines- Kinematics, Dynamics and Synthesis | Michael M Stanisic | Cengage Learning | 1 st edition, 2016 |
| 3 | Theory of Machines & Mechanisms | Shigley. J. V. and Uickers, J. J. | OXFORD University press | 4 th edition, 2004 |
| 4 | Theory of Machines -I | A. S. Ravindra | Sudha Publications | 5 th edition, 2004 |

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/112/106/112106270/
- https://www.youtube.com/playlist?list=PLYRGB44zNZWVibVLmWANp-7obQzOhJLRt
- https://archive.nptel.ac.in/courses/112/104/112104114/
- https://archive.nptel.ac.in/courses/112/101/112101096/

| Course | | | | |] | Progra | m Out | comes | (POs) |) | | | | |
|-------------------|-----|-----|-----|-----|-----|--------|-------|-------|-------|------|------|------|------|------|
| Outcomes (COs) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | P011 | P012 | PSO1 | PSO2 |
| 22MEC53.1 | - | 2 | | - | - | - | - | - | - | - | - | - | - | 2 |
| 22MEC53.2 | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| 22MEC53.3 | - | - | - | 2 | - | - | - | - | - | - | - | - | 1 | - |
| 22MEC53.4 | - | 2 | - | - | - | - | - | - | - | - | - | - | 1 | - |
| 22MEC53.5 | - | 2 | - | - | - | - | - | - | - | - | - | - | 1 | - |
| 22MEC53.6 | - | - | 3 | - | - | - | - | - | - | - | - | 1 | - | - |

Course Articulation Matrix

| CONTROL ENGINEERING | | | | | | | | | | |
|------------------------------------|---------------------------------|----------------------|---------|--|--|--|--|--|--|--|
| Course Code | 22MEC54 | CIE Marks | 50 | | | | | | | |
| Course Type | Theorem | SEE Marks | 50 | | | | | | | |
| (Theory/Practical/Integrated) | Theory | Total Marks | 100 | | | | | | | |
| Teaching Hours/Week (L:T:P) | 2:2:0 | SEE | 3 Hours | | | | | | | |
| Total Hours | 40 hours | Credits | 03 | | | | | | | |
| Course Learning Objectives: The ob | jective of the course is | | | | | | | | | |
| • To develop comprehensive know | wledge and understanding of m | odern control theory | /, | | | | | | | |
| industrial | | | | | | | | | | |
| • automation, and systems analysis | is. | | | | | | | | | |
| • To model mechanical, hydraulic | , pneumatic and electrical syst | ems. | | | | | | | | |
| • To represent system elements h | heales and its reduction tech | iquas | | | | | | | | |

- To represent system elements by blocks and its reduction techniques.
- To understand transient and steady state response analysis of a system.
- To carry out frequency response analysis using polar plot, Bode plot.
- To analyse a system using root locus plots.

Module-1 Introduction (8 hours)

Introduction: Components of a control system, Open loop and closed loop systems. Types of controllers: Proportional, Integral, Differential, Proportional-Integral, and Proportional-Integral-Differential controllers.

Modelling of Physical Systems: Mathematical Models of Mechanical, Electrical, Thermal, Hydraulic Systems

Module-2 Time domain performance of control systems (8 hours)

Time domain performance of control systems: Typical test signal, Unit step response and time domain specifications of first order, second order system. Steady state error, error constants.

Module-3 Block diagram & signal flow graphs (8 hours)

Block diagram & Signal flow graphs: Block diagram algebra, Reduction of block diagram, Signal flow graphs, Gain formula for signal flow graphs, State diagram from differential equations.

Module-4 Stability of linear control systems (8 hours)

Stability of linear control systems: Routh's criterion, Root locus, Determination of phase margin and gain margin using root locus.

Module-5 Stability analysis (8 hours)

Stability analysis: Stability analysis using Polar plot, bode plot, Determination of phase margin and gain margin using Bode plot.

| Course Outc | Course Outcomes: At the end of the course the student will be able to: | | | | | | | |
|--------------------|---|--|--|--|--|--|--|--|
| 22MEC54.1 | Identify the type of controller and control actions. | | | | | | | |
| 22MEC54.2 | Develop the mathematical model of the physical systems | | | | | | | |
| 22MEC54.3 | Estimate the response and error in response of first and second order systems subjected standard step input | | | | | | | |
| 22MEC54.4 | Represent the complex physical system using block diagram and signal flow graph and obtain transfer function. | | | | | | | |
| 22MEC54.5 | Analyze a linear feedback control system for stability using Hurwitz criterion, Routh's criterion and root Locus technique in complex domain | | | | | | | |
| 22MEC54.6 | Analyze the stability of linear feedback control systems in frequency domain using polar plots, and Bode plots | | | | | | | |

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|------------|--------------------------------|-----------------------------|---------------------------------------|-----------------------------------|
| Text | books | | | |
| 1 | Modern control Engineering | K. Ogata | Pearson | 5 th edition, 2010 |
| 2 | Control Systems Engineering | I.J. Nagrath, & M. Gopal | New Age International (P) Ltd | 5 th edition, 2009 |
| 3 | Control Systems Engineering | S Palani | Tata McGraw Hill Publishing Co Ltd | 2 nd edition, 2010 |
| Refe | rence Books | | | |
| 1 | Control Systems Engineering | Norman S Nice | Wiley India Pvt Ltd | 4 th edition, 2007 |
| 2 | Modern control Systems | Richard C Dorf | Pearson | 13 th edition, 2016 |
| 3 | Automatic Control Systems | Farid G., Kuo B. C | McGraw Hill Education | 10 th edition, 2018 |

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/108/106/108106098/
- https://www.youtube.com/watch?v=RcuGxWc0HyQ
- https://www.youtube.com/watch?v=vVFDm_CdQw

Course Articulation Matrix

| Course | | Program Outcomes (POs) | | | | | | | | | | | | |
|-------------------|-----|------------------------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| Outcomes (COs) | PO1 | PO2 | PO3 | PO4 | PO5 | P06 | PO7 | PO8 | 909 | PO10 | P011 | P012 | PSO1 | PSO2 |
| 22MEC54.1 | 3 | 3 | - | - | 1 | - | - | - | - | - | - | - | 1 | - |
| 22MEC54.2 | 3 | 3 | - | - | 1 | - | - | - | - | - | - | - | 2 | - |
| 22MEC54.3 | 3 | 2 | - | - | 1 | - | - | - | - | 1 | I | 1 | 1 | - |
| 22MEC54.4 | 3 | 2 | - | - | 3 | - | - | - | - | - | - | - | 1 | - |
| 22MEC54.5 | 2 | 2 | - | - | 3 | - | - | - | - | - | - | - | 2 | - |
| 22MEC54.6 | 2 | 2 | 2 | _ | 3 | - | - | - | - | - | - | - | - | 1 |

| CNC PROGRAMMING AND 3D PRINTING LABORATORY | | | | | | | |
|--|------------|-------------|---------|--|--|--|--|
| Course Code | 22MEC55L | CIE Marks | 50 | | | | |
| Course Type | Drastical | SEE Marks | 50 | | | | |
| (Theory/Practical/Integrated) | Practical | Total Marks | 100 | | | | |
| Teaching Hours/Week (L:T:P) | 0:0:2 | SEE | 3 Hours | | | | |
| Total Hours | 10 hrs Lab | Credits | 01 | | | | |

Course Learning Objectives: The objective of the course is:

- To expose the techniques of CNC programming and cutting tool path generation through CNC simulation software by using G-Codes and M-codes.
- To educate and expose the students on the usage of CAM packages like CADEM etc.
- To expose the students on the usage of 3D Printing Technology.

| Sl. No | Experiments |
|--------|--|
| 1 | Manual CNC part programming using ISO Format G/M codes for Turning and Milling parts. |
| | Selection and assignment of tools, correction of syntax and logical errors, and verification |
| | of tool path using CNC program verification software. |
| 2 | CNC part programming using CAM packages: Simulation of Turning simulations to be |
| | carried out using simulation packages like: Cadem / CAMLab-Pro / Master-CAM. |
| 3 | CNC part programming using CAM packages: Simulation of Drilling simulations to be |
| | carried out using simulation packages like: Cadem / CAMLab-Pro / Master-CAM. |
| 4 | CNC part programming using CAM packages: Simulation of Milling simulations to be |
| | carried out using simulation packages like: Cadem / CAMLab-Pro / Master-CAM. |
| 5 | Internal and external threading operations: Write a CNC program to create internal and |
| | external threading on a cylindrical block. |
| 6 | Simple 3D Printing Model: - Creating Simple 3D model (example cube, gear, prism etc) |
| | in CAD software and printing the model using any 3D Printer (FDM/SLA/SLS printer). |
| 7 | Assembly Model-1: - Creating a 3D CAD model of NUT and Bolt (Example: - size |
| | M12x50), print the model using any 3D Printer and check for the assembly. |
| 8 | Assembly Model-2: - Creating a 3D CAD assembly model containing four or more parts |

| 0 | Assembly Model-2: - Cleating a 5D CAD assembly model containing four of mole parts |
|---|--|
| | (Example: - Screw jack, plumber block etc), print the model using any 3D Printer and check |
| | for the assembly. |
| | |

| Course Outco | Course Outcomes: At the end of the course the student will be able to: | | | | |
|--------------|---|--|--|--|--|
| 22MEC55L.1 | Explain the importance of CIM in today's technology, its impact on market competition and demonstrate the use of CAM software (SeeNC turn and SeeNC mill). | | | | |
| 22MEC55L.2 | Explain and Write CNC Lathe part program for Turning, Facing, Chamfering, Grooving, Step turning, Taper turning, Circular interpolation etc. | | | | |
| 22MEC55L.3 | Explain and Write CNC Mill Part programming for Point to point motions, Line motions, Circular interpolation, Contour motion, Pocket milling- circular, Rectangular, Mirror commands etc. | | | | |
| 22MEC55L.4 | Apply Canned Cycles for Drilling, Peck drilling, Boring, Tapping, Turning, Facing, Taper turning Thread cutting etc. | | | | |
| 22MEC55L.5 | Apply and visualize the 3D models / Assembly using CAD software. | | | | |
| 22MEC55L.6 | Create a 3D printed Models / Assembly of parts by using 3D printing technology. | | | | |

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year | | | |
|------------|---|---|--------------------------|----------------------------------|--|--|--|
| Text | books | | | | | | |
| 1 | Automation, Production System and Computer Integrated Manufacturing | M.P.Groover | Person India | 2 nd edition, 2007 | | | |
| 2 | Principles of Computer Integrated Manufacturing | S. Kant Vajpayee | Prentice Hall India | 1 st edition, 1998 | | | |
| Refe | Reference Books | | | | | | |
| 1 | Computer Integrated Manufacturing | ufacturing J.A. Rehg and Henry. W.Krabber | | 3rd edition, 2005 | | | |
| 2 | CAD/CAM | Ibrahim Zeid | Tata McGraw Hill | 2 nd edition, 2009 | | | |
| 3 | Fluid Power with Applications | Anthony Esposito | Pearson | 7 th edition, 2008 | | | |
| 4 | Hydraulics and Pneumatics | Andrew Parr | Jaico Publishing House | 1 st edition, 1993 | | | |

Web links and Video Lectures (e-Resources):

- https://saliterman.umn.edu/sites/saliterman.dl.umn.edu/files/general/cnc_mill_programming.pdf
- https://www.slideshare.net/moniraghu/cnc-milling-programs.
- https://nptel.ac.in/courses/112105211
- https://nptel.ac.in/courses/112102103
- https://nptel.ac.in/courses/112102103
- https://onlinecourses.nptel.ac.in/noc19_me46/preview
- https://nptel.ac.in/courses/112103306
- https://archive.nptel.ac.in/courses/112/105/112105211/
- https://onlinecourses.nptel.ac.in/noc20_me50/preview

| Course | Program Outcomes (PG | | | | | | | (POs) |) | | | | | |
|-------------------|----------------------|-----|-----|-----|-----|-----|-----|-------|-----|------|------|------|------|------|
| Outcomes (COs) | PO1 | P02 | PO3 | P04 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | P011 | P012 | PSO1 | PSO2 |
| 22MEC55L.1 | 2 | - | - | - | 3 | - | - | - | - | - | - | - | - | - |
| 22MEC55L.2 | 2 | - | I | I | 3 | 1 | 1 | - | - | I | I | 1 | 2 | - |
| 22MEC55L.3 | 2 | - | - | - | 3 | - | - | - | - | - | - | - | 2 | - |
| 22MEC55L.4 | 2 | - | - | - | 3 | - | - | - | - | - | - | - | - | - |
| 22MEC55L.5 | 2 | - | - | - | 3 | - | - | - | - | - | - | - | - | - |
| 22MEC55L.6 | 2 | - | - | - | 3 | - | - | - | - | - | - | - | - | - |

Course Articulation Matrix

1: Low 2: Medium 3: High

| MECHATRONICS | | | | | | |
|-------------------------------|----------|-------------|---------|--|--|--|
| Course Code | 22MEC561 | CIE Marks | 50 | | | |
| Course Type | Theory | SEE Marks | 50 | | | |
| (Theory/Practical/Integrated) | Theory | Total Marks | 100 | | | |
| Teaching Hours/Week (L:T:P) | 3:0:0 | SEE | 3 Hours | | | |
| Total Hours | 40 hours | Credits | 03 | | | |

Course Learning Objectives: The objective of the course is:

- To acquire a strong foundation in science and focus in mechanical, electronics, control, software, and computer engineering, and a solid command of the newest technologies.
- To understand the evolution and development of Mechatronics as a discipline.
- To substantiate the need for interdisciplinary study in technology education
- To understand the applications of microprocessors in various systems and to know the functions of each element.
- To demonstrate the integration philosophy in view of Mechatronics technology

Module-1 Introduction, Transducers and Sensors (8 hours)

Introduction: Scope and elements of mechatronics, mechatronics design process, measurement system, requirements and types of control systems, feedback principle, Basic elements of feedback control systems, Classification of control system. Examples of Mechatronics Systems such as Automatic Car Park system, Engine management system, Antilock braking system (ABS) control, Automatic washing machine.

Transducers and sensors: Definition and classification of transducers, Difference between transducer and sensor, Definition and classification of sensors, Principle of working and applications of light sensors, Potentiometers, LVDT, Capacitance sensors, force and pressure sensors, Strain gauges, temperature sensors, proximity switches and Hall Effect sensors.

Module-2 Signal Conditioning & Electro Mechanical Drives (8 hours)

Signal Conditioning: Introduction – Hardware – Digital I/O, Analog to digital conversions, resolution, Filtering Noise using passive components – Registers, capacitors, amplifying signals using OP amps. Digital Signal Processing – Digital to Analog conversion, Low pass, high pass, notch filtering. Data acquisition systems (DAQS), data loggers, Supervisory control and data acquisition (SCADA), Communication methods.

Electro Mechanical Drives: Relays and Solenoids – Stepper Motors – DC brushed motors – DC brushless motors – DC servo motors – 4-quadrant servo drives, PWM's – Pulse Width Modulation.

Module-3 Microprocessor & Microcontrollers (8 hours)

Microprocessor & Microcontrollers: Introduction, Microprocessor systems, Basic elements of control systems, Microcontrollers, Difference between Microprocessor and Microcontrollers.

Microprocessor Architecture: Microprocessor architecture and terminology-CPU, memory and address, I/O and Peripheral devices, ALU, Instruction and Program, Assembler, Data Registers, Program Counter, Flags, Fetch cycle, write cycle, state, bus interrupts. Intel's 8085A Microprocessor.

Module-4 Programmable Logic Controller & Application (8 hours)

Programmable Logic Controller: Introduction to PLCs, Basic structure of PLC, Principle of operation, input and output processing, PLC programming language, ladder diagram, ladder diagrams circuits, timer counters, internal relays, master control, jump control, shift registers, data handling, and manipulations, analogue input and output, selection of PLC for application.

Application of PLC control: Extending and retracting a pneumatic piston using latches, control of two pneumatic pistons, control of process motor, control of vibrating machine, control of process tank, control of conveyer motor etc.

Module-5 Mechatronics in CNC machines & Mechatronics Design process (8 hours)

Mechatronics in Computer Numerical Control (CNC) machines: Design of modern CNC machines - Machine Elements: Different types of guide ways, Linear Motion guideways. Bearings: anti-friction

bearings,

hydrostatic bearing and hydrodynamic bearing. Re-circulating ball screws. Typical elements of open and closed loop control systems. Adaptive controllers for machine tools.

Mechatronics Design process: Stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Automatic car park barrier.

| Course Outco | Course Outcomes: At the end of the course the student will be able to: | | | | |
|--------------|---|--|--|--|--|
| 22MEC561.1 | Illustrate various components of Mechatronics systems and assess various control systems used in automation | | | | |
| 22MEC561.2 | Choose appropriate sensors and transducers for different engineering applications | | | | |
| 22MEC561.3 | Assess various components of signal conditioning, Data acquisition systems, SCADA and illustrate the various types of electric motors | | | | |
| 22MEC561.4 | Assess the architecture and basic elements of microprocessors, microcontrollers & PLCs and develop PLC programs using ladder diagrams | | | | |
| 22MEC561.5 | Illustrate various elements of CNC machines and various types of bearings | | | | |
| 22MEC561.6 | Assess the Mechatronics systems by case studies | | | | |

| Sl. No. | Title of the Book | Name of the author/s | Name of the Publisher | Edition &Year | |
|------------|--|-----------------------------------|--------------------------|----------------------------------|--|
| Text | books | | | | |
| 1 | Mechatronics – Electronic control systems in Mechanical and Electrical Engineering | Bolton | Pearson Education | 7 th edition, 2023 | |
| 2 | Mechatronics – Principles, Concepts and Applications | Nitaigour Premchand Mahalik | Tata McGraw Hill | 2 nd edition, 2017 | |
| Refer | rence Books | | | | |
| 1 | Mechatronics | HMT Ltd | Tata McGraw Hill | 2 nd edition, 2017 | |
| 2 | Mechatronics System Design | Devadas Shetty, Richard A Kolk | Cengage Publishers | 3 rd edition, 2012 | |
| 3 | Introduction to Mechatronics and Measurement systems | David G A & Michael B H | McGraw Hill Inc USA | 2 nd edition, 2017 | |
| 4 | Introduction to Robotics: Analysis, Systems, Applications | Saeed B Niku | Pearson Education | 2 nd edition, 2011 | |

Web links and Video Lectures (e-Resources):

1. http://nptel.ac.in/courses/112107298 (Mechatronics)

2. http://nptel.ac.in/courses/112103174 (Mechatronics & Manufacturing Automation)

Course Articulation Matrix

| Course | | | | |] | Progra | ım Ou | tcome | s (POs | 3) | | | | |
|-------------------|-----|-----|-----|-----|-----|--------|-------|-------|--------|------|------|------|------|------|
| Outcomes (COs) | P01 | P02 | PO3 | P04 | PO5 | P06 | PO7 | PO8 | 909 | P010 | P011 | P012 | PSO1 | PSO2 |
| 22MEC561.1 | 3 | - | - | - | - | - | - | - | - | - | 2 | - | - | - |
| 22MEC561.2 | - | 2 | - | - | - | - | - | - | 2 | - | 2 | - | - | - |
| 22MEC561.3 | - | 1 | - | - | - | 2 | - | - | - | - | - | - | - | - |
| 22MEC561.4 | 2 | 2 | - | - | - | - | - | - | 2 | - | - | - | - | - |
| 22MEC561.5 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - | - |
| 22MEC561.6 | _ | 2 | _ | _ | _ | 2 | _ | _ | 2 | _ | _ | _ | - | _ |

| SUSTAINABLE ENGINEERING | | | | | | |
|-------------------------------|----------|-------------|---------|--|--|--|
| Course Code | 22MEC562 | CIE Marks | 50 | | | |
| Course Type | Theory | SEE Marks | 50 | | | |
| (Theory/Practical/Integrated) | Theory | Total Marks | 100 | | | |
| Teaching Hours/Week (L:T:P) | 3:0:0 | SEE | 3 Hours | | | |
| Total Hours | 40 hours | Credits | 03 | | | |

Course Learning Objectives: The objective of the course is to

- Explain sustainable development and different environmental agreements and protocols
- Discuss real-time activities causing environmental issues and different methods of using renewable energy resources
- Explain local and global environmental issues
- Differentiate between carbon emissions for regular and sustainable cities and explain different practices to move industries towards sustainability
- Discuss different renewable energy resources and explain methods to implement green technology

Module-1 Sustainable development and role of engineers (8 hours)

Sustainable development- Need- various agreements and Role of Engineering- Sustainable Development and Engineering Profession. Sustainable Engineering concepts, Goals of Sustainability, Life cycle Thinking, and circular economy, Sustainable Development Goals (SDGs).

Module-2 Sustainable engineering and concepts, principles and frame work (8 hours)

Guiding principles of sustainable engineering, Frameworks for sustainable Engineering Certification, GRIHA certification, Tools for sustainability Assessment: - Environmental Management System (EMS), concept of ISO14000, Environmental impact assessment (EIA), environmental auditing, bio mimicking, case studies.

Module-3 Fundamentals of life cycle assessment (8 hours)

Goal and Scope, Life cycle inventory, Life Cycle Impact Assessment, Interpretation and Presentation of Results, iterative nature of LCA, Methodological Choices, LCA Software's, Strengths and Limitations of LCA, Introduction -Valuing the Environment, Market-based Incentives (or Economic Instruments) for Sustainability.

Module-4 Sustainability and engineering design (8 hours)

Problems Solving in Engineering, conventional to Sustainable Engineering Design Process, Design for Life Guidelines and Strategies, Measuring Sustainability, Sustainable Design through sustainable procurement criteria, Case studies on sustainable Engineering Design Process ~Sustainable Process Design, Sustainable Production Design, Sustainable product design with Artificial Intelligence and Internet of Things.

Module-5 Green technology and green business (8 hours)

Renewable energy resources- solar energy, fuel cells, wind energy, small hydro plants and biogas systems.

Green technology and Green Business: Sustainable business, green technology, green energy, green construction, green transportation, green chemistry, green computing. Case Study: Sustainability Report Preparation

| Course Outcomes: At the end of the course the student will be able to: | | | | |
|--|--|--|--|--|
| 22MEC562.1 | Describe the significance of sustainability and concepts of sustainability Engineering | | | |
| 22MEC562.2 | Identify the tools for sustainability assessment. | | | |
| 22MEC562.3 | Illustrate the fundamentals of Life Cycle Assessment | | | |
| 22MEC562.4 | Explain the Environmental, Social, and Governance Concepts | | | |

| 22MEC562.5 | Analyze and design the sustainable Engineering Process |
|------------|--|
| 22MEC562.6 | Develop and submit a sustainability report within a collaborative setting. |

| Sl. No. | Title of the Book | Title of the BookName of the Author/s | | Edition and Year | |
|------------|---|---|---|----------------------------------|--|
| Text | books | | | | |
| 1 | Sustainability Engineering: Concepts, Design and Case Studies | Allen, D. T. and Shonnard, D. R., | Pearson | 1 st edition, 2017 | |
| 2 | Engineering applications in sustainable design and development | Bradley. A.S; Adebayo,A.O., Maria, P. | Cengage learning | 1 st edition, 2015 | |
| 3 | Sustainable Engineering: Principles and Practice | Bakshi Bhavik R. | Cambridge University Press | 2 nd edition, 2022 | |
| Refer | rence Books | | | | |
| 1 | Introduction to Sustainable Engineering | Rag R L, Ramesh Lekshmi Dinachandran | P. H. I. Learning | 2 nd edition, 2016 | |
| 2 | Environmental Life Cycle Assessment: Measuring the environmental performance of products | Rita Schenck | American Center for Life Cycle Assessment | 1 st edition, 2014 | |

Web links and Video Lectures (e-Resources):

- Ramesh C. Grover, Sachin Grover, Winning The Environmental Challenge With ISO 14001:2015 Implementation of Environmental Management System ISBN: 9781947697324, 1947697323, Notion Press, 2017
- IGBC New Green Building Rating system. https://igbc.in/igbc/html_pdfs/abridged/IGBC%20Green%20New%20Buildings%20Rating%20System%20(Version%203.0).pdf
- https://beeindia.gov.in/sites/default/files/BEE_ECBC%202017.pdf (Energy Conservation Building Code (ECBC), 2017)
- https://onlinecourses.nptel.ac.in/noc21_ce47/preview (Sustainable Engineering Concepts And Life Cycle Analysis- NPTEL course)

| Course | Articulation | Matrix |
|--------|--------------|--------|
|--------|--------------|--------|

| Course | | Program Outcomes (POs) | | | | | | | | | | | | |
|-------------------|-----|------------------------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| Outcomes (COs) | P01 | P02 | PO3 | P04 | PO5 | PO6 | PO7 | PO8 | 909 | PO10 | P011 | P012 | PSO1 | PSO2 |
| 22MEC562.1 | 2 | - | - | - | - | - | 3 | - | - | - | - | - | - | - |
| 22MEC562.2 | 2 | - | - | - | - | - | 3 | - | - | - | - | - | - | - |
| 22MEC562.3 | 2 | - | - | - | - | - | 3 | - | - | - | - | - | - | - |
| 22MEC562.4 | - | 2 | - | - | - | - | 3 | - | - | - | - | - | - | - |
| 22MEC562.5 | - | 1 | 2 | - | - | - | 3 | - | - | - | - | - | - | - |
| 22MEC562.6 | - | 2 | _ | - | - | - | - | - | 2 | 2 | - | - | - | - |

1: Low 2: Medium 3: High

| SUPPLY CHAIN MANAGEMENT | | | | | | | | |
|--|---|--|---|--|--|--|--|--|
| Course Code | 22MEC563 | CIE Marks | 50 | | | | | |
| Course Type | | SEE Marks | 50 | | | | | |
| (Theory/Practical/Integrated) | Theory | Total Marks | 100 | | | | | |
| Teaching Hours/Week (L:T:P) | 3:0:0 | SEE | 3 Hours | | | | | |
| Total Hours | 40 hours | Credits | 03 | | | | | |
| Course Learning Objectives: The objective of the c | ourse is | | | | | | | |
| • To acquaint with key drivers of supply chain per | formance and thei | r inter-relationsh | ips with | | | | | |
| strategy. | | | | | | | | |
| • To impart analytical and problem-solving skills new | cessary to develop | solutions for a v | ariety of | | | | | |
| supply chain management & design problems. | 1 | 1 / | 1 | | | | | |
| • To study the complexity of inter-firm and intra-firm | coordination in imp | olementing progra | ims such | | | | | |
| as e-collaboration, quick response, jointly managed | inventories and str | ategic alliances. | | | | | | |
| • 10 understand the usage of SAP inaterial managend Module 1 Stratogic Sourcing (| ant system | ure) | | | | | | |
| Introduction: Supply Chain Eurodementals Ex | olution Role in I | uis) Economy Impo | rtanca | | | | | |
| Decision Phases – Supplier Manufacturer-Customer | chain - Enablers/ | Drivers of Suppl | v Chain | | | | | |
| Performance, Supply chain strategy - Supply Chain P | erformance Measu | res. | ly Cham | | | | | |
| Strategic Sourcing Outsourcing – Make Vs buy | - Identifying core | e processes - Ma | arket Vs | | | | | |
| Hierarchy - Make Vs buy continuum -Sourcing s | strategy - Supplier | Selection and | Contract | | | | | |
| Negotiation. Creating a world class supply base Supp | lier Development - | World Wide Sou | ircing. | | | | | |
| Module-2 Warehouse Management & Supply (| Chain Network Dis | stribution and D | esign | | | | | |
| (8 hours |) | | | | | | | |
| Warehouse Management Stores management-stores | systems and proce | dures-incoming r | naterials | | | | | |
| control stores accounting and stock verification C | bsolete, surplus a | nd scrap-value a | analysis- | | | | | |
| material handling transportation and traffic managem | ent -operational ef | ficiency-productiv | vity-cost | | | | | |
| effectiveness-performance measurement. | | | ~ . | | | | | |
| Supply Chain Network Distribution Network De | sign – Role - Fac | tors Influencing | Options, | | | | | |
| Value Addition – Distribution Strategies - Models for Distribution Control Logistica Models | or Facility Location | and Capacity all | location. | | | | | |
| Distribution Centre Location Models. | timization Model | a (9 h auna) | | | | | | |
| Module-5 Supply Chain Network Of | | | <u> </u> | | | | | |
| Supply Chain Network optimization models. In | pact of uncertain | y on Network I | Jesign - | | | | | |
| location inventory management. Driging and Revenue | Management | -multiple item - | Network Design, decisions using Decision trees. Planning Demand, -multiple item -multiple | | | | | |
| Module-4 Current Trends & | Management. | location inventory management. Pricing and Revenue Management. | | | | | | |
| Wiodule-4 Current Hends of | Module-4 Current Trends & Mapping (8 hours) | | | | | | | |
| Current Trends: Supply Chain Integration - Building partnership and trust in Supply Chain Value | | | | | | | | |
| Current Trends: Supply Chain Integration - Building | g partnership and tr | rs) ust in Supply Cha | in Value | | | | | |
| Current Trends: Supply Chain Integration - Building of Information: Bullwhip Effect - Effective forecastic Chain restructuring Supply Chain | g partnership and tr ng - Coordinating | rs) ust in Supply Cha the supply chain | in Value . Supply | | | | | |
| Current Trends: Supply Chain Integration - Building of Information: Bullwhip Effect - Effective forecastic Chain restructuring, Supply Chain | g partnership and tr ing - Coordinating | (s) ust in Supply Cha the supply chain | in Value . Supply | | | | | |
| Current Trends: Supply Chain Integration - Building of Information: Bullwhip Effect - Effective forecastic Chain restructuring, Supply Chain Mapping - Supply Chain process restructuring, Postpu- Chain - Agile Supply Chains - Reverse Supply chain | g partnership and tr ng - Coordinating one the point of diff | (s) ust in Supply Cha the supply chain Ferentiation – IT in | in Value . Supply | | | | | |
| Current Trends: Supply Chain Integration - Building of Information: Bullwhip Effect - Effective forecastic Chain restructuring, Supply Chain Mapping - Supply Chain process restructuring, Postpe Chain - Agile Supply Chains -Reverse Supply chain. supply chain | g partnership and tr ing - Coordinating one the point of diff Future of IT in su | rs) ust in Supply Cha the supply chain ferentiation – IT in pply chain- E Bu | in Value . Supply n Supply siness in | | | | | |
| Current Trends: Supply Chain Integration - Building of Information: Bullwhip Effect - Effective forecast Chain restructuring, Supply Chain Mapping - Supply Chain process restructuring, Postp Chain - Agile Supply Chains -Reverse Supply chain. supply chain Module-5 Introduction t | g partnership and tr ing - Coordinating one the point of diff Future of IT in su | rs) ust in Supply Cha the supply chain ferentiation – IT in pply chain- E Bu | in Value . Supply n Supply siness in | | | | | |
| Current Trends: Supply Chain Integration - Building of Information: Bullwhip Effect - Effective forecastic Chain restructuring, Supply Chain Mapping - Supply Chain process restructuring, Postpo Chain - Agile Supply Chains -Reverse Supply chain. supply chain Module-5 Introduction to Introduction to SAP. SAP Material Management. F | g partnership and tr ing - Coordinating one the point of diff Future of IT in su o SAP (8 hours) Procurement proces | rs) ust in Supply Cha the supply chain ferentiation – IT in pply chain- E Bu s. Organization s | in Value . Supply n Supply siness in | | | | | |
| Current Trends: Supply Chain Integration - Building of Information: Bullwhip Effect - Effective forecast Chain restructuring, Supply Chain Mapping - Supply Chain process restructuring, Postp Chain - Agile Supply Chains -Reverse Supply chain. supply chain Module-5 Introduction to Introduction to SAP, SAP Material Management, F Enterprise structure, Master data management, pure | g partnership and tr ing - Coordinating one the point of diff Future of IT in su o SAP (8 hours) Procurement process chase Info record, | rs) ust in Supply Cha the supply chain ferentiation – IT in pply chain- E Bu s, Organization s source list, proc | in Value . Supply n Supply siness in tructure, urement | | | | | |
| Current Trends: Supply Chain Integration - Building of Information: Bullwhip Effect - Effective forecastic Chain restructuring, Supply Chain Mapping - Supply Chain process restructuring, Postpy Chain - Agile Supply Chains -Reverse Supply chain. supply chain Module-5 Introduction t Introduction to SAP, SAP Material Management, Pure Enterprise structure, Master data management, pure cycle, purchase requisition, request for quotation, pure cycle, purchase | g partnership and tr ing - Coordinating one the point of diff Future of IT in su o SAP (8 hours) Procurement process chase Info record, chase order, invent | rs) ust in Supply Cha the supply chain ferentiation – IT in pply chain- E Bu s, Organization s source list, proc | in Value . Supply n Supply siness in tructure, urement , invoice | | | | | |
| Current Trends: Supply Chain Integration - Building of Information: Bullwhip Effect - Effective forecastic Chain restructuring, Supply Chain Mapping - Supply Chain process restructuring, Postpu Chain - Agile Supply Chains -Reverse Supply chain. supply chain Module-5 Introduction to Introduction to SAP, SAP Material Management, F Enterprise structure, Master data management, pure cycle, purchase requisition, request for quotation, pur verification, service management, transaction code. | g partnership and tr ing - Coordinating one the point of diff Future of IT in su o SAP (8 hours) Procurement process chase Info record, rchase order, invent | rs) ust in Supply Cha the supply chain Ferentiation – IT in pply chain- E Bu s, Organization s source list, proc ory management | in Value . Supply n Supply siness in tructure, urement , invoice | | | | | |
| Current Trends: Supply Chain Integration - Building of Information: Bullwhip Effect - Effective forecastic Chain restructuring, Supply Chain Mapping - Supply Chain process restructuring, Postpo Chain - Agile Supply Chains -Reverse Supply chain. supply chain Module-5 Introduction to Introduction to SAP, SAP Material Management, F Enterprise structure, Master data management, pure cycle, purchase requisition, request for quotation, pure verification, service management, transaction code. | g partnership and tr ing - Coordinating one the point of diff Future of IT in su o SAP (8 hours) Procurement process chase Info record, rchase order, invent | rs) ust in Supply Cha the supply chain Ferentiation – IT in pply chain- E Bu s, Organization s source list, proc | in Value . Supply n Supply siness in tructure, urement , invoice | | | | | |

| 22MEC563.1 | Describe the framework and scope of supply chain management. |
|------------|--|
| 22MEC563.2 | Build and manage a competitive supply chain using strategies, models, techniques |
| | and information technology. |

| 22MEC563.3 | Plan the demand, inventory and supply and optimize supply chain network. |
|------------|--|
| 22MEC563.4 | Discuss the emerging trends and impact of IT on Supply chain. |
| 22MEC563.5 | Explain the basics of SAP material management system |
| 22MEC563.6 | Present the applications of SAP in industry |

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|------------|---|---|--|----------------------------------|
| Text | books | | | |
| 1 | Supply Chain Management | Janat Shah | Pearson Education | 1 st edition, 2009 |
| 2 | Supply Chain Management Strategy Planning and Operation | Sunil Chopra and Peter Meindl | PHI Learning / Pearson Education | 1 st edition, 2007 |
| 3 | The SAP Materials Management Handbook | Ashfaque Ahmed, | CRC Press Publication | 1 st edition, 2014 |
| Refe | rence Books | | | |
| 1 | Business Logistics and Supply Chain Management | Ballou Ronald H | Pearson Education | 1 st edition, 2007 |
| 2 | Designing and Managing the Supply Chain: Concepts, Strategies, and Cases | David Simchi-Levi, Philip Kaminsky | Tata McGraw- Hill | 1 st edition, 2005 |
| 3 | Principles of Supply Chain Management | Joel D. Wisner, G. Keong Leong, KeahChoon Tan South- Western | Cengage Learning | 1 st edition, 2008 |

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc21_mg45/preview
- https://nptel.ac.in/courses/110106045
- https://www.udemy.com/course/sap-mm-training/
- https://www.udemy.com/course/sap-s4hana-mm-sourcing-and-procurement/
- https://nptel.ac.in/courses/110105095

Course Articulation Matrix

| Course | Program Outcomes (POs) | | | | | | | | | | | | | |
|-------------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| Outcomes (COs) | P01 | P02 | PO3 | P04 | PO5 | P06 | P07 | P08 | 909 | P010 | P011 | P012 | PSO1 | PSO2 |
| 22MEC563.1 | - | 1 | - | - | - | 3 | - | - | - | - | - | - | - | - |
| 22MEC563.2 | 2 | - | - | - | - | - | - | - | 1 | - | - | - | - | - |
| 22MEC563.3 | - | 1 | - | - | - | 3 | - | - | - | - | - | - | - | - |
| 22MEC563.4 | 2 | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| 22MEC563.5 | 2 | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| 22MEC563.6 | - | 2 | - | - | - | 3 | - | - | - | - | - | - | - | - |

| ENERGY ENGINEERING | | | | | | | |
|-------------------------------|----------|-------------|---------|--|--|--|--|
| Course Code | 22MEC564 | CIE Marks | 50 | | | | |
| Course Type | Theory | SEE Marks | 50 | | | | |
| (Theory/Practical/Integrated) | Theory | Total Marks | 100 | | | | |
| Teaching Hours/Week (L:T:P) | 3:0:0 | SEE | 3 Hours | | | | |
| Total Hours | 40 hours | Credits | 03 | | | | |

Course Learning Objectives: The objective of the course is to

- Gain a comprehensive understanding of various conventional and renewable energy sources, including their principles, generation methods, components, and applications.
- Acquire proficiency in applying theoretical knowledge to design, analyze, and optimize energy systems, including power plants and renewable energy installations, considering technical, economic, and environmental factors.

Module-1 Steam Power Plant (8 hours)

Automated Coal Conveyor Systems, Dry and wet Bottom Ash Handling Systems Generation of steam using forced circulation, high and supercritical pressures, LaMount, Benson, Velox, Loeffer, Schmidt steam generators, Cooling towers and Ponds, Accessories such as Superheaters, Desuperheater, Economizers, Air preheaters.

Module-2 Solar Energy and Biomass (8 hours)

Solar Energy: Introduction, Solar radiation at the earth's surface, Solar radiation measurements, Flat plate collectors, Focusing collectors, Solar pond, Solar electric power generation-Solar photovoltaics.

Biomass Energy: Photosynthesis, photosynthetic oxygen production, energy plantation. Bio Chemical Route: Biogas production from organic wastes by anaerobic fermentation, Bio gas plants-KVIC, Janta, Deenbhandu models, factors affecting bio gas generation. Thermal gasification of biomass, updraft and downdraft

Module-3 Geothermal, Tidal and Wave Energy (8 hours)

Geothermal Energy: Forms of geothermal energy, Dry steam, wet steam, hot dry rock and magmatic chamber systems.

Tidal Energy: Tidal power, Site selection, Single basin and double basin systems, Advantages and disadvantages of tidal energy.

Wind Energy: Wind Energy-Advantages and limitations, wind velocity and wind power, Basic components of wind energy conversion systems, horizontal and vertical axis windmills, coefficient of performance of a wind mill rotor, Applications of wind energy.

Module-4 Hydroelectric and OTEC (8 hours)

Hydroelectric plants: Advantages & disadvantages of hydro power, Hydrographs and flow duration curves numerical, Storage and pondage, General layout of hydel power plants- components such as Penstock, surge tanks, spill way and draft tube and their applications, pumped storage plants, Detailed classification of hydroelectric plants, water hammer.

Ocean Thermal Energy: Ocean thermal energy conversion, Principle and working of Rankine cycle, Problems associated with OTEC.

Module-5 Nuclear Energy (8 hours)

Nuclear energy: Principles of release of nuclear energy-Fusion and fission reactions. Nuclear fuels used in the reactors, Chain reaction, Moderation, breeding, Multiplication and thermal utilization factors. General components of a nuclear reactor and materials, Brief Description-Pressurized water reactor, Boiling water reactor, Sodium graphite reactor, Fast Breeder reactor, Homogeneous graphite reactor and gas cooled reactor, Radiation hazards, Shielding, Nuclear waste, Radioactive waste disposal.

| Course Outcomes: At the end of the course the student will be able to: | | | | | |
|---|---|--|--|--|--|
| 22MEC564.1 | Demonstrate comprehensive knowledge of energy generation technologies, encompassing coal-fired power plants, nuclear reactors, solar, wind, biomass, geothermal, tidal, and ocean thermal energy. | | | | |
| 22MEC564.2 | Analyze energy systems, evaluating efficiency, reliability, cost-effectiveness, and environmental sustainability to make informed decisions on energy resource utilization. | | | | |
| 22MEC564.3 | Optimizing energy systems, including power plants and renewable installations, adhering to technical specifications, operational needs, safety standards, and regulatory requirements. | | | | |
| 22MEC564.4 | Solve problems in energy generation, transmission, and use by applying a variety of knowledge from different fields and coming up with new ideas in the energy industry. | | | | |
| 22MEC564.5 | Explain technical ideas, analysis results, and energy system plans clearly to different groups through speeches and written documents. | | | | |
| 22MEC564.6 | Explain the social and environmental consequences of various energy technologies. | | | | |

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year | | | | | |
|------------|--|-------------------------|--------------------------|----------------------------------|--|--|--|--|--|
| Text | books | | | | | | | | |
| 1 | Power Plant Engineering | P. K. Nag | Tata McGraw Hill | 3 rd edition, 2012 | | | | | |
| 2 | Non-conventional Sources of Energy | G.D.Rai | Khanna Publishers | 5 th edition, 2015 | | | | | |
| Refer | Reference Books | | | | | | | | |
| 1 | Principles of Energy conversion | A. W. Culp Jr | McGraw Hill | 2 nd edition, 1996 | | | | | |
| 2 | Solar Energy: principles of Thermal Collection and Storage | S.P. Sukhatme | Tata McGraw Hill | 2 nd edition, 1984 | | | | | |

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/103103206
- https://nptel.ac.in/courses/115103123

Course Articulation Matrix

| | | Program Outcomes (POs) | | | | | | | | | | | | |
|--------------------------|-----|------------------------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| Course Outcomes (COs) | POI | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | 60d | PO10 | PO11 | P012 | PSO1 | PSO2 |
| 22MEC564.1 | 3 | - | - | - | - | 2 | - | - | - | - | - | - | - | - |
| 22MEC564.2 | - | 2 | - | - | - | - | 2 | - | - | - | - | - | - | - |
| 22MEC564.3 | - | - | 2 | - | - | 2 | - | - | - | - | - | - | - | - |
| 22MEC564.4 | 2 | - | - | - | - | - | 2 | - | - | - | - | - | - | - |
| 22MEC564.5 | 2 | - | - | - | - | - | - | - | - | 2 | - | - | - | - |
| 22MEC564.6 | 2 | - | - | - | - | - | - | 2 | - | - | _ | _ | - | - |

| RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS | | | | | | | | |
|--|----------|-------------|---------|--|--|--|--|--|
| Course Code | 22RMI57 | CIE Marks | 50 | | | | | |
| Course Type | Theory | SEE Marks | 50 | | | | | |
| (Theory/Practical/Integrated) | Theory | Total Marks | 100 | | | | | |
| Teaching Hours/Week (L:T:P) | 2:0:0 | SEE | 3 Hours | | | | | |
| Total Hours | 25 hours | Credits | 02 | | | | | |

Course Learning Objectives: The objective of the course is

- To understand the basic concepts related to research
- To learn the concept of literature survey, review and technical writing
- To discuss the basics of intellectual property
- To explain the patents, copyrights, trademarks, industrial designs and geographical indications

Module-1 Research Methodology and Literature Survey (5 hours)

Research Methodology: Meaning, Objectives, Types of research, Method versus methodology, Research process, Criteria of good research.

Literature Survey, Literature Review: Introduction, process, databases and management tools. Identifying gap areas from literature review. Plagiarism: Introduction, tools for detection, avoiding plagiarism. Illustrations.

Textbook 1: Chapter 1, Textbook 2: Ch 7-9, 14-17.

Module-2 Technical Writing and Presentations (5 hours)

Research Paper Writing: Importance, steps of writing research papers, Contents of a research article, Illustrations.

Thesis Writing: Synopsis, Introduction, Literature review, Aim and Objectives, Methodology, Time frame, Results and discussions, Conclusions. Illustrations.

Research Proposal Writing: Preliminary requirements for proposal writing, Standard heads in research proposal. Illustrations.

Textbook 2: Chapter 20-22, 26-28, 35.

Module-3 Introduction to IPR and Patents (5 hours)

Introduction to Intellectual Property: Types of IP, Role of IP in the economic and cultural development of the society, IP governance, IP as a global indicator of innovation, National IPR Policy in India. Textbook 3: Chapter 1,

Patents: Conditions for patent, Non-patentable matters, Inventions Eligible for Patenting, Salient features of the Indian Patent 1970, Process of patenting, Types of patent applications, Patent infringements. Case examples. Textbook 3: Chapter 2: 2.1.

Module-4 Copyright and Trademarks (5 hours)

Copyright: Classes of copyrights, Salient features of the Indian Copyright Act 1957, Criteria for copyright, Copyrights of the author, Copyright Infringements, Non-Copyright Work, Process of copyright registration. Copyright cases.

Trademark: Eligibility Criteria, Classification, Trade Mark Rules 2017, Advantages of registration, Types of trademark registered in India, Process for Trademarks Registration, Case examples.

Textbook 3: Chapter 2: 2.2 and 2.3.

Module-5 Industrial Designs and Geographical Indications (5 hours)

Industrial Designs: Introduction, Eligibility criteria, Famous industrial designs, Features of Design Act 2000, Non-Protectable industrial designs in India, Procedure for Registration of Industrial Designs, Case examples.

Geographical Indications (GIs): Introduction, Rights granted to holders, Popular GIs registered in India, salient features of Geographical Indications of Goods (Registration & Protection) Act, 1999, Non-Registerable GI, Procedure for GI Registration, Case examples.

Textbook 3: Chapter 2: 2.4 and 2.5.

Course Outcomes: At the end of the course the student will be able:

22RMI57.1 To conduct literature survey, review and define a research problem.

| 22PMI57 2 | To follow research ethics and develop the art of writing technical papers and |
|----------------------|--|
| 22 X IVII37.2 | reports. |
| 22RMI57.3 | To discuss the role of Intellectual Property and Patents in India. |
| 22RMI57.4 | To explain the various aspects of Copyright and Trademark in Indian context. |
| 22RMI57 5 | To explain legal aspects of Industrial Designs and Geographical Indications in |
| 221(()1157.5 | India. |
| 22RMI57.6 | To discuss the case studies related to the different Intellectual Property. |

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year | | | | |
|-------------|---|--|--|-------------------------------------|--|--|--|--|
| Text | books | | | | | | | |
| 1 | Research Methodology: Methods and Techniques | C R Kothari and Gaurav Garg | New Age International Publishers | 4 th edition, 2019 | | | | |
| 2 | Academic Writing | Ajay Semalty | B S Publications | 2021 | | | | |
| 3 | Intellectual Property: A Primer for Academia | Prof. Rupinder Tewari and Ms. Mamta Bhardwaj | Publication Bureau, Panjab University, India | 2021 | | | | |
| Refe | rence Books | | | | | | | |
| 1 | Research Methodology: A Step-by-Step Guide for Beginners | Ranjit Kumar | Sage Publications India Pvt Ld New Delhi | 4 th edition, 2014 | | | | |
| 2 | Intellectual PropertyThe Institute of Company SecretariesDelhi Computer Services, New2018Practiceof India, New DelhiDelhi | | | | | | | |
| Addi htt | Additional Resources: Web links/NPTEL Courses https://ipindia.gov.in/ (Official website of Intellectual Property India) https://dpiit.gov.in/policies-rules-and-acts/policies/national-ipr-policy | | | | | | | |
| htt | tps://www.icsi.edu/media/webm | odules/FINAL_IPR&LP_B0 | OOK_10022020.pdf | | | | | |

https://corpbiz.io/learning/design-infringement-in-india/

https://nptel.ac.in/courses/121106007 (Introduction to Research (Research Methodology))

https://nptel.ac.in/courses/109105112 (Introduction on Intellectual Property to Engineers)

Course Articulation Matrix

| G | | | | - | Progr | am Out | come | s (PO | s) | - | - | | - | - |
|-------------------|-----|-----|-----|-----|-------|--------|------|-------|-----|------|------|------|------|------|
| Outcomes (COs) | POI | PO2 | PO3 | P04 | PO5 | PO6 | PO7 | PO8 | P09 | PO10 | P011 | P012 | PSO1 | PSO2 |
| 22RMI57.1 | - | 2 | - | - | 1 | - | - | - | - | - | - | 2 | - | - |
| 22RMI57.2 | - | - | - | - | 1 | - | - | 3 | - | 2 | - | - | - | - |
| 22RMI57.3 | - | - | - | - | - | 2 | - | - | - | 2 | - | - | - | - |
| 22RMI57.4 | - | - | - | - | - | 2 | - | - | - | 2 | - | - | - | - |
| 22RMI57.5 | - | - | - | - | - | 2 | - | - | - | 2 | - | - | - | - |
| 22RMI57.6 | - | - | - | - | - | 2 | - | - | - | 2 | - | - | - | - |

| Emerging Technologies: A Primer | | | | | | | | | |
|---------------------------------|-------------------------|-----------|-----|--|--|--|--|--|--|
| Course Code | 22ETP58 | CIE Marks | 100 | | | | | | |
| Teaching Hours/Week (L:T:P) | (0:0:2) | SEE Marks | - | | | | | | |
| Credits | Credits 1 Exam Hours 03 | | | | | | | | |

Course Learning Objectives:

- 1. To develop a strong awareness of the ethical and societal implications associated with emerging technologies.
- 2. To instil practical skills related to AI (Artificial Intelligence), Blockchain, Digital Twins, RPA (Robotic Process Automation), and Cybersecurity.
- 3. To enable experiences of working on a team project, allowing students to apply their knowledge and skills to a real-world problem and present their findings effectively.

Module-1: AI and Web 3.0 (06 Hours)

Introduction to Emerging Technologies: Overview of the course, Importance of staying updated with emerging technologies, Ethical and societal considerations.

Artificial Intelligence (AI): Definition and history of AI, Machine learning and deep learning, Applications of AI in various industries, In-Class Assignment: AI in Everyday Life, Homework Assignment: Building a Simple Chatbot.

Web 3.0: Blockchain and Metaverse - Introduction to Blockchain technology, Metaverse and its potential, In-Class Assignment: Creating a Simple Smart Contract, Homework Assignment: Exploring a Metaverse Platform.

Module-2: Smart Manufacturing and Robotic Process Automation (06 Hours)

Smart Manufacturing and Digital Twins: The concept of Smart Manufacturing, Role of IoT and sensors, Digital Twins and their applications, In-Class Assignment: Explore the designs of Digital Twins, Homework Assignment: Analysing a Smart Manufacturing Case Study.

Robotic Process Automation: Understanding Robotic Process Automation (RPA), Types of robots and their applications, Human-robot collaboration, In-Class Assignment: Automating a Task with RPA, Homework Assignment: Researching Advances in Robotics.

Module-3: Cybersecurity and Quantum Computing (06 Hours)

Cybersecurity: Importance of cybersecurity in the digital age, Threats and vulnerabilities, Security best practices, In-Class Assignment: Ethical Hacking Simulation, Homework Assignment: Creating a Cybersecurity Plan.

Quantum Computing: Introduction to Quantum Mechanics, Quantum bits (qubits) and quantum gates, Quantum supremacy and real-world applications. Homework Assignment: Exploring Quantum Computing Research.

Module-4: Project Work (06 Hours)

Team Formation, Synopsis submission, Mid-Term Progress Review, Final Project Presentation.

| eourse outcome | s. At the one of the course the student will be able to. |
|----------------|--|
| 22ETP58.1 | Assess the ethical and societal impacts of emerging technologies, demonstrating critical thinking skills |
| | |
| 22ETP58.2 | Apply AI and Web 3.0 concepts to develop practical solutions and explore real- world applications. |
| | |
| 22ETP58.3 | Apply RPA principles and tools to automate common tasks to boost productivity. |
| 22ETP58.4 | Explain common cybersecurity threats and recommend best practices to safeguard digital assets. |
| 22ETD59.5 | |
| 22ETP58.5 | Explain the fundamentals of quantum computing and its real-world applications. |
| 22ETP58.6 | Develop a solution using emerging technologies for a real-world problem in teams. |

Course Outcomes: At the end of the course the student will be able to:

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|--|---|--|--|------------------------|
| Textbo | oks | | | |
| 1 | Artificial Intelligence: A Modern Approach | Stuart Russell, Peter Norvig | Pearson | Fourth Edition, 2020 |
| 2 | Blockchain Technology | Chandramouli Subramanian, Asha A George, Abhilash K A and Meena Karthikeyan | Universities Press (India) Pvt. Ltd. | First Edition 2020 |
| 3 | Metaverse and Web 3: A Beginner's Guide: A Beginner's Guide: A Digital Space Powered with Decentralized Technology | Utpal Chakraborty | BPB Publications | First Edition, 2022 |
| 4 | Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath | Alok Mani Tripathi | Packt Publishing | First Edition 2018 |
| 5 | Cybersecurity: The Beginner's Guide: A comprehensive guide to getting started in cybersecurity | Dr. Erdal Ozkaya | Packt Publishing Limited | First Edition 2019 |
| 6 | Quantum Computing: A Gentle Introduction | Eleanor G. Rieffel, Wolfgang H. Polak. | MIT Press | First Edition 2014 |
| Referei | nce Books | 1 | | |
| 1 | SmartManufacturingTechnologies for Industry 4.0:Integration,Benefits,andOperational Activities | Edited By: Jayakrishna Kandasamy, Kamalakanta Muduli, V. P. Kommula, Purushottam L. Meena | CRC Press | First Edition 2022 |
| 2 | The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems | Tom Taulli | Apress Berkeley, CA | 2020 |
| 3 | The Cyber Security Handbook: Prepare for, respond to and recover from cyber-attacks with the IT Governance Cyber Resilience Framework (CRF) | Alan Calder | IT Governance Publishing | First Edition 2020 |
| Web liı | nks/Video Lectures: | | | |
| Introdu | iction to Emerging Technologies | | | |
| $\begin{vmatrix} 1.\\ 2 \end{vmatrix}$ | https://aletnics.princeton.edu/case- | - <u>stuates/case-stuay-pdfs/</u> .ethics/ | | |
| $\frac{2}{3}$ | https://news.harvard.edu/gazette/s | tory/2020/10/ethical-concerns | s-mount-as-ai-tal | kes-bigger- |
| 5. | decision-making-role/ | | | |
| 4. | https://www.sciencedirect.com/sci | ience/article/pii/S0268401223 | 8000816 | |
| 5. | https://www.youtube.com/watch?v | v=G2fqAlgmoPo | | |
| 6. | https://www.youtube.com/watch?v | v=zizonToFXDs | | |
| Web 3. | 0: Blockchain and Metaverse | | | |
| 1. | What is Ethereum? ethereum.org | | | |
| 2. | Navigating Remix — Remix - Eth | ereum IDE 1 documentation | (remix-ide.readt | hedocs.io) |

- 3. <u>Solidity Solidity 0.6.8 documentation (soliditylang.org)</u>
- 4. https://www.youtube.com/watch?v=nalMdCI_pv8&t=765s
- 5. <u>The Decentralized Autonomous Organization and Governance Issues by Usman W. Chohan ::</u> <u>SSRN</u>
- 6. <u>Ethereum Smart Contract Best Practices (consensys.github.io)</u>
- 7. https://hackernoon.com/hack-solidity-reentrancy-attack

Smart Manufacturing and Digital Twins:

- 1. <u>https://www.youtube.com/watch?v=nwFed03fS_s</u>
- 2. <u>https://www.youtube.com/watch?v=ScmK-bKJ4MI</u>

RPA and Robotics:

- 1. <u>https://www.youtube.com/watch?v=9URSbTOE4YI</u>
- 2. <u>https://www.youtube.com/watch?v=UEbw7dIOg0g</u>
- 3. <u>https://www.uipath.com/resources/automation-case-studies</u>
- 4. https://www.ibm.com/products/robotic-process-automation/case-studies

Cybersecurity:

- 1. https://www.getastra.com/blog/security-audit/what-is-vapt/
- 2. <u>https://owasp.org/www-project-top-ten/</u>
- 3. https://owasp.org/www-project-mutillidae-ii/
- 4. https://www.youtube.com/watch?v=JAtwZoW76-I
- 5. Threat modelling (STRIDE framework): <u>https://learn.microsoft.com/en-us/azure/security/develop/threat-modeling-tool-threats</u>
- 6. Cyber Kill Chain:<u>https://www.lockheedmartin.com/en-us/capabilities/cyber/cyber-kill-chain.html</u>

Quantum Computing:

- 1. https://www.youtube.com/watch?v=e3fz3dqhN44
- 2. https://quantumai.google/

Course Articulation Matrix

| Course | | | | | Progr | am Out | comes | (POs) | | | | |
|-------------------|-----|-----|-----|-----|--------------|--------|-------|-------|-----|------|------|------|
| Outcomes (COs) | POI | P02 | PO3 | P04 | PO5 | PO6 | PO7 | PO8 | 909 | P010 | P011 | P012 |
| 22ETP58.1 | - | - | - | - | | 3 | - | 2 | - | | - | - |
| 22ETP58.2 | - | 2 | - | - | 3 | - | - | - | | - | - | 1 |
| 22ETP58.3 | - | - | - | 3 | 2 | - | - | - | | - | - | - |
| 22ETP58.4 | - | - | - | - | 3 | - | | - | - | - | - | 1 |
| 22ETP58.5 | 2 | - | - | - | 3 | - | - | - | - | - | - | - |
| 22ETP58.6 | - | - | 2 | - | 3 | - | | - | 2 | - | - | 1 |
| | | | 4 | - | A J C | 1. / | | | | | | |

VI Semester

| | HEAT TRANSFER | | |
|-------------------------------|--------------------------------|-------------|---------|
| Course Code | 22MEC61 | CIE Marks | 50 |
| Course Type | Integrated | SEE Marks | 50 |
| (Theory/Practical/Integrated) | Integrated | Total Marks | 100 |
| Teaching Hours/Week (L: T:P) | 2:2:2 | SEE | 3 Hours |
| Total Hours | 40 hours Theory + 10 Lab slots | Credits | 04 |

Course Learning Objectives: The objective of the course is to

- Study the modes of heat transfer and Learn how to formulate and solve 1-D steady and unsteady heat conduction problems.
- Apply empirical correlations for fully developed laminar, turbulent internal flows and external boundary layer convective flow problems.
- Study the basic principles of heat exchanger analysis and thermal design.
- Understand the principles of boiling and condensation including radiation heat transfer related engineering problems.

Module-1 Steady-state one-dimensional heat conduction (8 hours)

Introductory concepts and definitions: Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; Types of boundary conditions. General three-dimensional Heat Conduction Equation: Derivation of the equation in (i) Cartesian, coordinate only. Discussion of three-dimensional Heat Conduction Equation in (ii) Polar and (iii) Spherical Coordinate Systems.

Steady-state one-dimensional heat conduction problems in Cartesian System: Steady-state one-dimensional heat conduction problems (i) without heat generation and (ii) constant thermal conductivity - in a Cartesian system with various possible boundary conditions. Brief Introduction to variable thermal conductivity and heat generation [No numerical on variable thermal conductivity and heat generation] Thermal Resistances in Series and in Parallel. Critical Thickness of Insulation in cylinder and spheres Concept. Derivation

Module-2 Extended Surfaces & transient (8 hours)

Extended Surfaces or Fins: Classification, Straight Rectangular and Circular Fins, Temperature Distribution and Heat Transfer Calculations, Fin Efficiency and Effectiveness, Applications

Transient [Unsteady-state] heat conduction: Definition, Different cases - Negligible internal thermal resistance, negligible surface resistance, comparable internal thermal and surface resistance, Lumped body, Infinite Body and Semi-infinite Body, Numerical Problems, Heisler and Grober charts.

Module-3 Thermal radiation (8 hours)

Numerical Analysis of Heat Conduction: Introduction, one-dimensional steady conduction and one-dimensional unsteady conduction, boundary conditions, solution methods.

Thermal Radiation: Fundamental principles - Gray, White, Opaque, Transparent and Black bodies, Spectral emissive power, Wien's displacement law, Planck's laws, Hemispherical Emissive Power, Stefan-Boltzmann law for the total emissive power of a black body, Emissivity and Kirchhoff's Laws, View factor, Net radiation exchange between parallel plates, concentric cylinders, and concentric spheres, Radiation Shield.

Module-4 Convection (8 hours)

Forced Convection: Boundary Layer Theory, Velocity and Thermal Boundary Layers, Prandtl number, turbulent flow, Various empirical solutions, Forced convection flow over cylinders and spheres, Internal flows – laminar and turbulent flow solutions.

Free convection: Laminar and Turbulent flows, Vertical Plates, Vertical Tubes and Horizontal Tubes, Empirical solutions.

Module-5 Heat exchanger (8 hours)

Heat Exchangers: Definition, Classification, applications, LMTD method, Effectiveness - NTU method, Analytical Methods, Fouling Factors, Chart Solution Procedures for solving Heat Exchanger problems: Correction Factor Charts and Effectiveness-NTU Charts.

Introduction to boiling: pool boiling, Bubble Growth Mechanisms, Nucleate Pool Boiling, Critical Heat Flux in Nucleate Pool Boiling, Pool Film Boiling, Critical Heat Flux, Heat Transfer beyond the Critical Point, film wise and dropwise Condensation.

PRACTICAL MODULE A–Demonstration (offline/virtual):

A1. Analysis of steady and transient heat conduction, temperature distribution of plane wall and

cylinder using Numerical approach (ANSYS/CFD package).

A2. Determination of temperature distribution along a rectangular and circular fin subjected to heat loss through convection using Numerical approach (ANSYS/CFD package).

B-Exercise (compulsorily to be conducted):

B1. Determination of Thermal Conductivity of a Metal Rod.

- B2. Determination of Overall Heat Transfer Coefficient of a Composite wall.
- B3. Determination of Effectiveness on a Metallic fin.
- B4. Determination of Heat Transfer Coefficient in free Convection
- B5. Determination of Heat Transfer Coefficient in a Forced Convention
- B6. Determination of Emissivity of a Surface.

C-Structured Enquiry (compulsorily to be conducted):

C1. Determination of Stefan Boltzmann Constant.

C2. Determination of LMTD and Effectiveness in a Parallel Flow and Counter Flow Heat Exchangers.

- C3. Experiments on Boiling of Liquid and Condensation of Vapour.
- C4. Experiment on Transient Conduction Heat Transfer.
- C5. Experiment on Vapour compression Refrigeration Test Rig.
- C6. Experiment on Air Conditioning Test Rig.

| Course Out | Course Outcomes: At the end of the course the student will be able to: | | | | | | |
|-------------------|---|--|--|--|--|--|--|
| 22MEC61.1 | Compute temperature distribution and heat transfer rate in steady state and unsteady state heat conduction (Plane slabs, fins, critical insulation and transient conduction). | | | | | | |
| 22MEC61.2 | Calculate the heat transfer rate for a dimensional heat conduction problem using a numerical method. | | | | | | |
| 22MEC61.3 | Interpret heat transfer by radiation between objects with simple geometries. | | | | | | |
| 22MEC61.4 | Compute the heat transfer coefficient for forced and free convection heat transfer using different empirical relations | | | | | | |
| 22MEC61.5 | Analyze heat exchanger performance by using LMTD and NTU methods. | | | | | | |
| 22MEC61.6 | Investigate the phenomena of boiling and condensation and calculate heat transfer coefficient for boiling and condensation heat transfer. | | | | | | |

| Sl. No. | Title of the Book | Title of the BookName of the Author/s | | Edition and Year | |
|------------|-------------------------------------|--|-------------------|----------------------------------|--|
| Text | books | | | | |
| 1 | Principles of heat transfer | Frank Kreith, Raj M. Manglik, Mark S. Bohn | Cengage learning | 7 th edition, 2011. | |
| 2 | Heat transfer, a practical approach | Yunus A. Cengel | Tata Mc Graw Hill | 5 th edition, 2015 | |
| Refer | rence Books | | | | |
| 1 | Heat and mass transfer | Kurt C, Rolle | Cengage learning | 2 nd edition, 2015 | |

| 2 | Heat Transfer A Basic Approach | M Necati Ozisik | Mc Graw Hill, Newyork | 3 rd edition, 2005 |
|---|--|---------------------------------------|----------------------------------|----------------------------------|
| 3 | Fundamentals of Heat and Mass Transfer | Incropera, F. P. and De Witt, D. P | John Wiley and Sons, New York | 5 th edition, 2006 |
| 4 | Heat Transfer | Holman, J. P. | Tata McGraw Hill, New York | 9 th edition, 2008 |

Web links and Video Lectures (e-Resources):

NPTEL Heat Transfer course for Mechanical Engineering http://nptel.ac.in/courses/112101097/ https://nptel.ac.in/courses/103105140/

| | | | | COU | II SC A | i ucuia | uion r | viati iz | <u> </u> | | | | | |
|-------------------|-----|------------------------|-----|-----|---------|---------|--------|----------|----------|------|------|------|------|------|
| Course | | Program Outcomes (POs) | | | | | | | | | | | | |
| Outcomes (COs) | P01 | P02 | PO3 | P04 | PO5 | P06 | PO7 | PO8 | 909 | PO10 | PO11 | P012 | PSO1 | PSO2 |
| 22MEC61.1 | - | 3 | - | - | - | 2 | - | - | - | - | - | - | - | - |
| 22MEC61.2 | - | 3 | - | - | - | 1 | - | - | - | - | - | - | - | - |
| 22MEC61.3 | - | 1 | - | - | - | - | 1 | - | - | - | - | - | - | 1 |
| 22MEC61.4 | - | 1 | - | - | - | - | 2 | - | - | - | - | - | - | - |
| 22MEC61.5 | - | 2 | - | - | - | 3 | - | - | - | - | - | - | - | 1 |
| 22MEC61.6 | - | 2 | - | - | - | 2 | - | - | - | - | - | - | - | 2 |

Course Articulation Matrix

| MEG | CHANICAL VIBRATIONS | | |
|-------------------------------|--------------------------------|-------------|---------|
| Course Code | 22MEC62 | CIE Marks | 50 |
| Course Type | Interneted | SEE Marks | 50 |
| (Theory/Practical/Integrated) | Integrated | Total Marks | 100 |
| Teaching Hours/Week (L:T:P) | 2:2:2 | SEE | 3 Hours |
| Total Hours | 40 hours Theory + 10 Lab slots | Credits | 04 |

Course Learning Objectives: The objective of the course is to

- Enable the students to understand the theoretical principles of vibration and vibration analysis techniques for the practical solution of vibration problems.
- Enable the students to understand the importance of vibrations in mechanical design of machine parts subject to vibrations
- Make free and forced (harmonic, periodic, non-periodic) vibration analysis of single and multidegree of freedom linear systems.
- Write the differential equation of motion in vibratory systems

Module-1 Undamped free vibration of single-degree-of-freedom systems (8 hours)

Introduction: Types of vibrations, Definitions, Simple Harmonic Motion (S.H.M.), Principle of Superposition applied to SHM, Beats.

Undamped Free vibration of single-degree-of-freedom systems: Derivations for spring mass systems, Methods of Analysis, Natural frequencies of simple systems, Springs in series and parallel, Torsional and transverse vibrations.

Module-2 Damped free vibrations (8 hours)

Damped free vibrations: Types of damping, Analysis with viscous damping - Derivations for over, critical and under damped systems, Logarithmic decrement.

Module-3 Harmonically excited vibration (8 hours)

Harmonically excited vibration: Introduction, Analysis of forced vibration with constant harmonic excitation - magnification factor, rotating and reciprocating unbalances, excitation of support (relative and absolute amplitudes), force and motion transmissibility.

Whirling of shafts with and without damping, discussion of speeds above and below critical speeds.

Module-4 Vibration of two-degree-of-freedom systems (8 hours)

Vibration of two-degree-of-freedom systems: Principle modes of vibrations, Normal mode and natural frequencies of systems (without damping) – Simple spring mass systems, masses on tightly stretched strings, double pendulum, torsional systems, combined rectilinear and angular systems, Undamped dynamic vibration absorber.

Module-5 Vibration of multi degree freedom systems & condition monitoring (8 hours)

Vibration of multi degree freedom systems: Introduction, Maxwell's reciprocal theorem, Influence coefficients, Orthogonality of principal modes, Matrix method, Stodola method, Holzer's method.

Vibration Measuring Instruments.

Modal analysis and Condition Monitoring: Signal analysis, Dynamic testing of machines & structures, Experimental modal analysis, Machine condition monitoring and diagnosis

PRACTICAL MODULE

A-Structured Inquiry (compulsorily to be conducted):

- **1.** Longitudinal Spring Mass undamped system: Find the natural frequency in a single degree of freedom vibrating systems
- 2. Longitudinal Spring Mass damped system: Find the natural frequency, logarithmic decrement, damping ratio and damping coefficient in a single degree of freedom vibrating systems
- 3. Torsional Spring Mass undamped System: Determination of natural frequency, in a single degree of freedom vibrating systems.

- 4. Torsional Spring Mass damped System: Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a single degree of freedom vibrating systems.
- 5. Find the critical speed in a rotating shaft

B– Demonstration (offline/virtual): (nitk.vlabs.ac.in):

- 1. Free Vibration of cantilever beam
- 2. Free Vibration of simply supported beam
- 3. Free vibration of fixed beam

C–Exercise (compulsorily to be conducted):

1. Dynamic Analysis of Fixed-fixed beam to determine natural frequency using analysis software

2. Perform modal analysis on cantilever beam using analysis software

| Course Outo | comes: At the end of the course the student will be able to: |
|-------------|---|
| 22MEC62.1 | Develop mathematical models of mechanical system to obtain their governing equations of motion and hence their response by applying Newton's second law and the principle of superposition. |
| 22MEC62.2 | Analyze and find natural frequency of a freely vibrating single degree of freedom & multidegree of freedom undamped and damped systems |
| 22MEC62.3 | Analyze the motion and natural frequency of a forced vibrating single degree of freedom undamped and damped systems |
| 22MEC62.4 | Analyze the two degree of freedom system like Simple Spring mass systems, masses on tightly stretched strings, double pendulum, torsional systems, combined rectilinear and angular systems to find the principal mode shapes |
| 22MEC62.5 | Make use of Signal analysis and Condition Monitoring concepts in the machine structure design and monitoring the health of structures |
| 22MEC62.6 | Experimentally compute the natural frequency of the free and forced vibration of single degree freedom systems, critical speed of shafts |

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|------------|--|-------------------------|---|---------------------------------|
| Text | books | | | unu i cui |
| 1 | Mechanical Vibrations | S. S. Rao | Pearson Education Inc | 6 th edition, 2018. |
| 2 | Mechanical Vibrations | V.P. Singh | Dhanpat Rai & Co. Pvt. Ltd | 3^{rd} edition, 2016. |
| 3 | Mechanical Vibrations | W.T. Thomson | Prentice Hill India | 5 th edition, 2008 |
| Refe | rence Books | | | |
| 1 | Theory & Practice of Mechanical vibrations | J.S. Rao & K. Gupta | New Age International Publications, New Delhi | 2 nd edition 2001 |
| 2 | Mechanical Vibrations | S. Graham Kelly | Schaum's Outline Series, Tata McGraw Hill, | Special Indian Edition, 2011 |
| 3 | Mechanical Vibrations | G. K. Grover | Nem Chand and Bros | 8 th Edition, 2009. |

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/112/103/112103111/ (NPTEL material on Fundamentals of Mechanical Vibrations)
- Mechanical Vibration http://ocw.mit.edu/courses/mechanical-engineering/2-003scengineering-dynamics-fall-2011/mechanical-vibration/

• https://mdmv-nitk.vlabs.ac.in/List%20of%20experiments.html (NITK solve lab)

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|-------------------|-----|------------------------|-----|-----|-----|----------|-----|-----|-----|------|------|------|------|------|
| Course | | Program Outcomes (POs) | | | | | | | | | | | | |
| Outcomes (COs) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | 909 | PO10 | PO11 | P012 | PSO1 | PSO2 |
| 22MEC62.1 | 1 | 3 | - | 3 | 2 | - | - | - | - | - | - | - | - | - |
| 22MEC62.2 | 1 | 3 | - | 3 | 2 | - | - | - | - | - | - | - | - | - |
| 22MEC62.3 | - | 3 | - | - | 2 | - | - | - | - | - | - | - | - | - |
| 22MEC62.4 | 2 | 3 | - | - | 2 | - | - | - | - | - | - | - | - | - |
| 22MEC62.5 | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| 22MEC62.6 | 1 | 3 | - | 2 | 2 | - | - | - | - | - | - | - | - | 2 |

Course Articulation Matrix

| MACHINE DESIGN | | | | | | | | | | |
|-------------------------------|----------|-------------|---------|--|--|--|--|--|--|--|
| Course Code | 22MEC63 | CIE Marks | 50 | | | | | | | |
| Course Type | Theory | SEE Marks | 50 | | | | | | | |
| (Theory/Practical/Integrated) | Theory | Total Marks | 100 | | | | | | | |
| Teaching Hours/Week (L:T:P) | 2:2:0 | SEE | 3 Hours | | | | | | | |
| Total Hours | 40 hours | Credits | 03 | | | | | | | |

Course Learning Objectives: The objective of the course is to enable the students

- To explain the principles involved in design of machine elements, subjected to different kinds of forces, from the considerations of strength, rigidity.
- To develop the capability to design elements like shafts, springs, and flexible machine elements.
- To learn transmission elements like gears, belts and bearings from the manufacturers' catalogue.
- To design the mechanical systems involving machine elements like clutches, brakes and bearings.

Module-1 Static strength & fatigue loading (8 hours)

Design for Static strength: Static loads and factor of safety. Theories of failure: Maximum normal stress theory, Maximum shear stress theory, Distortion energy theory; Failure of brittle materials, Failure of ductile materials. Stress concentration, Determination of stress concentration factor **Fatigue loading:** Introduction to fatigue failure, Mechanism of fatigue failure, types of fatigue loading, S-N Diagram, Low cycle fatigue, High cycle fatigue, Endurance limit.

Module-2 Design of flexible elements & shafts (8 hours)

Design of Flexible Elements: Selection and design of flat and V-belts for different applications **Design of shafts**: Torsion of shafts, solid and hollow shaft design with steady loading based on strength and rigidity, ASME and BIS codes for power transmission shafting, design of shafts subjected to combined bending, torsion and axial loading.

Module-3 Design of springs & journal bearings (8 hours)

Springs: Types of springs, spring materials, stresses in helical coil springs of circular cross sections. Leaf Springs: Stresses in leaf springs, equalized stresses, and nipping of leaf springs.

Lubrication and Bearings: Hydrodynamic lubrication, pressure development in oil film, bearing modulus, coefficient of friction, minimum oil film thickness, heat generated, and heat dissipated

Module-4 Design of gears (8 hours)

Spur Gears: Design of Spur Gears: Definitions, stresses in gear tooth: Lewis equation and form factor, Design for strength, Dynamic load and wear load.

Helical Gears: Definitions, formative number of teeth; Design based on strength, dynamic and wear loads.

Bevel Gears: Definitions, formative number of teeth, design based on strength, dynamic load and wear.

Module-5 Design of clutches & brakes (8 hours)

Design of Clutches: Design of single plate and multi-plate clutch based on uniform pressure and uniform wear theories.

Design of Brakes: Different types of brakes, Concept of self-energizing and self-locking of brakes. Design of band brakes, block brakes and internal expanding brakes

| Course Outo | Course Outcomes: At the end of the course the student will be able to: | | | | | | | |
|--------------------|--|--|--|--|--|--|--|--|
| 22MEC63.1 | Analyze the performance and failure modes of mechanical components subjected to | | | | | | | |
| | combined loading and fatigue loading using the concepts of theories of failure | | | | | | | |
| 22MEC63 2 | Decide the right V belt / Flat belt selection based on power, torque and service factors | | | | | | | |
| 22IVIEC03.2 | for different applications using the manufacturers catalogue. | | | | | | | |
| 22MEC63.3 | Design springs, shafts considering the applications and different nature of loading. | | | | | | | |
| 22MEC62 4 | Analyze the load carrying capacity, heat generated, heat dissipated and power loss due | | | | | | | |
| 221VIEC03.4 | to friction in hydrodynamic bearings for different applications | | | | | | | |

| 22MEC63.5 | Inspect, select the module and material hardness for Spur gear, Helical gear and bevel gear based on strength, wear factor and dynamic load. |
|-----------|---|
| 22MEC63.6 | Assess the actuation force required to design the clutches and brakes based on power, heat generated, heat dissipated and torque transmitted. |

| Sl. No. | Title of the Book | Title of the BookName of the Author/s | | Edition and Year |
|------------|--|--|------------------------------|-----------------------------------|
| Text | books | | | |
| 1 | Design of Machine Elements-I | Dr.M H Annaiah Dr. J Suresh Kumar | New Age International (P) | 1 st edition., 2016 |
| 2 | Design of Machine Elements | V. B. Bhandari | Tata Mcgraw Hil | 4 th edition 2016 |
| 3 | Shigley's Mechanical Engineering Design | v's Mechanical Richard G. Budynas, ering Design and J. Keith Nisbett | | 10 th edition, 2015 |
| Refe | rence Books | | | |
| 1 | Design and Machine Elements | Spotts M.F., ShoupT.E | Pearson Education | 8 th edition, 2006 |
| 2 | Elements of Machine Design | H.G.Patil, S.C.Pilli, R.R.Malagi, M.S.Patil | IK International | 1 st edition, 2019 |
| 3 | Machine Design- an integrated approach | Robert L. Norton | Pearson Education | 2 nd edition, 2014 |

• Design Data Hand Book, K. Mahadevan and Balaveera Reddy, CBS publication

• Design Data Hand Book, K. Lingaiah, McGraw Hill, 2nd edition, 2003.

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/112/105/112105125/
- https://archive.nptel.ac.in/courses/112/106/112106137/

| | | | | | | | | | - | | | | | |
|-------------------|-----|------------------------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| Course | | Program Outcomes (POs) | | | | | | | | | | | | |
| Outcomes (COs) | PO1 | P02 | PO3 | P04 | 50d | 90d | 707 | PO8 | 909 | PO10 | P011 | P012 | PSO1 | PSO2 |
| 22MEC63.1 | 2 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | - |
| 22MEC63.2 | - | 2 | 3 | - | - | - | - | - | - | - | - | - | - | - |
| 22MEC63.3 | 1 | - | 3 | - | - | - | I | - | - | I | - | I | - | - |
| 22MEC63.4 | 2 | 2 | 3 | - | - | - | - | - | - | - | - | - | 1 | 2 |
| 22MEC63.5 | - | - | 3 | - | - | - | - | - | - | - | - | - | 1 | - |
| 22MEC63.6 | - | 2 | 3 | - | - | - | - | - | - | - | - | - | - | 2 |

Course Articulation Matrix

1: Low 2: Medium 3: High

| OPERATION RESEARCH | | | | | | | | | |
|---|----------|-------------|---------|--|--|--|--|--|--|
| Course Code | 22MEC641 | CIE Marks | 50 | | | | | | |
| Course Type (Theory/Prestical/Integrated) | Theory | SEE Marks | 50 | | | | | | |
| Course Type (Theory/Flactical/Integrated) | Theory | Total Marks | 100 | | | | | | |
| Teaching Hours/Week (L:T:P) | 3:0:0 | SEE | 3 Hours | | | | | | |
| Total Hours | 40 hours | Credits | 03 | | | | | | |

Course Learning Objectives: The objective of the course is

- To enable the students to understand the scientific methods of providing various departments of an organization with a quantitative basis of decision making.
- To enable the students to understand the importance of various tools and techniques in finding optimal solutions to problems involving limited resources in the form of Men, Materials and machinery.

Module-1 Introduction to Operation Research (8 hours)

Evolution of Operation Research (OR), Definitions of OR Scope of OR Applications of OR Phases in OR study. Characteristics and limitations of OR, models used in OR, Linear Programming Problem (LPP), Generalized LPP- Formulation of problems as L.P.P. Solutions to LPP by graphical method (Two Variables).

Module-2 Linear Programming Problems (8 hours)

Simplex method, Canonical and Standard form of LP problem, slack, surplus and artificial variables, Solutions to LPP by Simplex method, Big-M Method, Degeneracy in LPP. Concept of Duality, writing Dual of given LPP.

Module-3 Transportation Problems (8 hours)

Transportation Problem: Formulation of transportation problem, types, initial basic feasible solution using North-West Corner rule, Vogel's Approximation method. Optimality in Transportation problem by Modified Distribution (MODI) method. Unbalanced T.P. Maximization T.P. Degeneracy in transportation problems, application of transportation problem.

Module-4 Network Analysis (8 hours)

Network analysis: Introduction, Construction of networks, Fulkerson's rule for numbering the nodes, AON and AOA diagrams; Critical path method to find the expected completion time of a project, determination of floats in networks, PERT networks, determining the probability of completing a project, predicting the completion time of project.

Module-5 Game Theory (8 hours)

Game Theory: Definition, Pure Strategy problems, Saddle point, Max-Min and Min-Max criteria, Principle of Dominance, Solution of games with Saddle point. Mixed Strategy problems, Solution of 2Xn m and mX2 games by graphical method. Formulation of games.

| Course Outco | omes: At the end of the course the student will be able to: |
|--------------|--|
| 22MEC641.1 | Report the concepts and applications of OR in academic literature from the perspective of engineering and society to enhance quality of life for the given syllabus as per the given format. |
| 22MEC641.2 | Analyze the different principle/ methodologies of LPP and demonstrate its application in project management & finance through sensitivity analysis. |
| 22MEC641.3 | Analyze different methodologies of Transportation Problems by obtaining the optimal solution from the perspective of social welfare by identifying ethical aspects through group activities. |
| 22MEC641.4 | Justify a decision or course of action in evaluating the Network Analysis problems through credible academic literature. |

| 22MEC641.5 | Apply the concepts of game theory for the given case study by demonstrating ethical aspects. |
|------------|---|
| 22MEC641.6 | Report the advancement and research opportunities in the OR with credible academic literature and case studies. |

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|------------|--|-----------------------------------|---|-----------------------------------|
| Text | books | | | |
| 1 | Operations Research | P K Gupta and D S Hira | S. Chand and Company LTD. Publications, New Delhi | 11 th edition, 2017 |
| 2 | Operations Research, An Introduction | Hamdy A. Taha | PHI Private Limited | 10 th edition, 2019 |
| Refei | rence Books | | | |
| 1 | Operations Research, Theory and Applications | J K Sharma | Trinity Press, Laxmi Publications Pvt.Ltd. | 6 th edition, 2016 |
| 2 | Operations Research | A M Natarajan, P Balasubramani | Pearson Education | 4 th edition, 2009 |
| 3 | Introduction to Operations Research | Hillier and Lieberman | McGraw Hill | 9 th edition, 2018 |

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/110/106/110106062/
- https://www.edx.org/course/operations-research-an-active-approach

| | | | | Cour | <u>se Ar</u> | ticula | tion M | <u>latrix</u> | | | | | | |
|-------------------|-----|------------------------|-----|------|--------------|--------|--------|---------------|-----|------|------|------|------|------|
| G | | Program Outcomes (POs) | | | | | | | | | | | | |
| Outcomes (COs) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | P09 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| 22MEC641.1 | - | - | - | 1 | - | 1 | - | - | - | - | - | - | - | 1 |
| 22MEC641.2 | - | 2 | - | - | - | - | - | - | - | - | 2 | - | 1 | - |
| 22MEC641.3 | - | 2 | - | - | - | 1 | | 1 | - | - | - | - | - | - |
| 22MEC641.4 | - | 2 | - | - | - | - | - | - | - | - | 3 | - | - | - |
| 22MEC641.5 | 2 | - | - | - | - | - | - | 1 | - | - | - | - | 1 | - |
| 22MEC641.6 | - | - | - | 1 | - | 1 | - | - | - | - | - | - | - | - |

| REFRIGER | REFRIGERATION AND AIR-CONDITIONING | | | | | | | | | | | |
|-------------------------------|------------------------------------|-------------|---------|--|--|--|--|--|--|--|--|--|
| Course Code | 22MEC642 | CIE Marks | 50 | | | | | | | | | |
| Course Type | Theory | SEE Marks | 50 | | | | | | | | | |
| (Theory/Practical/Integrated) | Theory | Total Marks | 100 | | | | | | | | | |
| Teaching Hours/Week (L:T:P) | 3:0:0 | SEE | 3 Hours | | | | | | | | | |
| Total Hours | 40 hours | Credits | 03 | | | | | | | | | |

Course Learning Objectives: This course will enable students to

- Study the basic definition, ASHRAE Nomenclature for refrigerating systems
- Understand the working principles and applications of different types of refrigeration systems
- Study the working of air conditioning systems and their applications
- Identify the performance parameters and their relations of an air conditioning system

Module-1 Introduction to Refrigeration (8 Hours)

Introduction to Refrigeration: Basic Definitions, Heat pump and Refrigerating Machine, Best Refrigeration Cycle: The Carnot Principle, Gas as a Refrigerant in Reversed Carnot Cycle, Limitations of Reversed Carnot Cycle, Reversed Brayton or Bell Coleman Cycle, Application to Aircraft Refrigeration, Simple Numerical problems.

Industrial Refrigeration: Chemical and process industries, Dairy plants, Petroleum refineries, Food processing units.

Module-2 Vapor Compression Refrigeration System (08 Hours)

Vapor Compression Refrigeration System (VCRS): Modifications in Reversed Carnot Cycle with Vapor as a refrigerant, Vapor Compression Cycle, Ewing's Construction, Actual Vapor Compression Cycle, Effect of Operating Conditions. Simple Numerical problems.

Multistage or Compound Compression, Multi-evaporator systems, Cascade Systems, – Methods like Flash Gas removal, Flash inter cooling and water Inter cooling.

Module-3 Vapor Absorption Refrigeration Systems (08 Hours)

Vapor Absorption Refrigeration Systems: Simple Vapor Absorption System, Maximum Coefficient of Performance of a Heat Operated Refrigerating Machine, Absorbent–Refrigerant combinations, Water-Ammonia Systems, Practical problems, Lithium-Bromide System, Modifications to Simple Vapor-Absorption, Electrolux Refrigerator.

Other types of Refrigeration systems: (i) Steam-Jet refrigeration system and (ii) Thermoelectric refrigeration, (iii) pulse tube refrigeration, (iv) thermo acoustic refrigeration systems

Module-4 Refrigerants (08 Hours)

Refrigerants: Primary and Secondary refrigerants, Designation of Refrigerants, Desirable properties of refrigerants, Selection of a Refrigerant, Ozone Depletion Potential and Global Warming Potential of CFC Refrigerants. Thermodynamic requirements, Comparison between different refrigerants, Substitutes for CFC refrigerants, Secondary Refrigerants.

Module-5 Air-Conditioning (08 Hours)

Air-Conditioning: Basic Processes in Conditioning of Air, Psychrometric Processes in Air-Conditioning Equipment, Simple Air-Conditioning /system and State and Mass Rate of Supply Air, Summer Air Conditioning, Winter Air Conditioning.

Loading Calculation and Applied Psychometrics: Preliminary Considerations, Internal Hear Gains, System Heat Gains, Break-up of Ventilation Load and Effective Sensible Heat Factor, Cooling Load Estimate. Psychrometric Calculations for Cooling, Selection of Air-Conditioning Apparatus for Cooling and Dehumidification, Building Requirements and Energy Conservation in Air-Conditioned Buildings.

Transport air conditioning Systems: Air conditioning systems for automobiles (cars, buses etc.), Air conditioning systems for trains, Air conditioning systems for ships.

| Course Outcom | Course Outcomes: At the end of the course the student will be able to: | | | | | | | | |
|---------------|---|--|--|--|--|--|--|--|--|
| 22MEC642.1 | Apply the principles, nomenclature of refrigeration systems. | | | | | | | | |
| 22MEC642.2 | Explain vapor compression refrigeration system and identify methods for performance improvement | | | | | | | | |
| 22MEC642.3 | Apply the working principles of air, vapor absorption, thermoelectric and steam- jet and thermo acoustic refrigeration systems in solving problems | | | | | | | | |
| 22MEC642.4 | Analyze and estimate the performance of air-conditioning systems using the principles of psychometry. | | | | | | | | |
| 22MEC642.5 | Compute and Interpret cooling and heating loads in an air-conditioning system. | | | | | | | | |
| 22MEC642.6 | Identify suitable refrigerant for various refrigerating systems and analyze the selection of it for any specific applications | | | | | | | | |

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|--|---|---------------------------------|----------------------------|----------------------------------|
| Textb | oooks | | | |
| 1 | Principles of Refrigeration | Roy J. Dossat | Wiley Limited | 1 st edition, 1961 |
| 2 | Refrigeration and Air- conditioning | Arora C.P., | Tata a. McGraw Hill | 2ndEdition, 2001 |
| 3 | Refrigeration and Air- conditioning | Stoecker W.F., and Jones J.W | McGraw Hill | Delhi 2nd edition, 1982. |
| Refer | ence Books | | | |
| 1 | Principles of Refrigeration | Dossat | Pearson publications | 1 st edition, 2006 |
| 2 | Heating, Ventilation and Air Conditioning | Wiley Students | Pearson Education Asia | 5 th edition 2000 |
| 3 Refrigeration and Air- Conditioning | | S C Arora & S Domkundwar | Dhanpat Rai Publication | 5 th edition, 2010 |
| Web 1 | links/Video Lectures/MOO http://nptel.ac.in/courses/11 | Cs 2105128/# | | |

Course Articulation Matrix

| a | | | | | I | Progra | m Out | comes | s (POs |) | | | | |
|-----------------------------|-----|-----|-----|-----|-----|--------|-------|-------|--------|------|------|------|------|------|
| Course Outcomes (COs) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | 909 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| 22MEC642.1 | 3 | - | 1 | - | - | - | - | - | - | - | - | - | - | 1 |
| 22MEC642.2 | - | - | - | 1 | - | - | - | - | 3 | - | - | - | - | - |
| 22MEC642.3 | 3 | 2 | - | - | - | - | - | - | - | - | - | - | - | - |
| 22MEC642.4 | - | 1 | - | - | - | - | 3 | - | - | - | - | - | - | - |
| 22MEC642.5 | - | - | 2 | - | - | - | - | - | - | - | - | - | - | 1 |
| 22MEC642.6 | - | - | - | 2 | - | - | - | - | - | - | - | - | - | 2 |

| PRODUCT LIFE CYCLE MANAGEMENT | | | | | | | | | | | |
|-------------------------------|----------|-------------|-------|--|--|--|--|--|--|--|--|
| Course Code | 22MEC643 | CIE Marks | 50 | | | | | | | | |
| Course Type | | SEE Marks | 50 | | | | | | | | |
| (Theory/Practical/Integrated) | Theory | Total Marks | 100 | | | | | | | | |
| Teaching Hours/Week (L:T:P) | 3:0:0 | SEE | 3 Hrs | | | | | | | | |
| Total Hours | 40 hours | Credits | 03 | | | | | | | | |
| | | | | | | | | | | | |

Course Learning Objectives: This course will enable students to

- Familiarize with various strategies of PLM
- Understand the concept of product design and simulation.
- Develop New product development, product structure and supporting systems
- Interpret technology forecasting and product innovation and development in business processes
- Understand product building and Product Configuration.

Module-1 Introduction to PLM and PDM (8 hours)

Introduction to PLM and PDM: Introduction to PLM, Need for PLM, opportunities and benefits of PLM, different views of PLM, components of PLM, phases of PLM, PLM feasibility study. PLM Strategies, strategy elements, its identification, selection and implementation. Product Data Management, implementation of PDM systems.

Module-2 Product design (8 hours)

Product design: Engineering design, organization and decomposition in product design, product design process, methodical evolution in product design, concurrent engineering, design for X and design central development model. Strategies for recovery at end of life, recycling, human factors in product design. Modeling and simulation in product.

Module-3 Product development (8 hours)

Product development: New Product Development, structuring new product development, building decision support system, estimating market opportunities for new product, new product financial control, implementing new product development, market entry decision, launching and tracking new product program. Concept of redesign of product.

Module-4 Technology forecasting (8 hours)

Technology forecasting: Technological change, methods of technology forecasting, relevance trees, morphological methods, flow diagram and combining forecast of technologies Integration of technological product innovation and product development in business processes within enterprises, methods and tools in the innovation process according to the situation, methods and tools in the innovation process according to the situation.

Module-5 Product building and structures (8 hours)

Product building and structures: Virtual product development tools for components, machines, and manufacturing plants: 3D CAD systems, digital mock-up, model building, model analysis, production (process) planning, and product data technology, Product structures: Variant management, product configuration, material master data, product description data, Data models, Life cycles of individual items, status of items.

| Course Outcom | Course Outcomes: At the end of the course the student will be able to: | | | | | | | |
|----------------------|--|--|--|--|--|--|--|--|
| 22MEC643.1 | Explain the various strategies of PLM and Product Data Management | | | | | | | |
| 22MEC643.2 | Describe decomposition of product design and model simulation | | | | | | | |
| 22MEC643.3 | Apply the concept of New Product Development and its structuring. | | | | | | | |
| 22MEC643.4 | Analyze the technological forecasting and the tools in the innovation. | | | | | | | |
| 22MEC643.5 | Apply the virtual product development and model analysis | | | | | | | |

22MEC643.6 Apply the concept of Leveraging Manufacturing

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|------------|---|--|--------------------------|----------------------------------|
| Text | books | | | |
| 1 | ProductLifecycleManagement:Paradigm for21stCenturyProductRealisationProduct | Stark, John | Springer-Verlag | 4 th edition, 2004 |
| 2 | Product Design for the environment-A lifecycle approach | Fabio Giudice, Guido La Rosa | Taylor & Francis | 1 st edition, 2006 |
| Refer | ence Books | | | |
| 1 | Product Life Cycle Management | SaaksvuoriAntti / ImmonenAnselm ie Dreamtecl | | 2 nd edition, 2008 |
| 2 | Product Lifecycle Management | Michael Grieves | Tata McGraw Hill | 2 nd edition, 2005 |

Web links and Video Lectures (e-Resources):

- PLCM life cycle model: https://youtu.be/ePZheUvsH0w
- PDM working: https://youtu.be/HgDfCFkBAxM
- Process of product design: https://youtu.be/CnKeVs-_9zs

Course Articulation Matrix

| Course | | | | |] | Progra | m Out | comes | (POs |) | | | | |
|-------------------|-----|-----|-----|-----|-----|--------|-------|-------|------|------|------|------|------|------|
| Outcomes (COs) | P01 | P02 | PO3 | P04 | PO5 | P06 | PO7 | PO8 | 909 | PO10 | P011 | P012 | PSO1 | PSO2 |
| 22MEC643.1 | 3 | - | - | - | - | - | - | - | - | - | 2 | - | - | - |
| 22MEC643.2 | 3 | - | - | - | - | - | - | - | 2 | - | - | - | - | - |
| 22MEC643.3 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - | - |
| 22MEC643.4 | 2 | - | - | - | - | - | - | - | 2 | - | - | - | - | - |
| 22MEC643.5 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - | - |
| 22MEC643.6 | - | - | 2 | - | - | - | - | - | 2 | - | - | - | - | - |

| DESIGN FOR MANUFACTURING AND ASSEMBLY | | | | | | | | |
|---------------------------------------|----------|-------------|---------|--|--|--|--|--|
| Course Code | 22MEC644 | CIE Marks | 50 | | | | | |
| Course Type | Theory | SEE Marks | 50 | | | | | |
| (Theory/Practical/Integrated) | | Total Marks | 100 | | | | | |
| Teaching Hours/Week (L:T:P) | 3:0:0 | SEE | 3 Hours | | | | | |
| Total Hours | 40 hours | Credits | 03 | | | | | |

Course Learning Objectives: The objective of the course is to

- Understand the various steps in the product development process and significance of early phases of design for economical production.
- Identify the interrelation of part geometry, tolerance and casting process.
- Recognize the knowledge in metal joining process and to design for welding, forging and extruded sections.
- Learn design of products for ease of assembly and manufacture.
 - Study the design of the manual assembly process.

Module 1 Introduction (8 Hours)

Introduction Design philosophy - steps in design process – General design rules for manufacturability – basic principle for designing for economical production – Creativity in design **Materials** Selection of materials in design developments in material technology - criteria for material selection – material selection interrelationship with process selection, process selection charts.

Module 2 Machining process & Metal Casting (8 Hours)

Machining process Overview of machining process - general design rules for machining -Dimensional tolerance and surface roughness - Design for machining - Ease -Redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

Metal Casting Appraisal of various casting processes, selection of casting process, - general design considerations for casting - casting tolerances - use of solidification simulation in casting design - product design rules for sand casting.

Module 3 Metal Joining, Extrusion & Sheet Metal Work (8 Hours)

Metal Joining Appraisal of various welding processes, Factors in design of weldments -general design guidelines - pre and post treatment of welds - effects of thermal stresses in weld joints - design of brazed joints.

Extrusion & Sheet Metal Work Design guidelines for extruded sections - design principles for Punching, Blanking, Bending, and Deep Drawing - Keeler Goodman Forming Line Diagram-Component Design for Blanking

Module 4 Automatic Assembly Transfer Systems (8 Hours)

Assemble Advantages Development of the assemble process, choice of assemble method; assemble advantages social effects of automation.

Automatic Assembly Transfer Systems Continuous transfer, intermittent transfer, indexing mechanisms, and operator - paced tree – transfer machine

Module 5 Design of Manual Assembly & Handling system (8 Hours)

Design of Manual Assembly Design for assembly fits in the design process, general design guidelines for manual assembly, development of the systematic DFA methodology, assembly efficiency.

Design for Handling system classification system for manual handling. Classification system for manual insertion and fastening, effect of part symmetry on handling time, effect of part thickness and size on handling time, effect of weight on handling time, parts requiring two hands for manipulation, effects of combinations of factors, effect of symmetry effect of chamber design on insertion operations, estimation of insertion time

| Course Outcomes: At the end of the course the student will be able to: | | | | | |
|---|--|--|--|--|--|
| 22MEC644.1 | Describe the various steps in the product development process and significance of early phases of design for economical production | | | | |
| 22MEC644.2 | Identify the interrelation of part geometry, tolerance and casting process. | | | | |
| 22MEC644.3 | Recognize the knowledge in metal joining process and to design for welding, forging and extruded sections | | | | |
| 22MEC644.4 | Apply design of products for ease of assembly and manufacture | | | | |
| 22MEC644.5 | Apply the design of manual assembly process | | | | |
| 22MEC644.6 | Describe the automatic assembly system. | | | | |

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year | | | |
|------------|---|---|--------------------------|----------------------------------|--|--|--|
| Text | books | | | | | | |
| 1 | Assembly Automation and Product Design | Geoffrey Boothroyd | Marcel Dekker Inc | 2 nd edition, 2005 | | | |
| 2 | Engineering design – material and processing approach | Igineering design – aterial and processing George e deiter proach | | 4 th edition, 2008 | | | |
| Refer | Reference Books | | | | | | |
| 1 | Handbook of product design | Geoffrey Boothroyd | Marcel Dekker Inc | 3 rd edition, 2010 | | | |
| 2 | Engineering Design | ngineering Design Eggert, R. J | | 1 st edition, 2004 | | | |

Web links and Video Lectures (e-Resources):

• DFMA – NPTEL - https://archive.nptel.ac.in/courses/107/103/107103012/

| Course | | Program Outcomes (POs) | | | | | | | | | | | | |
|-------------------|-----|------------------------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| Outcomes (COs) | PO1 | PO2 | PO3 | PO4 | PO5 | 90d | LOJ | PO8 | 60d | PO10 | PO11 | PO12 | 10S4 | PSO2 |
| 22MEC644.1 | 1 | 2 | - | - | - | - | 2 | - | - | - | - | - | - | - |
| 22MEC644.2 | 1 | 2 | - | - | - | - | 2 | - | - | - | - | - | - | - |
| 22MEC644.3 | 1 | 2 | - | - | - | - | 1 | - | - | - | - | - | - | - |
| 22MEC644.4 | 1 | 2 | - | - | - | - | 1 | - | - | - | - | - | - | - |
| 22MEC644.5 | 1 | 2 | 2 | - | 3 | - | - | - | - | - | - | - | - | - |
| 22MEC644.5 | 1 | 2 | 2 | - | 3 | - | - | - | - | - | - | - | - | - |

Course Articulation Matrix

1: Low 2: Medium 3: High

| PROJE | ECT MANAGEMI | ENT | | | | |
|--|----------------------------|--------------------------------|-----------------|--|--|--|
| Course Code: | 22MEC651 | CIE Marks | 50 | | | |
| Course Type | | SEE Marks | 50 | | | |
| (Theory/Practical/Integrated) | Theory | Total Marks | 100 | | | |
| Teaching Hours/Week (L: T: P) | 3:0:0 | SEE | 3 Hrs | | | |
| Total Hours | 40 Hours | Credits | 03 | | | |
| Course Learning Objectives: The objectives | tive of the course is | 3 | | | | |
| • To understand how to break down a | complex project | into manageable segmer | nts and use of | | | |
| effective project management tools a | and techniques to | arrive at solution and e | nsure that the | | | |
| project meets its objectives. | | | | | | |
| • To impart knowledge on various com | ponents, phases, an | d attributes of a project. | . 111 | | | |
| • To prepare students to plan, develop | , lead, manage, an | d successfully implement | nt and deliver | | | |
| projects within their chosen practice a | Irea. | Hours) | | | | |
| Introduction: Definition of project of | areatoristics of pr | rojects, understand proje | acts types of | | | |
| projects scalability of project tools project | ct roles Project Se | ection and Prioritizati | on = Strategic | | | |
| planning process. Strategic analysis, strate | egic objectives, por | tfolio alignment – identit | fving potential | | | |
| projects, methods of selecting projects | , financial mode | / scoring models to se | elect projects. | | | |
| prioritizing projects, securing and negotia | ting projects. | 8 | 1 5 / | | | |
| Textbook 1: Chapter 1 and 2. | | | | | | |
| Module-2 Pl | anning Projects (| 08 Hours) | | | | |
| Planning Projects: Defining the project scope, Project scope checklist, Project priorities, Work | | | | | | |
| Breakdown Structure (WBS), Integratin | ng WBS with org | ganization, coding the | WBS for the | | | |
| information system. Scheduling Project | s: Purpose of a pro | ject schedule, historical | development, | | | |
| how project schedules are limited and c | reated, develop pro | oject schedules, uncertai | nty in project | | | |
| schedules, Gantt chart. Case Studies on pr | roject planning met | hodologies in mechanica | al industries. | | | |
| Textbook 1: Chapter / and 8. Module-3 Res | sourcing Projects | (08 Hours) | | | | |
| Resourcing Projects. Abilities needed w | hen resourcing pro | iects estimate resource r | needs creating | | | |
| staffing management plan, project team | composition issues | Budgeting Projects: (| Cost planning | | | |
| cost estimating, cost budgeting, estab | olishing cost con | trol. Project Risk Pl | anning: Risk | | | |
| Management Planning, risk identification | n, risk analysis, ris | k response planning, Pr | oject Quality | | | |
| Planning and Project Kickoff: Developr | nent of quality cond | cepts, project quality man | agement plan, | | | |
| project quality tools, kick off project, ba | seline and commun | nicate project manageme | ent plan, using | | | |
| Microsoft Project for project baselines. | | | | | | |
| Textbook 1: Chapter 9-12. | | | | | | |
| Module-4 Performing Projects (08 Hours) | | | | | | |
| Performing Projects : Project supply cha | in management: - | Plan purchasing and acq | uisitions, plan | | | |
| contracting, contact types, project partnering and collaborations, project supply chain management. | | | | | | |
| financial issues Finishing the project . Terminate project early finish projects on time secure | | | | | | |
| customer feedback and approval knowledge management perform administrative and contract | | | | | | |
| closure. | | | | | | |
| Textbook 1: Chapter 13-15. | | | | | | |
| Module-5 Network Analysis (08 Hours) | | | | | | |
| Network Analysis: Introduction, network construction - rules, Fulkerson's rule for numbering the | | | | | | |

Network Analysis: Introduction, network construction - rules, Fulkerson's rule for numbering the events, AON and AOA diagrams; Critical path method (CPM) to find the expected completion time of a project, floats; PERT for finding expected duration of an activity and project, determining the probability of completing a project, predicting the completion time of project; crashing of simple projects. Application Project planning software (MS Project).

Textbook 2: Chapter 15.

| Course Outcomes: At the end of the course the student will be able to: | | | | |
|---|---|--|--|--|
| 22MEC651.1 | Apply the concepts of project selection, prioritization and initiation of individual projects and strategic role of project management. | | | |
| 22MEC651.2 | Analyze the work breakdown structure by integrating it with organization. | | | |
| 22MEC651.3 | Discuss the scheduling, uncertainty in projects, risk management planning using project quality tools. | | | |
| 22MEC651.4 | Determine project progress and results through balanced scorecard approach. | | | |
| 22MEC651.5 | Draw the network diagram to calculate the duration of the project and reduce it using crashing. | | | |
| 22MEC651.6 | Apply the concept of Project management for a given case study through Project management software. | | | |

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year | |
|------------|---|--|-----------------------------------|--|--|
| Texth | oooks | | | | |
| 1 | Contemporary Project Management | Timothy J. Kloppenborg, Vittal Anantatmula and Kathryn N. Wells | Cengage Learning | 4 th Edition, 2019, Print Year: 2024 | |
| 2 | Operations Research | S. Kalavathy | Vikas Publishing House Pvt.Ltd | 4 th Edition, 2013, Print Year: 2024 | |
| Refe | erence Books | | | | |
| 1 | Project Management -A Systems Approach to Planning Scheduling and Controlling | Harold Kerzner | John Wiley and Sons, New Jercy | 13 th Edition, 2022 | |
| 2 | Project Management: Case Studies | Harold Kerzner | John Wiley and Sons, New Jercy | 5 th Edition, 2017 | |
| Web | links/Video Lectures/MOOCs | | | | |

- <u>https://onlinecourses.nptel.ac.in/noc24_mg01/preview</u> (Project Management, IIT Roorkee)
- <u>https://onlinecourses.nptel.ac.in/noc24_mg78/preview</u> (Project Management : Planning, Execution, Evaluation and Control)
- <u>https://www.coursera.org/professional-certificates/google-project-management</u>
- <u>https://www.youtube.com/watch?v=Ajw75H9Hh1M</u> (Project Management Full Course 2025 | Project Management Tutorial for Beginners)

| Course | Progra | am Ou | tcome | es (POs | s) | | | | | | | | | |
|-------------------|--------|-------|-------|---------|-----|-----|-----|-----|-----|------|------|------|------|------|
| Outcomes (COs) | PO1 | P02 | PO3 | P04 | PO5 | PO6 | PO7 | PO8 | 909 | PO10 | P011 | P012 | PSO1 | PSO2 |
| 22MEC651.1 | 3 | - | - | - | - | 2 | - | 1 | - | - | 3 | - | - | - |
| 22MEC651.2 | - | 2 | - | - | - | - | 1 | - | - | - | - | 2 | - | - |
| 22MEC651.3 | 2 | - | - | - | - | 1 | - | - | - | - | 3 | - | - | - |
| 22MEC651.4 | - | 2 | - | - | - | - | 1 | - | - | - | - | - | - | - |
| 22MEC651.5 | 2 | - | - | - | - | - | - | 1 | - | - | - | 2 | - | - |
| 22MEC651.6 | 2 | - | - | - | 1 | 1 | - | 1 | - | - | - | 1 | 1 | - |

1: Low 2: Medium 3: High

| PRODUCT LIFE CYCLE MANAGEMENT | | | | | | | |
|-------------------------------|----------|-------------|-------|--|--|--|--|
| Course Code | 22MEC652 | CIE Marks | 50 | | | | |
| Course Type | Theory | SEE Marks | 50 | | | | |
| (Theory/Practical/Integrated) | Theory | Total Marks | 100 | | | | |
| Teaching Hours/Week (L:T:P) | 3:0:0 | SEE | 3 Hrs | | | | |
| Total Hours | 40 hours | Credits | 03 | | | | |

Course Learning Objectives: The objective of the course is to

- Familiarize with various strategies of PLM
- Understand the concept of product design and simulation.
- Develop New product development, product structure and supporting systems
- Interpret technology forecasting & product innovation & development in business processes
- Understand product building and Product Configuration.

Module-1 Introduction to PLM and PDM (8 hours)

Introduction to PLM and PDM: Introduction to PLM, Need for PLM, opportunities and benefits of PLM, different views of PLM, components of PLM, phases of PLM, PLM feasibility study. PLM Strategies, strategy elements, its identification, selection and implementation. Product Data Management, implementation of PDM systems.

Module-2 Product design (8 hours)

Product design: Engineering design, organization and decomposition in product design, product design process, methodical evolution in product design, concurrent engineering, design for X and design central development model. Strategies for recovery at end of life, recycling, human factors in product design. Modeling and simulation in product.

Module-3 Product development (8 hours)

Product development: New Product Development, structuring new product development, building decision support system, estimating market opportunities for new product, new product financial control, implementing new product development, market entry decision, launching and tracking new product program. Concept of redesign of product.

Module-4 Technology forecasting (8 hours)

Technology forecasting: Technological change, methods of technology forecasting, relevance trees, morphological methods, flow diagram and combining forecast of technologies Integration of technological product innovation and product development in business processes within enterprises, methods and tools in the innovation process according to the situation, methods and tools in the innovation process according to the situation.

Module-5 Product building and structures (8 hours)

Product building and structures: Virtual product development tools for components, machines, and manufacturing plants: 3D CAD systems, digital mock-up, model building, model analysis, production (process) planning, and product data technology, Product structures: Variant management, product configuration, material master data, product description data, Data models, Life cycles of individual items, status of items.

| Course Outcomes: At the end of the course the student will be able to: | | | | | |
|--|--|--|--|--|--|
| 22MEC652.1 | Explain the various strategies of PLM and Product Data Management | | | | |
| 22MEC652.2 | Describe decomposition of product design and model simulation | | | | |
| 22MEC652.3 | Apply the concept of New Product Development and its structuring. | | | | |
| 22MEC652.4 | Analyze the technological forecasting and the tools in the innovation. | | | | |
| 22MEC652.5 | Apply the virtual product development and model analysis | | | | |
| 22MEC652.6 | Apply the concept of Leveraging Manufacturing | | | | |

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year | |
|------------|---|---|--------------------------|----------------------------------|--|
| Text | books | | | | |
| 1 | ProductLifecycleManagement:Paradigmfor 21st CenturyProductRealisation | Stark, John | Springer- Verlag | 4 th edition, 2004 | |
| 2 | Product Design for the environment-A lifecycle approach | Product Design for the environment-A lifecycle approach Fabio Giudice, Guido La Rosa | | 1 st edition, 2006 | |
| Refer | rence Books | | | | |
| 1 | Product Life Cycle Management | SaaksvuoriAntti Antti / Immonen Anselmie | Springer, Dreamtech | 2 nd edition, 2008 | |
| 2 | Product Lifecycle Management | Michael Grieves | Tata McGraw Hill | 2 nd edition, 2005 | |

Web links and Video Lectures (e-Resources):

- PLCM life cycle model: https://youtu.be/ePZheUvsH0w
- PDM working: https://youtu.be/HgDfCFkBAxM
- Process of product design: https://youtu.be/CnKeVs-_9zs

Course Articulation Matrix

| Course | Program Outcomes (POs) | | | | | | | | | | | | | |
|-------------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| Outcomes (COs) | P01 | PO2 | PO3 | P04 | PO5 | PO6 | PO7 | PO8 | 60d | PO10 | P011 | P012 | PSO1 | PSO2 |
| 22MEC652.1 | 3 | - | - | - | - | - | - | - | - | - | 2 | - | - | - |
| 22MEC652.2 | 3 | - | - | - | - | - | - | - | 2 | - | - | - | - | - |
| 22MEC652.3 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - | - |
| 22MEC652.4 | 2 | - | - | - | - | - | - | - | 2 | - | - | - | - | - |
| 22MEC652.5 | - | - | 2 | - | - | - | - | - | - | - | 2 | - | - | - |
| 22MEC652.6 | - | - | 2 | _ | - | - | - | - | 2 | - | _ | _ | - | - |

| MECHATRONICS | | | | | | | |
|-------------------------------|----------|-------------|---------|--|--|--|--|
| Course Code | 22MEC653 | CIE Marks | 50 | | | | |
| Course Type | | SEE Marks | 50 | | | | |
| (Theory/Practical/Integrated) | Theory | Total Marks | 100 | | | | |
| Teaching Hours/Week (L:T:P) | 3:0:0 | SEE | 3 Hours | | | | |
| Total Hours | 40 hours | Credits | 03 | | | | |

Course Learning Objectives: The objective of the course is

•

- To acquire a strong foundation in science and focus in mechanical, electronics, control, software, and computer engineering, and a solid command of the newest technologies.
- To understand the evolution and development of Mechatronics as a discipline.
- To substantiate the need for interdisciplinary study in technology education
- To understand the applications of microprocessors in various systems and to know the functions of each element.
- To demonstrate the integration philosophy in view of Mechatronics technology
 - To be able to work efficiently in multidisciplinary teams.

Module-1 Introduction (8 hours)

Introduction: Scope and elements of mechatronics, mechatronics design process, measurement system, requirements and types of control systems, feedback principle, Basic elements of feedback control systems, Classification of control system. Examples of Mechatronics Systems such as Automatic Car Park system, Engine management system, Antilock braking system (ABS) control, Automatic washing machine.

Transducers and sensors: Definition and classification of transducers, Difference between transducer and sensor, Definition and classification of sensors, Principle of working and applications of light sensors, Potentiometers, LVDT, Capacitance sensors, force and pressure sensors, Strain gauges, temperature sensors, proximity switches and Hall Effect sensors.

Module-2 Signal Conditioning & Electro Mechanical Drives (8 hours)

Signal Conditioning: Introduction – Hardware – Digital I/O, Analog to digital conversions, resolution, Filtering Noise using passive components – Registers, capacitors, amplifying signals using OP amps. Digital Signal Processing – Digital to Analog conversion, Low pass, high pass, notch filtering. Data acquisition systems (DAQS), data loggers, Supervisory control and data acquisition (SCADA), Communication methods.

Electro Mechanical Drives: Relays and Solenoids – Stepper Motors – DC brushed motors – DC brushless motors – DC servo motors – 4-quadrant servo drives, PWM's – Pulse Width Modulation.

Module-3 Microprocessor & Microcontrollers (8 hours)

Microprocessor & Microcontrollers: Introduction, Microprocessor systems, Basic elements of control systems, Microcontrollers, Difference between Microprocessor and Microcontrollers. Microprocessor Architecture: Microprocessor architecture and terminology-CPU, memory and address, I/O and Peripheral devices, ALU, Instruction and Program, Assembler, Data Registers, Program Counter, Flags, Fetch cycle, write cycle, state, bus interrupts. Intel's 8085A Microprocessor.

Module-4 Logic Controller (8 hours)

Programmable Logic Controller: Introduction to PLCs, Basic structure of PLC, Principle of operation, input and output processing, PLC programming language, ladder diagram, ladder diagrams circuits, timer counters, internal relays, master control, jump control, shift registers, data handling, and manipulations, analogue input and output, selection of PLC for application.

Application of PLC control: Extending and retracting a pneumatic piston using latches, control of two pneumatic pistons, control of process motor, control of vibrating machine, control of process tank, control of conveyer motor etc.

Module-5 Computer Numerical Control (CNC) machines (8 hours)

Mechatronics in Computer Numerical Control (CNC) machines: Design of modern CNC machines - Machine Elements: Different types of guide ways, Linear Motion guideways. Bearings:

anti-friction bearings, hydrostatic bearing and hydrodynamic bearing. Re-circulating ball screws. Typical elements of open and closed loop control systems. Adaptive controllers for machine tools.

Mechatronics Design process: Stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Automatic car park barrier.

| Course Outco | Course Outcomes: At the end of the course the student will be able to: | | | | | | |
|--------------|---|--|--|--|--|--|--|
| 22MEC653.1 | Illustrate various components of Mechatronics systems and assess various control systems used in automation | | | | | | |
| 22MEC653.2 | Choose appropriate sensors and transducers for different engineering applications | | | | | | |
| 22MEC653.3 | Assess various components of signal conditioning, Data acquisition systems, SCADA and illustrate the various types of electric motors | | | | | | |
| 22MEC653.4 | Assess the architecture and basic elements of microprocessors, microcontrollers & PLCs and develop PLC programs using ladder diagrams | | | | | | |
| 22MEC653.5 | Illustrate various elements of CNC machines and various types of bearings | | | | | | |
| 22MEC653.6 | Assess the Mechatronics systems by case studies | | | | | | |

| Sl. No. | Title of the Book | Name of the author/s | Name of the Publisher | Edition &Year |
|------------|--|-----------------------------------|--------------------------|----------------------------------|
| Text | books | | | |
| 1 | Mechatronics – Electronic control systems in Mechanical and Electrical Engineering | W.Bolton | Pearson Education | 1 st edition, 2003 |
| 2 | Mechatronics – Principles, | Nitaigour | Tata McGraw | 1 st edition, |
| Z | Concepts and Applications | Premchand Mahalik | Hill | 2003 |
| Refer | ence Books | | | |
| 1 | Mechatronics | HMT Ltd | Tata McGraw Hill | 1 st edition, 2000 |
| 2 | Mechatronics System Design | Devadas Shetty, Richard A Kolk | Cengage Publishers | 2 nd edition, 2010 |
| 3 | Introduction to Mechatronics and Measurement systems | David G A & Michael B H | McGraw Hill Inc USA | 1 st edition, 2003 |
| 4 | Introduction to Robotics: Analysis, Systems, Applications | Saeed B Niku | Pearson Education | 1 st edition, 2006 |
| Web l | inks and Video Lectures (e-Reso | urces): | | |

http://nptel.ac.in/courses/112107298http://nptel.ac.in/courses/112103174

Course Articulation Matrix

| | | Program Outcomes (POs) | | | | | | | | | | | | |
|-----------------------------|-----|------------------------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| Course Outcomes (COs) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | P012 | PSO1 | PSO2 |
| 22MEC653.1 | 3 | - | - | - | - | - | - | - | - | - | 2 | - | - | - |
| 22MEC653.2 | - | 2 | - | - | - | - | - | - | 2 | - | 2 | - | - | - |
| 22MEC653.3 | - | 1 | - | - | - | 2 | - | - | - | - | - | - | - | - |
| 22MEC653.4 | 2 | 2 | - | - | - | - | - | - | 2 | - | - | - | - | - |
| 22MEC653.5 | - | 3 | - | - | - | - | - | - | - | - | 2 | - | - | - |
| 22MEC653.6 | - | 2 | - | - | - | 2 | - | - | 2 | - | - | - | - | - |

| MODERN MOBILITY | | | | | | |
|-------------------------------|----------|-------------|---------|--|--|--|
| Course Code | 22MEC654 | CIE Marks | 50 | | | |
| Course Type | Theory | SEE Marks | 50 | | | |
| (Theory/Practical/Integrated) | Theory | Total Marks | 100 | | | |
| Teaching Hours/Week (L:T:P) | 3:0:0 | SEE | 3 Hours | | | |
| Total Hours | 40 hours | Credits | 03 | | | |

Course Learning Objectives: The objective of the course is to

- Understand the Principles of Modern Mobility and Sustainable Transportation
- Comprehend the Fundamentals of Electric Vehicles (EVs)
- Analyze Hybrid Vehicle Technologies
- Understand Autonomous Vehicle (AV) Technologies
- Analyze Smart Transportation Systems
- Evaluate the Impact and Implementation of Smart Mobility Solutions

Module-1 Introduction to Modern Mobility and its Sustainability (8 hours)

Understand modern mobility and its significance. Transportation challenges. Current and future trends in mobility. Impact of modern mobility on society and environment. Sustainable transportation. Alternative fuels and propulsion systems. Lifecycle analysis of transportation systems. Role of urban mobility solutions. Dimensions of transportation. Government policies and regulations to promote sustainable mobility.

Module-2 Electric Vehicles (8 hours)

Electric vehicles principle and components. Layout of two & 4-wheeler. Motors used in Electric vehicles –types. Overview of construction and working. Power transmission & control system in Electric vehicles. Batteries–construction & working principle of Lead acid, nickel-based, sodiumbased, Lithium & metal-air batteries. Battery charging types and requirements. Battery cooling. Fire safety measures in EV vehicles.

Module-3 Hybrid Vehicles (8 hours)

Introduction to Hybrid Vehicles. Pros and cons of different types of hybrid powertrains. Components of hybrid vehicles – ICE, motors and generators, and energy storage systems. Energy management strategies used in hybrid vehicles. Fuel efficiency analysis and emission. Success stories of popular hybrid models (Toyota Prius, Chevrolet Volt, etc.).

Module-4 Autonomous Vehicles (8 hours)

Definition and key concepts. SAE levels of driving automation (0-5). Types of sensors used in AVs: LIDAR, radar, cameras, and ultrasonic sensors. Data fusion and sensor redundancy. Basic concepts of environmental mapping and object detection in AVs. Overview of vehicle control systems and decision-making algorithms. Safety and reliability in AVs.

Module-5 Smart Transportation Systems (8 hours)

Introduction to smart transportation systems. Key elements of smart transportation. Intelligent infrastructure systems (such as Incident Management, Emergency Management, Arterial Management, Crash Prevention and Safety, etc.). Intelligent vehicle systems (such as Collision Avoidance Systems, Driver Assistance Systems, Collision Notification Systems, etc.). Smart parking solutions. Cybersecurity in smart transportation. Case Studies and Real-World Implementations.

| Course Outcomes: At the end of the course the student will be able to: | | | | | | |
|---|---|--|--|--|--|--|
| 22MEC654 1 | Articulate the significance of modern mobility, identify transportation challenges, | | | | | |
| 221VIEC034.1 | and evaluate current and future trends in mobility. | | | | | |
| | Demonstrate an understanding of the principles and components of electric | | | | | |
| 22MEC654.2 | vehicles, including the layout of two- and four-wheelers, types of motors, and the | | | | | |
| | construction and working principles of various battery types. | | | | | |

| 22MEC654 3 | Explain the different types of hybrid powertrains, components of hybrid vehicles, |
|------------|---|
| 22MEC034.3 | and energy storage systems, and evaluate energy management strategies |
| | Explain the key concepts of autonomous vehicles, and discuss vehicle control |
| 22MEC654.4 | systems and decision-making algorithms, and understand the importance of safety |
| | and reliability in AVs. |
| 22MEC(54.5 | Describe the key elements of smart transportation systems, including intelligent |
| 22MEC054.5 | infrastructure and vehicle systems. |
| | Analyze real-world implementations and case studies of smart transportation |
| 22MEC654.6 | solutions, and conduct a lifecycle analysis of transportation systems to evaluate their |
| | sustainability and long-term environmental impact |

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year | |
|------------|---|--|--------------------------|----------------------------------|--|
| Text | books | | | | |
| 1 | Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design | Mehrdad Ehsani & Yimin Gao & Ali Emadi | CRC Press | 2 nd edition, 2018 | |
| 2 | Sustainable Transportation Systems Engineering: Evaluation & Implementation | Francis Vanek, Lars T. Angenent, Mark A. Turnquist, James H. Banks, Ricardo A. Daziano | McGraw Hill | 1 st edition, 2014 | |
| Refei | rence Books | | | | |
| 1 | Electric Vehicle Technology Explained | John Lowry, James Larminie | Wiley | 2 nd edition, 2012 | |
| 2 | Autonomous Vehicles: Intelligent Transport Systems and Smart Technologies | Nicu Bizon, Lucian Dascalescu, Naser Mahdavi Tabatabaei | Nova | 1 st edition, 2014 | |

Course Articulation Matrix

| | | Program Outcomes (POs) | | | | | | | | | | | | |
|-----------------------------|-----|------------------------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| Course Outcomes (COs) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | P012 | PSO1 | PSO2 |
| 22MEC654.1 | 3 | - | 2 | - | - | - | 1 | - | - | - | - | - | - | - |
| 22MEC654.2 | - | 2 | 3 | - | - | - | - | - | - | - | - | - | - | - |
| 22MEC654.3 | 3 | - | 2 | - | - | - | - | - | - | - | - | - | - | - |
| 22MEC654.4 | - | 3 | 2 | - | - | - | - | - | - | - | - | - | - | - |
| 22MEC654.5 | 3 | - | 2 | - | - | - | - | - | - | - | - | - | 1 | - |
| 22MEC654.6 | - | 3 | - | - | - | 2 | - | - | - | - | - | - | - | 1 |

| Major Project Phase I | | | | | |
|-------------------------------|-----------|-------------|-----|--|--|
| Course Code | 22MEC66 | CIE Marks | 100 | | |
| Course Type | Drastical | SEE Marks | - | | |
| (Theory/Practical/Integrated) | Practical | Total Marks | 100 | | |
| Teaching Hours/Week (L:T:P) | (0:0:4) | SEE | - | | |
| Total Hours | 48 hours | Credits | 02 | | |

Course Learning Objectives:

- 1. Utilize fundamental principles of engineering and interdisciplinary knowledge to identify, analyse, and solve complex problems in the project domain.
- 2. Develop and execute a comprehensive project plan that includes designing, prototyping, testing, and evaluating a system, component, or process to meet specific needs and constraints.
- 3. Conduct in-depth research, critically review literature, and integrate innovative solutions or techniques within the project framework.
- 4. Demonstrate effective teamwork, communication, and collaboration skills in a multidisciplinary environment to achieve project objectives.
- 5. Incorporate ethical considerations, societal impact, and sustainable practices in the project development, while adhering to professional engineering standards.
- 6. Prepare and present a well-structured project report, supported by technical documentation and visual aids, and confidently defend the work during project viva-voce or presentations.

1. Project Selection

- **Relevance**: Projects should align with the students' specialization and current industry trends.
- **Innovation**: Projects that offer innovative solutions to existing problems or explore new ideas are encouraged.
- Feasibility: The project should be achievable within the given timeframe and resources.
- **Team Composition**: Students can work in teams, typically comprising maximum 4 members.

2. Project Proposal

- **Submission**: Students must submit a detailed project proposal (project synopsis) outlining the problem statement, objectives, methodology, expected outcomes, and a work plan.
- **Approval**: The proposal should be reviewed and approved by the Department Project Evaluation Committee (DPEC).

3. Project Execution

- **Regular Meetings**: Students should meet regularly with their project-guide to discuss progress, challenges, and next steps.
- **Documentation**: Maintain detailed documentation throughout the project in a project workdairy, including design decisions, experiments, and testing results.
- **Milestones**: Set clear milestones and deadlines to ensure steady progress. These could include design completion, initial prototype, testing, etc.

4. Mid-term Review

- **Progress Presentation**: DPEC shall conduct a mid-term review where students present their progress to a panel of faculty members.
- Feedback: Provide constructive feedback and guidance to help students refine their projects.

5. Report Submission

- **Report**: The project report should include an abstract, introduction, literature review, methodology, completed portion of the project work with the available results, discussion, conclusion, and references.
- Code and Data: If applicable, students should submit their code, datasets, and any other relevant materials.

6. Project Presentations

• **Oral Presentation**: Students should present their projects to a panel, explaining their work, findings, and contributions.

- **Demonstration**: If possible, include a live demonstration of the project or show relevant • simulations and results.
- **Q&A**: Be prepared to answer questions from the panel and justify the project's methodology and conclusions.

7. Evaluation Criteria

- Originality and Innovation: Assess the novelty and creativity of the project. •
- **Technical Competence**: Evaluate the depth of technical knowledge and problem-solving ability • demonstrated.
- **Project Execution**: Consider the effectiveness of project planning, adherence to timelines, and • quality of implementation.
- Presentation and Communication: Judge the clarity and coherence of the project report, • presentation, and the ability to answer questions.

8. Plagiarism Check

- Academic Integrity: Ensure that the work submitted is original and properly cites all references • and sources.
- Plagiarism Check: Run all reports through plagiarism detection software and ensure that • similarity index is less than the threshold value (25%).

9. Mentorship and Feedback

- Feedback: Students are required to consult with their project guide regularly throughout the • project work to seek guidance and feedback.
- Weekly Meetings: At least one mentorship meeting every week shall be held and recorded in • the project work-dairy.

| Continuous Internal Evaluation (CIE) | | | | | | | | |
|---|---|-----------------|--|--|--|--|--|--|
| Description | Proposed Dates | CIE Weightage | | | | | | |
| Description | rioposed Dates | (Max 100 marks) | | | | | | |
| 1. Project Synopsis Evaluation | roject Synopsis Evaluation Beginning of the 6 th Semester 20 marks | | | | | | | |
| 2. Project Progress EvaluationMiddle of the 6th Semester30 marks | | | | | | | | |
| 3. Project Report Evaluation | End of the 6 th Semaster | 50 marks | | | | | | |
| (Phase I) | End of the o Semester | JU Marks | | | | | | |
| Marks given for the Project Report shall be the same for all project team members, However, | | | | | | | | |
| marks may differ for presentations and viva-voce depending upon the individual student | | | | | | | | |
| performance. | | | | | | | | |

Semester End Examinations (SEE)

4. There is No SEE component for Major Project Phase I.

| Course Outcome | Course Outcomes: At the end of the course the student will be able to : | | | | | | | | |
|----------------|--|--|--|--|--|--|--|--|--|
| 22MEC66.1 | Demonstrate the ability to identify, define, and solve complex engineering problems | | | | | | | | |
| | using appropriate methodologies and modern tools. | | | | | | | | |
| 22MEC66.2 | Successfully design, develop, and test an engineering solution that meets specified | | | | | | | | |
| | requirements, addressing technical, economic, environmental, and social | | | | | | | | |
| | constraints. | | | | | | | | |
| 22MEC66.3 | Apply research skills to review existing literature, gather and analyze data, and | | | | | | | | |
| | incorporate innovative or state-of-the-art technologies in the project | | | | | | | | |
| 22MEC66.4 | Collaborate effectively within a team, taking on leadership or supportive roles as | | | | | | | | |
| | needed, while ensuring clear communication and efficient project management. | | | | | | | | |
| 22MEC66.5 | Demonstrate awareness of professional ethics, societal impact, and sustainability in | | | | | | | | |
| | the design and implementation of engineering solutions. | | | | | | | | |

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22MEC66.6

Exhibit strong written and oral communication skills by preparing technical reports, project documentation, and delivering persuasive project presentations.

| Commo | | | C | ourse i | D | | •1at1 | 1A (D | | | | | | |
|-------------------|------------------------|-----|-----|---------|-----|-----|-------|----------|-----|------|------|------|------|------|
| Course | Program Outcomes (POS) | | | | | | | | | | | | | |
| Outcomes (COs) | P01 | P02 | P03 | P04 | P05 | P06 | P07 | PO8 | P09 | P010 | P011 | P012 | PS01 | PSO2 |
| 22MEC66.1 | 2 | 3 | - | - | 1 | - | - | - | - | - | - | - | - | - |
| 22MEC66.2 | - | - | 3 | - | - | 2 | 1 | - | - | - | - | - | - | - |
| 22MEC66.3 | 1 | 2 | - | 3 | - | - | - | - | - | - | - | - | - | - |
| 22MEC66.4 | - | - | - | - | - | 1 | - | - | 3 | 2 | 2 | - | - | - |
| 22MEC66.5 | - | - | 1 | - | - | - | 2 | 3 | - | - | - | - | - | - |
| 22MEC66.6 | - | - | - | - | - | - | - | - | - | 3 | 2 | 1 | - | - |

Course Articulation Matrix

| Environmental Studies | | | | | | | | | | | |
|-------------------------------|----------|-------------|---------|--|--|--|--|--|--|--|--|
| Course Code | 22CIV67 | CIE Marks | 50 | | | | | | | | |
| Course Type | Theory | SEE Marks | 50 | | | | | | | | |
| (Theory/Practical/Integrated) | Theory | Total Marks | 100 | | | | | | | | |
| Teaching Hours/Week (L:T:P) | 1:0:0 | SEE | 2 Hours | | | | | | | | |
| Total Hours | 15 hours | Credits | 01 | | | | | | | | |

Course Learning Objectives: This course will enable

- To create environmental awareness among the students.
- To gain knowledge on different types of pollution in the environment.

Module-1 Introduction to Ecology (3 hours)

Ecosystems (Structure and Function): Forest, Desert, Wetlands, River, Oceanic, and Lake. Biodiversity: Types, Value; Hot spots; Threats and Conservation of Biodiversity, Forest Wealth, and Deforestation.

Module-2 Energy Systems and Natural Resources (3 hours)

Advances in Energy Systems (Merits, Demerits, Global Status, and Applications): Hydrogen, Solar, OTEC, Tidal, and Wind.

Natural Resource Management (Concept and case studies): Disaster Management, Sustainable Mining, case studies, and Carbon Trading.

Module-3 Environmental Pollution and Public Health (3 hours)

Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Surface and Ground Water Pollution; Noise pollution; Soil Pollution, and Air Pollution.

Waste Management & Public Health Aspects: Bio-medical Wastes; Solid waste; Hazardous wastes; E-wastes; Industrial and Municipal Sludge.

Module-4 Environmental Concerns (3 hours)

Global Environmental Concerns (Concept, policies, and case studies): Groundwater depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problems in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology.

Module-5 Environmental Management (3 hours)

Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems, ISO14001; Environmental Stewardship- NGOs. Fieldwork: A visit to an Environmental Engineering Laboratory or Green Building or Water Treatment Plant or Waste water treatment Plant; thought to be Followed by an understanding of the process and its brief documentation (Optional).

| Course Outcome | Course Outcomes: At the end of the course the student will be able to: | | | | | | | | |
|----------------|--|--|--|--|--|--|--|--|--|
| 22CIV67.1 | Identify the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale, | | | | | | | | |
| 22CIV67.2 | Develop critical thinking and/or observation skills and apply them to the analysis of a problem or question related to the environment. | | | | | | | | |
| 22CIV67.3 | Demonstrate ecology knowledge of a complex relationship between a biotic and abiotic component. | | | | | | | | |
| 22CIV67.4 | Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues. | | | | | | | | |
| 22CIV67.5 | Address problems related to waste management and public health aspects | | | | | | | | |
| 22CIV67.6 | List the Standards and latest tools to mitigate pollution. | | | | | | | | |

| Sl. | Title of the Book | Name of the | Name of the | Edition and |
|-------|--|---|--|--------------------|
| No. | THE OF HE DOOK | Author/s | Publisher | Year |
| Text | books | | | |
| 1 | Environmental studies | Benny Joseph | Tata McGraw-Hill | Edition 3, 2018 |
| 2 | Environmental Studies – From Crisis to Cure | R Rajagopalan | Oxford Uni-Press | Edition 3, 2020 |
| Refer | ence Books | | | |
| 1 | A Basic Course in Environmental Studies | Surinder Deswal, Anupama Deswal | Dhanpat Rai Publishing Co. (P) Ltd | 2017 |
| 2 | Text book of Environmental Studies for Undergraduate Courses | Bharucha Erach | Universities Press | Edition 2, 2017 |
| 3 | Environmental Studies | Ranjit R. J Daniels, Jagdish Krishnaswamy | John Wiley & Sons Inc. | 2010 |
| 4 | Perspective in Environmental Studies | Anubha Kaushik, C P Kaushik | New Age International Pvt. Ltd | Edition 3, 2009 |

Web links and Video Lectures (e-Resources):

- 1. Coursera Course: Introduction to Environmental Science Specialization https://coursera.org/share/e6c3c98f7215fd49f688e7ede71a0dfc
- 2. NPTEL: Environmental Studies https://onlinecourses.swayam2.ac.in/cec22_ge22/preview
- 3. Directory of Open Access Books (DOAB) Environmental Leadership Capacity Building in Higher Education: Experience and Lessons from Asian Program for Incubation of Environmental Leaders : http://link.gpringer.gom/openuel/2gepre=book &ishp=078_4_431_54330_8
 - http://link.springer.com/openurl?genre=book&isbn=978-4-431- 54339-8
- 4. Lec 31: Environmental Management Systems (EMS) <u>https://youtu.be/BYqLRGawoH0</u>
- 5. ISO 14001:2015 Training Environmental Management https://youtu.be/2f4pBIvXkBs

| Course | | Program Outcomes (POs) | | | | | | | | | | | | |
|-----------|-----|------------------------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| (COs) | P01 | P02 | P03 | P04 | PO5 | P06 | P07 | PO8 | PO9 | PO10 | P011 | P012 | PSO1 | PSO2 |
| 22CIV67.1 | - | - | - | - | - | 1 | 3 | - | - | - | - | - | - | - |
| 22CIV67.2 | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - |
| 22CIV67.3 | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - |
| 22CIV67.4 | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - |
| 22CIV67.5 | _ | - | - | _ | - | 2 | 3 | 1 | _ | - | - | - | - | - |
| 22CIV67.6 | _ | - | - | _ | 1 | - | _ | 2 | _ | - | - | - | _ | - |

Course Articulation Matrix

| Innovation and Intellectual Property | | | | | | | | | | | |
|--------------------------------------|------------------|-------------|---------|--|--|--|--|--|--|--|--|
| Course Code | 22IIP68 | CIE Marks | 100 | | | | | | | | |
| Course Type | Prostical | SEE Marks | - | | | | | | | | |
| (Theory/Practical/Integrated) | Practical | Total Marks | 100 | | | | | | | | |
| Teaching Hours/Week (L:T:P) | 0:0:2 | Exam Hours | 3 Hours | | | | | | | | |
| Total Hours | 20 Hrs | Credits | 01 | | | | | | | | |

Course Learning Objectives:

- 1. Learn how to use online databases and search tools for conducting patent searches.
- 2. Develop skills in analyzing patent documents and identifying relevant prior art.
- 3. Gain proficiency in evaluating the patentability criteria for engineering inventions.
- 4. Understand the principles of technology gap analysis and patentability search.
- 5. Understand the patent drafting and patent prosecution.

Module-1 Basics of Intellectual Property Rights (4 Hours)

Creativity, Invention, and Innovation – Introduction to Intellectual Property Rights-types and Importance – Overview of Patent Law – Intellectual Property Management and Commercialization – Emerging Issues in Intellectual Property – Case Studies and Practical Examples – Ethical and Social Considerations.

Activity: Trademark Design Challenge – IP Case Study Analysis

Module-2 Patent Landscape Analysis – Technology Gap Analysis (4 Hours)

Overview of Patent Databases and Search Tools – Keyword Searching, Classification Searching, and Citation Searching – Methods for Analyzing Patent Data: Patent Counts, Citation Analysis, and Patent Mapping – Technology Gap Analysis – Patent Portfolios – Portfolio Strength Assessment – Identification of Key Players – Competitive Intelligence and Market Analysis.

Activity: Conduct Patent Landscape Analysis for the Proposed Capstone Project.

Module-3 Patentability Assessment (6 Hours)

Significance of Patentability Assessment – Patentability Criteria: Novelty, Non-obviousness (Inventive Step), and Industrial Applicability/Utility – Prior Art Searching and Analysis (Keyword Searching, Classification Searching, and Citation Searching) – Non-Patent Literature Search and Other sources of Prior Art – Patentability Reports and Assessments – Case Studies and Practical Examples.

Activity: Conduct a Patentability Search for the Proposed Capstone Project.

Module-4 Patent Drafting and Prosecution (6 Hours)

Significance of Patent Drafting and Prosecution – Structure and Components of a Patent Application – Drafting of Patent Specifications, Claims, and Drawings – Overview of Patent Prosecution Process

Activity: Prepare a Patent Draft for the Proposed Capstone Project.

| Course Out | comes: At the end of the course, the student will be able to: |
|------------|---|
| 22IIP68.1 | Demonstrate proficiency in utilizing various online databases and search tools for conducting patent searches |
| 22IIP68.2 | Develop advanced skills in analyzing patent documents to identify relevant prior art, including patents, patent applications, and non-patent literature. |
| 22IIP68.3 | Demonstrate a comprehensive understanding of the patentability criteria, including novelty, non-obviousness, and utility. |
| 22IIP68.4 | Explain the principles and methodologies of technology gap analysis and its relevance to patentability searches. |
| 22IIP68.5 | Gain insight into the patent drafting process, including the structure and components of patent applications, and patent prosecution. |
| 22IIP68.6 | Apply the acquired knowledge and skills in conducting practical activities, such as conducting patent landscape analysis, patentability searches, and drafting patent |

applications, to solve real-world problems and challenges in the field of intellectual property rights.

| Sl. | Title of the Book | Name of the | Name of the | Edition | | | | |
|------|--------------------------------|--|---------------------------|---------------|--|--|--|--|
| No. | | Author/s | Publisher | and Year | | | | |
| Refe | rence Books/Sources | | | | | | | |
| | Intellectual Property-A Primer | Rupinder Tewari | Publication Bureau, | 2021 | | | | |
| 1 | for Academia | Mamtha | Panjab University | 2021 | | | | |
| | (For Module 1) | Bhardway | Chandigarh India | | | | | |
| | Patant Landscapa Paparts | WIPO - Worl | d Intellectual Property C | rganization | | | | |
| 2 | (For Modulo 2) | https://www.wipo.int/patentscope/en/programs/patent_la | | | | | | |
| | (For Module 2) | ndscapes | | | | | | |
| | Guidelines for Preparing | Anthony Trippe, | World Intellectual | | | | | |
| 3 | Patent Landscape Reports | Patinformatics, | Property | 2015 | | | | |
| | (For Module 2) | LLC | Organization (WIPO) | | | | | |
| | Patent Searching - Tools and | | John Wilow & Song | First adition | | | | |
| 4 | Techniques | David Hunt | John whey & Sons | | | | | |
| | (For Module 3) | | IIIC | 2007 | | | | |
| | The Complete Patent Book_ | | | | | | | |
| 5 | Everything You Need to Obtain | Jamas I. Dogara | Sphiny Dublishing | First Edition | | | | |
| 5 | Your Patent | James L. Rogers | Spinitx Fublishing | 2003 | | | | |
| | (For Module 4) | | | | | | | |

Additional Resources:

- 1. WIPO Patent Drafting Manual Second Edition 2023, <u>https://www.wipo.int/edocs/pubdocs/en/wipo-pub-867-23-en-wipo-patent-drafting-manual.pdf</u>
- 2. Patent Drafting for Beginners <u>https://elearn.nptel.ac.in/shop/nptel/patent-drafting-for-beginners/?v=c86ee0d9d7ed</u>
- 3. The Office of the Controller General of Patents, Designs and Trade Marks, Government of India <u>https://www.ipindia.gov.in/</u>
- 4. Copyright Office, Government of India https://copyright.gov.in/
- 5. United States Patent and Trademark Office https://www.uspto.gov/
- 6. Espacenet patent search https://worldwide.espacenet.com/
- 7. The Lens Free & Open Patent and Scholarly Search https://www.lens.org/
- 8. WIPO PATENTSCOPE https://patentscope.wipo.int/search/en/search.jsf

Course Articulation Matrix

| Course | | Program Outcomes (POs) | | | | | | | | | | | | |
|-------------------|-----|------------------------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| Outcomes (COs) | P01 | P02 | P03 | P04 | P05 | P06 | PO7 | P08 | P09 | P010 | P011 | P012 | PS01 | PSO2 |
| 22IIP68.1 | 2 | - | - | - | 3 | - | - | - | - | - | - | 1 | - | - |
| 22IIP68.2 | 2 | - | - | 3 | - | - | - | - | - | - | - | 1 | - | - |
| 22IIP68.3 | 3 | - | - | - | - | - | - | - | - | - | 1 | - | - | - |
| 22IIP68.4 | 2 | - | 3 | - | - | - | - | - | - | - | - | - | - | - |
| 22IIP68.5 | 1 | 3 | - | - | - | - | - | - | - | - | - | 2 | - | - |
| 22IIP68.6 | - | - | - | - | 2 | - | - | - | - | - | - | 3 | - | - |

1: Low 2: Medium 3: High

Core Values of the Institution

SERVICE

A Josephite will keep service as the prime goal in everything that is undertaken. Meeting the needs of the stakeholders will be the prime focus of all our endeavors.

EXCELLENCE

A Josephite will not only endeavor to serve, but serve with excellence. Preparing rigorously to excel in whatever we do will be our hallmark.

ACCOUNTABILITY

Every member of the SJEC Family will be guided to deliver on assurances given within the constraints set. A Josephite will always keep budgets and deadlines in mind when delivering a service.

CONTINUOUS ADAPTATION

Every member of the SJEC Family will strive to provide reliable and continuous service by adapting to the changing environment.

COLLABORATION

A Josephite will always seek to collaborate with others and be a team-player in the service of the stakeholders.

Objectives

- Provide Quality Technical Education facilities to every student admitted to the College and facilitate the development of all round personality of the students.
- Provide most competent staff and excellent support facilities like laboratory, library and internet required for good education on a continuous basis.
- Encourage organizing and participation of staff and students in in-house and outside Training programmes, seminars, conferences and workshops on continuous basis.
- Provide incentives and encouragement to motivate staff and students to actively involve in research-innovative projects in collaboration with industry and R&D centres on continuous basis
- Invite more and more number of persons from industry from India and abroad for collaboration and promote Industry-Institute Partnership.
- Encourage consultancy and testing and respond to the needs of the immediate neighbourhood.



St Joseph Engineering College

AN AUTONOMOUS INSTITUTION

Affiliated to VTU, Belagavi | Recognised by AICTE, New Delhi Accredited by NAAC with A+ Grade B.E. (CSE, ECE, EEE, ME, CIV), MBA & MCA Accredited by NBA, New Delhi

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