PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF SCIENCE & TECHNOLOGY

NEP 2020 Compliant Curriculum for Final Year B.Tech. Mechanical Engineering with effect from 2026-2027

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF SCIENCE & TECHNOLOGY

NEP 2020 Compliant Curriculum of Final Year B. Tech. Mechanical Engineering

With effect from 2026-2027

Semester -VII

Distribution	*Course Code*	*Name of the Course*	*Engagement Hours*			*Credits*	*FA*	*SA*			*Total*
			L	*T*	*P*		*ESE*	*ISE*	*ICA*	*OE/ POE*	
PCC	MECHPCC-13	Automation and Robotics	3	-	-	03	70	30	-	-	100
PCC	MECHPCC-14	Refrigeration and Air Conditioning	2	-	2	03	70	30	25	-	125
PEC	MECHPEC-04	Programme Elective Course -IV or MOOCS ##	4	-	-	04	100	-	-	-	100
Project	MECHProject	Capstone Project	-	-	8*	04	-	-	100	100	200
RM	RM	Research Methodology and IPR	3	-	2	04	70	30	25	-	125
MDM	MDM-05	Multidisciplinary Minor-V	2	-	-	02	70	30	-	-	100
		Total	**14**	**-**	**12**	**20**	**380**	**120**	**150**	**100**	**750**

Students should attend MOOCs in 4 hrs., if MOOCs is chosen.

PCC- Programme Core Course, PEC: Programme Elective Courses, RM-Research Methodology, MDM-Multidisciplinary Minor

*Load based on the project groups

MDM – Multidisciplinary Minor: It should be selected from other UG engineering minor program.

List of MOOCs courses related to MECHPEC04 will be provided by BOS time to time

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF SCIENCE & TECHNOLOGY

NEP 2020 Compliant Curriculum of Final Year B. Tech. Mechanical

Engineering With effect from 2026-2027

Semester -VIII

Distribution	*Course Code*	*Name of the Course*	*Engagement Hours*			*Credits*	*FA*	*SA*			*Total*
			L	*T*	*P*		*ESE*	*ISE*	*ICA*	*OE/ POE*	
PCC	MECHPCC-15	Energy Engineering	4#	-	-	04	100	-	-	-	100
PEC	MECHPEC-05	Programme Elective Course-V or MOOCS	4#	-	-	04	100	-	-	-	100
OJT	MECHOJT	On-Job Training	-	-	24	12	-	-	200	100	300
		Total	**8**	**-**	**24**	**20**	**200**	**-**	**200**	**100**	**500**

PCC- Programme Core Course, PEC: Programme Elective Courses, OJT-On job Training

#PCC-15:-Students will practice or attend in Self-Learning mode

#PEC-05: - Students will practice or attend in Self-Learning mode or MOOCS.

List of MOOCs courses related to MECHPEC05 will be provided by BOS time to time

Basket of Programme Elective Course (PEC)

PEC/Sem	Course code and name
MECHPEC - 01/V	MECHPEC – 01A:Metrology and Quality Control MECHPEC – 01B:Internal Combustion Engines MECHPEC – 01C:Product Life cycle Management MECHPEC – 01D:Mechatronics systems
MECHPEC –02/VI	MECHPEC – 02A:Plastic Engineering MECHPEC – 02B: Tool engineering MECHPEC – 02C: Automobile Engineering MECHPEC – 02D: CAD-CAM-CAE
MECHPEC – 03/VI	MECHPEC – 03A:Finite Element Method MECHPEC – 03B: Industrial Engineering MECHPEC – 03C: Power plant and Energy Engineering MECHPEC – 03D: Railway Transportation
MECHPEC – 04/VII **OR**	MECHPEC – 04A: Production and Operation Management MECHPEC – 04B: Supply chain Management MECHPEC – 04C: Industrial Hydraulics and Pneumatics MECHPEC – 04D: Railway systems and Management
MECHPEC – 04/VII	MOOC Courses MECHPEC – 04E: <As per the list provided by BoS>
MECHPEC – 05/VIII **OR**	MECHPEC – 05A: Marketing Management MECHPEC – 05B: Industrial Safety and hazards MECHPEC – 05C: Material Handling System MECHPEC – 05D: Business Economics
MECHPEC – 05/VIII	MOOC Courses MECHPEC – 05E: <As per the list provided by BoS>

A. Multidisciplinary Minor in "Material Science and Energy Engineering"

Semester	Course Code	Course Title
III	MECHMDM-01A	Fundamentals of Material Science and Engineering
IV	MECHMDM-02A	Materials for Technology Development
V	MECHMDM-03A	Advanced Materials and Manufacturing Process
VI	MECHMDM-04A	Renewable Energy Resources
VII	MECHMDM-05A	Energy Conversion Systems

B. Multidisciplinary Minor in "Industrial and Project Management"

Semester	Course Code	Course Title
III	MECHMDM-01B	Industrial Management
IV	MECHMDM-02B	Production and Operation Management
V	MECHMDM-03B	Operation Research
VI	MECHMDM-04B	Project Management
VII	MECHMDM-05B	Marketing Management

A. Honors in Robotics Engineering

Semester	*Course Code*	*Name of the Course*	*Engagement Hours*			*Credits*	*FA*	*SA*			*Total*
			L	*T*	*P*		*ESE*	*ISE*	*ICA*	*OE/ POE*	
III	MechHon - 01A	Industrial Robotics	3	-	2	4	70	30	25	-	125
IV	MechHon - 02A	Machine Vision	3	-	2	4	70	30	25	-	125
V	MechHon - 03A	Industrial Networks and Controllers	2	-	2	3	70	30	25	-	125
VI	MechHon - 04A	Advanced topics in Robotics	3	-	2	4	70	30	25	-	125
VII	MechHon - 05A	Mini Project	1	-	4*	3	-	-	50	-	50
		Total	-	-	-	**18**	**280**	**120**	**150**	-	**550**

*Indicates Contact Hours
Honors Course will be for the students of same Program

B. Honors in Electric Vehicle Engineering

Semester	*Course Code*	*Name of the Course*	*Engagement Hours*			*Credits*	*FA*	*SA*			*Total*
			L	*T*	*P*		*ESE*	*ISE*	*ICA*	*OE/ POE*	
III	MechHon - 01B	Introduction to Automobile Engineering	3	-	2	4	70	30	25	-	125
IV	MechHon - 02B	Introduction to Electric and Hybrid Vehicles	3	-	2	4	70	30	25	-	125
V	MechHon - 03B	Battery Technology and Charging Infrastructure	2	-	2	3	70	30	25	-	125
VI	MechHon - 04B	Advanced topics in Electric Vehicles	3	-	2	4	70	30	25	-	125
VII	MechHon - 05B	Mini project	1	-	4*	3	-	-	50	-	50
		Total				**18**	**280**	**120**	**150**	-	**550**

* Indicates Contact Hours

Honors Course will be for the students of same Program

Honors with Research

Semester	*Course Code*	*Name of the Course*	*Engagement Hours*	*Credits*	*SA*		*Total*
			P		*ICA*	*OE*	
VII	MECHRES-01	Research Project Phase- 01	9 #	9	100	100	200
VIII	MECHRES-02	Research Project during OJT	9 ##	9	100	100	200
		Total	**18**	**18**	**200**	**200**	**400**

Along with 9 hours of engagement hours, 4.5 hours activities for preparation for community engagement and service, preparation of reports, etc.

Along with 9 hours of engagement hours, 4.5 Hrs. activities for preparation for community engagement and service, preparation of reports, etc. and independent reading during On Job Training and preferably related to On Job Training activities

Final Year B.TECH. (Mechanical Engineering)
Semester-VII

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Fourth Year B.TECH. (Mechanical Engineering)
Semester-VII
MECHPCC-13: Automation and Robotics

***Teaching Scheme**
Lectures: 03 Hours/week, 03 Credits

***Examination Scheme**
ESE: 70 Marks
ISE: 30 Marks

Course Introduction:
Automation and Robotics is a course that introduces the principles, technologies and applications of robotic and automated systems used in modern mechanical engineering practice. The course covers the fundamentals of industrial robots, their components and specifications, sensing and actuation systems, robot motion and control, machine vision, work cell integration and major industrial applications. The course emphasizes how mechanical systems are combined with electronics, control and computing to develop efficient and flexible automation solutions for manufacturing and allied industries. Students gain an understanding of how robots are selected, integrated and deployed for tasks such as material handling, assembly, welding, inspection and automated storage.

Course Objectives:
During this course, student is expected to:

1. Introduce the fundamentals, types and key specifications of industrial robots
2. Understand commonly used sensors, actuators and end effectors for robotic applications
3. Develop conceptual understanding of robot kinematics, dynamics and control techniques
4. Become familiar with machine vision systems and basic image processing used in robotics
5. Acquire knowledge of robot work-cell layouts, safety and programming methods
6. Gain exposure to major industrial applications of robotics including ASRS

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

1. Explain the fundamentals, classifications and specifications of industrial robots
2. Select appropriate sensors, actuators and end effectors for given application
3. Interpret basic robot motion using kinematic concepts of Forward & Inverse Kinematics
4. Choose appropriate machine vision components for given application
5. Analyze a robot work-cell layout for effective usage and safety requirements.
6. Propose suitable robotic solutions based on application requirements

Section I

Unit-1: Fundamentals of Robotics **No. of lectures- 06**

History and Evolution of Industrial Robots, Definitions of Industrial Robot & Service Robot as per ISO & IFR

Basic Components of an Industrial Robot, Classification of Robots (by structure only), Specifications of Industrial Robots

Introduction to Collaborative Robots, Industrial Robots vs Collaborative Robots

Concept of Mobile Robots (AGVs & AMRs), Navigation techniques in Mobile Robots, Applications

Unit-2: Sensors, Actuators and End Effectors **No. of lectures- 08**

Sensors: Commonly Used Sensors in Robotics (with working principle & applications) – Encoder, Potentiometer, LVDT, Resolver, Tachometer, Hall Effect Sensor, Strain Gauge, Piezoelectric Sensor, Limit Switch, Pneumatic Switch, Inductive & Capacitive Proximity Sensor, Ultrasonic Sensor, Microwave Sensor, Infra-red Sensor, LASER Sensor, Vision Sensor; Criteria for sensor selection

Actuators: Compare Hydraulic, Pneumatic and Electric actuators; Linear Electric Actuators, DC Motors - Stepper motors & Servo Motors (with applications), Criteria for actuator selection

End Effectors: Introduction to End effectors and grippers; Mechanical, vacuum and magnetic grippers classification, applications, Criteria for End Effector selection

Unit-3: Robot Kinematics and Control **No. of lectures- 06**

Degrees of freedom and coordinate systems, Concept of Forward kinematics, Inverse kinematics, Forward & Inverse Kinematics of 2 DOF planar manipulators, Forward Kinematics of 3 DOF planar manipulators

Dynamics : Introduction to Trajectory Planning, Velocity Jacobian, Singularities

Robot Control : Non-Servo Control, Servo Control (Point to Point and Continuous Path Control), Overview of advanced control techniques - Force control, PID control, Adaptive control

Section II

Unit-4: Machine Vision **No. of lectures- 7**

Machine Vision definition, System Components, Major Applications of Machine Vision,

Common Light Sources, Lighting techniques, Steps in Image Processing, CCD & CMOS Sensors (Working & Comparison), Area Scan Vs Line Scan

Camera specifications, Camera Calibration, Selection Criteria for Machine Vision Camera

Unit-5: Robot Work-cells and Programming Methods **No. of lectures- 7**

Robot work cell concept, Types of Robot Work Cell (Robot Centered, In-Line Robot, Mobile Robot Work Cells), Considerations in work-cell design,

Work Cell Control (Sequence control, Operator interface, Safety monitoring), Work Cell Controllers

Human machine interface (HMI), Types of HMIs, Robot Work Cell Safety

Robot Programming –Robot Programming Languages, Types of Programming – Online Programming (Lead through, walk through), Offline programming

Unit-6: Industrial Applications of Robotics **No. of lectures- 6**

General considerations for selecting robots for any application for - Material handling & Pick-Place, Machine tending, Continuous & Spot Welding, Sealant application, Spray painting, General Assembly, Electronics assembly

Automated Storage and Retrieval Systems (ASRS): Need and functions of ASRS, Components and Terminologies of ASRS, Types of ASRS

Text Books:

1. S.K Saha - Introduction to Robotics, McGraw-Hill.
2. Mikell Groover- Automation, Production Systems and Computer Integrated Manufacturing, Pearson Education.

Reference Books:

1. Amber G.H & Amber P.S. - Anatomy of Automation, PrenticeHall.
2. Asitava Ghosal, Robotics: Fundamental Concepts and Analysis, Oxford Press.
3. Frank Lamb - Industrial Automation_ Hands On, McGraw-Hill Professional.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
MECHPCC-14: Refrigeration and Air Conditioning

***Teaching Scheme**
Lectures: 02 Hours/week, 02 Credits
Practical : 02 Hours/week, 01Credit

***Examination Scheme**
ESE:70Marks
ISE: 30Marks
ICA: 25Marks

Course Introduction:

The course consists of different refrigeration cycles such as Air refrigeration cycle, Vapour Compression cycle, Vapour absorption cycle. It also covers properties of refrigerants and various alternative refrigerants and understanding of psychrometric and psychrometric processes used for the purpose of air- conditioning. Further, the comfort air-conditioning and cooling load calculations are also addressed in this course.

Course Objectives:

During this course, student is expected to:

1. Understand the fundamental principles of refrigeration, thermodynamic cycles, and properties, selection, and environmental impact of refrigerants.
2. Study the working, analysis, and performance evaluation of vapour compression and vapour absorption refrigeration systems.
3. Understand the components, configurations, and applications of HVAC systems used in comfort and industrial air conditioning.
4. Learn the concepts and methods of heating and cooling load estimation for air-conditioning systems.
5. Understand psychrometric properties, processes, and human comfort conditions using charts and tables.
6. Acquire knowledge of air distribution systems, including duct design methods, fans, and pressure losses.

Course Outcomes:

At the end of this course, student will be able to:

1. Apply the fundamental principles of refrigeration and select suitable refrigerants considering necessary properties.
2. Analyze and evaluate the performance of vapour compression and vapour absorption refrigeration systems.
3. Analyze and compare different HVAC system configurations for comfort and industrial air-conditioning applications.
4. Apply standard methods to identify load components and perform heating and cooling load calculations for air-conditioning systems.
5. Analyze air-conditioning processes using psychrometric charts and relations to assess human comfort conditions.
6. Evaluate and design duct systems, compare duct design methods, and assess fan performance for effective air distribution.

Section I

Unit-1:Basics of Refrigeration and Refrigerants **No. of lectures- 5**

A) Thermodynamics
Principles and fundamentals of heat transfer, Refrigeration, Units of refrigeration, Applications of refrigeration, Reversed Carnot cycle with vapour as refrigerant, Calculation of COP (Numerical Treatment).
B) Refrigerants
Classification, Desirable Properties, Nomenclature of Refrigerants, Selection of refrigerant, Secondary refrigerants, Effect on Ozone depletion and Global warming, Total equivalent warming impact (TEWI), Alternative Refrigerants

Unit-2:Vapour Compression Refrigeration Systems **No. of lectures- 5**

Working of a simple vapour compression system, representation of different vapour compression cycle (VCC) on T-s and P-h diagram, Sub-cooling, Superheating, Analysis and Performance calculations of above cycles. Effect of operating parameters on performance of VCC, actual VCC, methods of improving COP, Working of simple vapour absorption system (VAS), Difference between VCRS & VARS.

Unit-3:HVAC Systems **No. of lectures- 5**

Central AC systems, DX systems, Comparison between Central and DX systems, VRF system, Heat recovery systems, Desiccant wheel, Air handling unit, Fan coil unit, Role of HVAC engineer

Section II

Unit-4:Psychrometry **No. of lectures- 6**

A) Introduction
Psychometrics terms, Dalton's law of partial pressure, Psychometrics relations, Enthalpy of moist air, Use of psychometric tables and Charts, Psychometrics Processes, Combinations and Calculations, SHF, BPF, ADP Coil condition line, (Numerical Treatment)
B) Comfort Conditions
Human Comfort Thermodynamics of human body, comfort and comfort chart, factors affecting human comfort, concept of infiltration and ventilation, indoor air quality requirements.

Unit-5:Heating and Cooling Load Calculations **No. of lectures- 5**

Enumeration and brief explanation of the factors forming load on refrigeration and air conditioning systems, Ventilation requirements according to ASHRAE std. 62.1, Design conditions, U-value for different building materials, Cooling load calculations, Load analysis by RSHF, GSHF (Numerical Treatment).

Unit-6:Duct Design **No. of lectures- 4**

Classification of ducts, pressure in ducts, flow through duct, equivalent diameter, Methods of duct system design: equal friction, velocity reduction, static regain method, types of fans used air conditioning applications, fan laws, External Static Pressure (ESP)

Internal Continuous Assessment (ICA):
List of Experiments/Assignments/Case Studies, etc.

A) Group I

1. Study of Refrigeration methods
2. Study of Refrigeration Equipments
3. Study of charging, leak testing of refrigeration systems
4. Case Study (Any One of the following)

    a. Refrigeration and Air-Conditioning systems used in commercial applications

    a. ASHRAE standards for Refrigeration and Air-Conditioning

B) Group II (Any three experiments out of the following)

1. Trial on Refrigeration primer / bench
2. Trial on mini ice plant
3. Trial on Air conditioning tutor
4. Calculation of cooling load for given space drawing

C) Group II (Any one out of the following)

1. Visit to Refrigeration plant or Central Air Conditioning plant
2. Design and CAD Drafting of an HVAC System for a Specified Area

Text Books:

1. Khurmi, R. S., & Gupta, J. K. (2014). Refrigeration and air conditioning. S. Chand Publishing.
2. Arora, C. P. (2010). Refrigeration and air conditioning. Tata McGraw-Hill Education.
3. Arora, C. P., & Domkundwar, S. (2001). Refrigeration and air conditioning. Dhanpat Rai & Co.
4. Sapali, S. N. (2012). Refrigeration and air-conditioning. Tech-Neo Publications.

Reference Books:

1. Dossat, R. J. (2002). Principles of refrigeration (4th ed.). Pearson Education.
2. Jones, W. P. (2001). Air conditioning applications and design. McGraw-Hill Education.
3. Stocker, W. F., & Jones, J. W. (2002). Refrigeration and air conditioning. McGraw-Hill Education.
4. Prasad, M. (2006). Refrigeration and air conditioning. New Age International Publishers.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
MECHPEC–04A: Production and Operation Management

***Teaching Scheme**
Lectures: 04 Hours/week, 04 Credits

***Examination Scheme**
ESE:100Marks

Course Introduction:

Strategic growth & competitiveness of organizations are depending upon the effective utilization of the critical production resources of the organization. Production / operations function is concerned with design & control systems responsible for the productive use of raw materials, human resources, equipment and facilities in the development of a product or services. The syllabus is divided into two sections, each section contains three chapters.

Course Objectives:
During this course, student is expected to:

1. Understand the concepts, objectives, scope, and evolution of Production and Operations Management and different manufacturing systems.
2. Apply forecasting techniques and capacity planning methods for decision-making in production systems.
3. Apply the principles of production planning and control for effective routing, scheduling, loading, sequencing, and line balancing.
4. Apply inventory management models and control techniques to achieve cost-effective inventory operations.
5. Understand plant maintenance concepts, types, reliability, and life testing for improving equipment performance.
6. Understand the principles of value engineering, value analysis, and advanced manufacturing systems for productivity and waste reduction.

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

1. Explain the concepts, objectives, scope, and evolution of Production and Operations Management and classify different manufacturing systems.
2. Apply forecasting techniques and capacity planning methods to solve numerical problems related to production systems.
3. Apply production planning and control techniques such as routing, scheduling, loading, sequencing, and line balancing.
4. Apply inventory control models and techniques including EOQ, EBQ, ABC analysis, and MRP for effective inventory management.
5. Explain maintenance concepts, types, reliability, and life testing, and identify breakdown causes using basic analytical tools.
6. Explain the principles of value engineering, value analysis, and advanced manufacturing systems such as Lean, JIT, Kaizen, Six Sigma, and SCM.

Section I

Unit-1: Introduction to Production and Operation Management **No. of lectures-05**

Introduction to POM- Definitions, objectives, Scope and History of Production Management, Manufacturing system and their types

Unit-2: Forecasting and Capacity Planning **No. of lectures-10**

Forecasting: Need, types of Forecasting, Statistical method, Moving average method, exponential smoothing method, Least square method, Regression and Co-relation method. (Numerical Treatment)

Capacity Planning: Concept, measurement and measures of capacity, factor affecting capacity planning procedure, aggregate planning, Investment decision and replacement analysis. (Numerical Treatment)

Unit-3: Production Planning and Control **No. of lectures-05**

Objectives, Functions, Co-ordination of PPC with other Department, Routing, Scheduling, Loading and Sequencing, Line balancing, Production Control – Dispatching, Function and documents, Follow up, Evaluation.

Section II

Unit-4:Inventory Management **No. of lectures-07**

Inventory concepts, objectives, types of Inventory, different costs of Inventory, EOQ model, Economic batch quantity (EBQ) model, Inventory control techniques, ABC analysis, MRP, Fixed period and fixed quantity system. (Numerical treatment)

Unit-5:Plant Maintenance **No. of lectures-05**

Definition, Need, Importance, Functions, scope and organization of maintenance department. Types of maintenance- preventive, break down, Identification of break down using fishbone diagram, and TPM, Reliability and life testing

Unit-6: Value Engineering and Value Analysis and Advanced manufacturing System **No. of lectures-08**

Value Engineering and Value Analysis-Definition, objectives and use of value analysis, reason of unnecessary cost, value analysis procedure.

Advanced manufacturing System – Lean Manufacturing Basics, Just- In Time (JIT), Kanban System, KAIZAN, Zero defect, six sigma, Supply chain Management.

Text Books:

1. Industrial engineering and Production management by Martand Telsang. (S. Chand)
2. Elements of Production Planning and Control by Samuel. (Universal Pub.)
3. Modern Production/Operation Management by BuffaSarin. (Wiley)
4. Industrial Engineering and Management by O. P. Khanna

Reference Books:

1. Production and Operation Management by M. E. Thukaram Rao. (New Age International Pub)
2. Sunil Chopra and Peter Meindl Strategy, Planning th Edition, 6th Edition Pearson Education Asia, 2016.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
MECHPEC-04B: Supply Chain Management

***Teaching Scheme**
Lectures: 04 Hours/week, 04 Credits

***Examination Scheme**
ESE:100 Marks

Course Introduction:
Supply Chain Management (SCM) involves the planning, organization, coordination, and control of the flow of goods, services, and information from the point of origin to the point of consumption. It plays a critical role in ensuring timely delivery, optimal quantities, and cost-effective operations. This course introduces students to the fundamental concepts and practices of SCM, enabling them to understand supply chain objectives, structures, and decision-making processes. Through this course, students gain essential knowledge and practical tools to effectively manage supply chains and enhance overall operational performance.

Course Objectives:
During this course, student is expected to:

1. Understand the fundamental concepts, types, and drivers of supply chain management.
2. Learn strategies for achieving coordination, trust, and partnerships in supply chains.
3. Develop skills to align supply chain strategy with business objectives.
4. Apply inventory management and modeling techniques for efficient supply chain operations.
5. Understand performance measurement, benchmarking, and evaluation in global supply chains.
6. Learn latest trends and innovations in supply chain management, including green SCM and e-commerce.

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

1. Explain the basic concepts, evolution, and typologies of supply chain management.
2. Analyze coordination challenges and strategies to improve performance in supply chains.
3. Explain how to use supply chain as a competitive advantage and align it with business strategy.
4. Solve inventory and routing problems using quantitative models and forecasting techniques.
5. Evaluate supply chain performance using metrics, benchmarking, and global best practices.
6. Describe current trends and innovations such as e-commerce, outsourcing, and green supply chains.

Section I

Unit-1: Basics of Supply Chain Management **No. of lectures- 07**
Introduction, Definition of Supply Chain Management, Evolution of the Concept of Supply Chain Management, Key Drivers of Supply Chain Management, Typology of Supply Chains, Cycle View of Supply Chain, Types of SCM, Problems in SCM and Suggested Solutions.

Unit-2: Coordination in Supply Chain **No. of lectures- 07**
Importance of Coordination in Supply Chain, Bullwhip Effect, Effect of lack of Coordination on performance, Obstacles to Coordination, Strategies to achieve coordination, Building Strategic Partnership and Trust In Supply Chain

Unit-3: Supply Chain Strategy **No. of lectures- 06**

Supply chain as a competitive advantage, Global Supply chain strategy, Structuring supply chain capabilities, Business matching supply chain design with business strategy

Section II

Unit-4: Inventory Flow modeling **No. of lectures- 07**

Approaches to Inventory Management in Global Supply Chain Management, Distribution Resource Planning, Symptoms of poor Inventory Management, Modeling in Supply chain: inventory models, safety stock determination for service level, and lead time, forecasting models, routing problem

Unit-5: Performance Measurement and Trends **No. of lectures- 07**

Dimensions of Performance Metrics, Approaches/tools for Performance Measurement, Measuring logistics cost and performance. Benchmarking the supply chain, Performance measurement and evaluation in global supply chains, Impediments to improve Performance, Trends in International supply chain management

Unit-6: Recent Trends in Supply Chain Management **No. of lectures- 06**

Introduction, New Developments in Supply Chain Management, Outsourcing Supply Chain Operations, Co-Maker ship, The Role of E-Commerce in Supply Chain Management, Green Supply Chain Management, Distribution Resource Planning, World Class Supply Chain Management.

Text Books:

1. Supply Chain Logistics Management - Bowersox, Closs & Cooper – McGrawHill, 2nd Indian Ed.

2. Sridhar R. Tayur (Editor), Michael J. Magazine (Editor), RAM Ganeshan (Editor) Quantitative Models for Supply Chain Management Kluwer Academic.

Reference Books

1. Douglas Long International Logistics: Global Supply Chain Management Springer Verlag New York, LLC;2004

2. Philippe-Pierre Dornier, Panos Kouvelis, Michel Fender Global Operations and Logistics: Text and Cases Wiley, John & Sons, Incorporated 1998

3. Alan Branch Global Supply Chain Management in International Logistics Routledge 2007

4. Kent N. Gourdin Global Logistics Management: A Competitive Advantage for the New Millennium Blackwell Publishing 2006

Punyashlok Ahilyadevi Holkar Solapur University,Solapur
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
MECHPEC–04C: Industrial Hydraulics and Pneumatics

***Teaching Scheme**
Lectures: 04 Hours/week, 04 Credits

***Examination Scheme**
ESE: 100 Marks

Course Introduction:
This course introduces students to hydraulic and pneumatic systems, focusing on the construction, working, and applications of fluid power components. Students will learn to prepare hydraulic and pneumatic circuit diagrams using ISO standard symbols, and to select components using manufacturer catalogs. The course also familiarizes students with software tools for hydraulic and pneumatic circuit design, enabling practical and industry-relevant skills.

Course Objectives:
During this course, student is expected to:

1. Understand the advantages and limitations of fluid power systems.
2. Become familiar with the construction and function of hydraulic and pneumatic components.
3. Learn to select suitable components for specific applications.
4. Understand the operation of basic hydraulic and pneumatic circuits.
5. Gain knowledge of industrial applications of fluid power systems.
6. Interpret process flow diagrams in hydraulic and pneumatic schematics.

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

1. Choose appropriate hydraulic or pneumatic systems for different applications.
2. Explain the construction and working of system components.
3. Select suitable actuators and devices for specific applications.
4. Draw ISO symbols of hydraulic and pneumatic components.
5. Prepare hydraulic and pneumatic circuit diagrams for various applications.
6. Identify and interpret process flows on hydraulic or pneumatic schematics.

Section I

Unit-1: Introduction to Fluid Power System & Hydraulic Actuators **No. of lectures- 06**

Fluid Power System: Introduction, Types, advantages, limitations & applications. Basic components of Hydraulic system, Hydraulic Actuators- Linear & Rotary, Types, Working, Construction, Cushioning effects, Calculation of velocity & force, Seals & Packing- Types, materials, applications

Unit-2: Pumps, Accumulators, Intensifiers & Valves **No. of lectures- 08**

Pumps- Classification, construction, operation, advantages, applications, Pump performance, Characteristics. System components: Accumulators, Intensifiers, their types, working, applications, Hydraulic Pressure control valves- Direct acting type, pilot operated, sequence, counter balancing, unloading, pressure reducing, Construction & Working, Direction control valves- Types, construction & working, Spool actuation methods, spool centre positions. Flow control valves- Compensated & Non-Compensated, Construction & Working, One way valve. Symbols of above components/ devices.

Unit-3: Hydraulic circuits **No. of lectures- 06**

Simple circuit, Speed control circuits: Meter in, Meter out & bleed off circuits, Regenerative circuit, Sequencing circuit, Counter balancing, Synchronizing, Circuits with accumulator & intensifier

Section II

Unit-4: Introduction to Pneumatic system & Actuators **No. of lectures- 06**

Pneumatic system: Advantages, limitations & applications of pneumatic system, Comparison of hydraulic & pneumatic system, ISO symbols used in pneumatic circuits, pneumatic cylinders and air motors, types, construction and working.

Unit-5: Pneumatic System Elements & Valves **No. of lectures- 08**

Air compressors, types, working, selection criteria, FRL unit, construction and working, Direction control valves, Flow control valves and pressure control valves – types and working, Quick Exhaust valve, time delay valve.

Unit-6: Pneumatic circuits **No. of lectures- 06**

Simple Pneumatic circuits, time delay circuit, Pneumatic clamping system, Pneumatic braking systems, Pneumatic power tools

Text Books:

1. Oil Hydraulics- Principle & Maintenance, S. R. Majumdar, Tata McGraw Hill.
2. Hydraulics and Pneumatics H.L.Stewart – Industrial Press.
3. Pneumatics- Principle & Maintenance, S. R. Majumdar, Tata McGraw Hill.
4. Fluid Power with Applications, Anthony Esposito, Pearson Education.

Reference Books:

1. Eaton-Vickers Industrial Hydraulics Manual.
2. Festo's Manual on Pneumatic Principle, applications.
3. Hydraulics And Pneumatics, Jagadeesha T, Dreamtech Press.

Punyashlok Ahilyadevi Holkar Solapur University,Solapur
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
MECHPEC – 04D: Railway Systems Management

***Teaching Scheme**
Lectures: 04 Hours/week, 04 Credits

***Examination Scheme**
ESE: 100 Marks

Course Introduction:

This course seeks to provide a basic knowledge of railway systems & their management techniques. The first half of the syllabus covers various railway systems like Suspension & Braking Systems, Coupling, Bogie Assembly, HVAC Systems, Drive Train, Traction, and Signal Systems, whereas second half gives ideas about the Vehicle Maintenance and Management followed in railway workshops and manufacturing units also Vehicle Maintenance and Management, Vehicle Safety & Environment and Cutting-edge technologies in railways related issues are highlighted.

Course Objectives:

During this course, student is expected to:

1. Differentiate between various suspension & Braking Systems used in railways.
2. Analyse the design of bogies considering various mechanisms and HVAC systems.
3. Correlate the generation of tractive effort traction and Signal System.
4. Study Track maintenance procedures. Scrap management.
5. Evaluate the impact of traffic composition on the environment and safety considerations in the vehicle.
6. Study the concept of Cutting-edge technologies in railways.

Course Outcomes:

At the end of this course, student will be able to:

1. Explain various working of various suspension & Braking Systems used in railways.
2. Identify the assembly of bogies and the working of various mechanisms used in bogies.
3. Describe the generation of power for the tractive effort through various units and the working of each unit.
4. Classify and Describe the Vehicle Maintenance of Railways.
5. Describe the Vehicle Safety and Environment.
6. State and Explain Cutting-edge technologies in railways.

Section I

Unit-1: Suspension & Braking System **No. of lectures- 08**

Suspension System: Sprung and unsprung mass, types of suspension linkages, types of suspension springs- leaf, coil, air springs, hydro gas, rubber suspension, interconnected suspension, self-leveling suspension (active suspension), damping and shock absorbers, Dampers- Fresh Air Dampers, Diversion Dampers. Suspension systems of Diesel locomotives and effect on tractive effort.

Braking System: Types of brake systems - air brakes, vacuum brakes, dynamic brakes, servo and power braking, ABS, Recuperative braking system. Friction braking, Regenerative braking system, Utilization of generated power, Selection of appropriate braking system. Emergency braking system.

Unit-2: Coupling, Bogie Assembly and HVAC System **No. of lectures- 06**

Railway coupling: Mechanism used to connect rolling stocks, Screw coupler, Janney coupler, CBC Coupler.

Bogie Assembly: Components and design consideration.

HVAC System: Air Conditioning- Heating, Ventilation and cooling, heat exchangers to preheat or precool incoming air. Ventilation Cut-Out Switch, Freeze Protection.

Unit-3: Drive Train, Traction, and Signal **No. of lectures- 06**

Drive train and traction: Power generation units, OHE (Catenary) System, Pantograph electric system, Transformer system, AC to DC conversion- Rectifier. Traction motors, Batteries. Lighting System & Accessories.

Signal System: Signals, Classification of Signals- Manual and Automatic.

Section II

Unit-4: Vehicle Maintenance and Management **No. of lectures- 06**

Introduction, Maintenance Services, Classification of Maintenance/Repairs, Inspection and Maintenance - Records: Inspection and Records of maintenance, Building Inspection Register, Monitoring of Maintenance and Improvement, Duties of Engineering Officials, Water Treatment, Drainage, Sewerage, and Sanitation.

Unit-5: Vehicle Safety & Environment **No. of lectures- 08**

Railway safety: Types of Railway Incidents and Definition of Railway Safety, Significance of Safety in Railway Systems and Differences in Road Safety, Classification of Railway Incidents, Causes of Railway Incidents.

Environment: Natural environment of the railway, Air pollution, soil and water pollution, Ecosystem disturbance, Disturbance of local resident activities, Ground-borne noise, and vibrations. Green Initiatives in railway sectors. Solar Trains. Rainwater harvesting in Railways. Human waste management: Bio toilets, Vacuum toilets.

Unit-6: Cutting-edge technologies in railways **No. of lectures- 06**

Definition and Classification of Cutting-Edge Technologies, Smart Windows, Carbon and Glass Fibers, Laser Railhead Cleaner Systems, Catenary-Free Power Supply of Tramway Systems, Ground power supply systems: The APS system, The Tram Wave system, The PRIMOVE system.

Text Books:

1. Railway Transportation Systems – Design, Construction and Operation, Christos N. Pyrgidis, 2019, CRC Press.
2. Indian Railway Transportation Management, Vinod Pal, Bahri Brothers, (2018) edition 5.
3. A Text Book of Railway Engineering, S.C. Saxena, S.P.Arora, DhanpatRai Publications (p)Ltd.-new Delhi, 2010.

Reference Books:

1. Technology in Rail Transport Management, Prabha Shastri Ranade,ICFAI Books; UK ed. edition (20 October 2009).
2. Indian Railway Maintenance Manual (Works).
3. Indian Railway Track, M. M. Agarwal, Ruby Jubilee.
4. Railway Management and Engineering, V Profillidis, Routledge; 1 edition (29 Nov. 2017).

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
MECHProject: Capstone Project

***Teaching Scheme**
Practical: 08 Hours/week, 04 Credits

***Examination Scheme**
ICA: 100 Marks
POE: 100 Marks

Course Introduction:

Project work in the final year of engineering enables students to apply the knowledge gained through earlier courses to design, develop, and evaluate innovative solutions. The project is expected to address real-life problems related to industry or society. Through project execution, students develop essential professional competencies, including problem-solving ability, the use of modern engineering tools, leadership, ethics, communication skills, project and financial management, teamwork, and lifelong learning.

Course Objectives:

During this course, students are expected to:

1. Understand the fundamental concepts and broad principles of industrial or socially relevant project ideas.
2. Acquire sound technical knowledge related to the selected project topic.
3. Identify and define engineering problems relevant to industry or society.
4. Review state-of-the-art literature and existing solutions related to the problem.
5. Plan, design, implement, and execute engineering solutions systematically.
6. Develop skills in teamwork, communication, ethical practices, and project management.

Course Outcomes:

At the end of this course, students will be able to:

1. Identify and analyse engineering problems related to industry or society.
2. Conduct literature surveys and state-of-the-art studies relevant to the project.
3. Plan and execute project activities using appropriate engineering principles.
4. Design, model, simulate, fabricate, or implement suitable solutions.
5. Test, analyse, and interpret results using appropriate tools and techniques.
6. Prepare technical reports and deliver effective presentations in accordance with professional and ethical standards.

Project Work Components

1. Work Diary: The work diary shall reflect continuous progress and include:
   a) Identification and selection of project topic
   b) Literature survey (journals, conference papers, books, reports)
   c) Feasibility study and problem definition
   d) Design concepts, calculations, models, simulations, or experimental planning
   e) Weekly activities, constraints faced, and future plans
2. Project Execution: Depending on the nature of the project, students are expected to:
   1. Formulate the problem and propose solutions
   2. Design and develop virtual and/or physical models
   3. Perform simulations, experimentation, fabrication, or testing

4. Analyse results and draw logical conclusions

3. Report and Presentation

a) Preparation of a structured project report as per standard format

b) Preparation of PowerPoint presentations highlighting objectives, methodology, results, and conclusions

c) Demonstration of the project wherever applicable

Internal Continuous Assessment (100 Marks)

The final year project shall be evaluated in **two stages only** as follows:

1. Intermediate Review – 50 Marks

Evaluation will be based on:

1. Problem identification and literature survey
2. Work diary maintenance and progress consistency
3. Project planning and methodology
4. Technical understanding of the selected topic
5. Quality of intermediate presentation and ability to respond to questions

2. End Semester Review – 50 Marks

Evaluation will be based on:

1. Completion and depth of project work
2. Design, modelling, simulation, experimentation, or fabrication quality
3. Analysis, results, and conclusions
4. Quality of final report
5. Effectiveness of presentation, demonstration, and defence of the project

PROJECT REPORT FORMAT

Front Cover Page (Font Size: 16–18)

Title of the Project, Academic Year, Degree and Branch, Names of Students, Guide Name, Department Name, Institute Name and Address

Certificate (Font Size: 14)

Certification of successful completion of the project work, duly signed by the Project Guide, Head of the Department, and Principal.

Acknowledgement (Font Size: 14)

Expression of gratitude to the guide, department, institution, and others who contributed to the successful completion of the project.

Abstract (Font Size: 12)

A brief summary of the project including the problem statement, methodology, tools used, and key outcomes.

Table of Contents / List of Figures / List of Tables (Font Size: 12)

Chapter 1: Introduction (Chapter Title: 16 | Text: 12)

1. Background and importance of the project
2. Problem identification
3. Objectives and scope of the project

Chapter 2: Literature Review (Chapter Title: 16 | Text: 12)

1. Review of relevant journals, conference papers, books, and previous work
2. Identification of research gaps

Chapter 3: Methodology / Design / Experimentation (Chapter Title: 16 | Text: 12)

1. Project methodology
2. Design calculations, flowcharts, or block diagrams
3. Tools, software, and materials used

Chapter 4: Implementation and Testing (Chapter Title: 16 | Text: 12)

1. Model development (virtual/physical)
2. Experimental setup or simulation procedure
3. Testing methods and observations

Chapter 5: Results and Discussion (Chapter Title: 16 | Text: 12)

a) Result analysis using tables and graphs
b) Discussion and interpretation of results

Chapter 6: Conclusion and Future Scope (Chapter Title: 16 | Text: 12)

1. Summary of work carried out
2. Conclusions drawn
3. Scope for future improvements

References (Font Size: 12)

1. Books, journals, and research papers cited in standard format

Appendix (if any) (Font Size: 12)

1. Additional data, drawings, or calculations

General Formatting Guidelines

1. Font: Times New Roman
2. Line Spacing: 1.5
3. Paper Size: A4
4. Margins: Left – 1.5", Right – 1", Top – 1", Bottom – 1.32"
5. Page Numbers: Footer, Right Aligned (Font Size: 10)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Third Year B.TECH. (Mechanical Engineering)
Semester-VII
MECHMDM-05A: Energy Conversion Systems

***Teaching Scheme**
Lectures: 02 Hours/week, 02 Credits

***Examination Scheme**
ESE:70Marks
ISE: 30Marks

Course Introduction:
Energy Conversion Systems is a course that deals with the principles and applications of converting various forms of energy into useful mechanical and electrical power. The course provides comprehensive knowledge of conventional power generation systems such as steam, gas turbine, internal combustion engine, and nuclear power plants, along with emerging renewable energy conversion technologies.

Emphasis is placed on thermodynamic cycles, system components, performance analysis, efficiency improvement methods, and environmental aspects of power generation. The course also introduces sustainable energy solutions through renewable energy systems, enabling students to understand current energy challenges and future technological trends. This course equips students with the analytical ability to evaluate different energy conversion systems and supports their preparedness for careers in power generation, energy management, design, and higher studies.

Course Objectives:
During this course, student is expected to:

1. Introduce students to the fundamentals of energy resources and basic principles of energy conversion systems
2. Develop understanding of steam power plants, Rankine cycle and their components with performance analysis.
3. Explain and analyze gas turbine and combined cycle power plants using Brayton cycle concepts.
4. Provide knowledge of internal combustion engine power plants, their performance characteristics and emission aspects.
5. Familiarize students with nuclear energy conversion, reactor types, safety measures and waste disposal methods
6. Create awareness of renewable energy conversion systems and enable evaluation of sustainable energy solutions

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

1. Explain fundamental principles of energy conversion and classify various energy resources.
2. Analyze the working and performance of steam power plants and Rankine cycle systems.
3. Evaluate gas turbine and combined cycle power plants using Brayton cycle concepts
4. Compare and analyze IC engine power plants with respect to performance, efficiency and emissions
5. Explain nuclear energy conversion systems, reactor types, safety aspects and waste management
6. Assess renewable energy conversion systems and select suitable systems for sustainable applications

Section I

Unit-1: Introduction to Energy Conversion **No. of lectures- 05**

Energy resources: renewable and non-renewable, Basic principles of energy conversion, Energy conversion efficiency and losses, Thermodynamic laws applied to energy conversion systems, Direct and indirect energy conversion, Overview of power generation systems.

Unit-2: Steam Power Plants **No. of lectures- 05**

Layout and working of steam power plant, Rankine cycle and its modifications, Boilers: types, mountings and accessories, Steam turbines: impulse and reaction turbines, Condensers and cooling towers, Performance and efficiency of steam power plants

Unit-3: Gas Turbine and Combined Cycle Power Plants **No. of lectures- 05**

Gas turbine power plant: layout and working, Brayton cycle and its modifications, Components: compressors, combustion chamber, turbines, Regeneration, intercooling and reheating, Combined cycle power plants, Applications and performance analysis

Section II

Unit-4: Internal Combustion Engine Power Plants **No. of lectures- 05**

IC engine power plant layout and working, Diesel and petrol power plants, Performance characteristics of IC engines, Governing and cooling systems, Supercharging and turbocharging, Environmental aspects and emissions

Unit-5: Nuclear Power Plants **No. of lectures- 05**

Principles of nuclear energy conversion, Nuclear fission and fusion, Types of nuclear reactors, Components of nuclear power plants, Shielding, safety and waste disposal, Advantages, limitations and applications

Unit-6: Renewable Energy Conversion Systems **No. of lectures- 05**

Solar energy conversion: solar thermal and photovoltaic systems, Wind energy conversion systems, Hydroelectric power plants, Biomass and biogas energy systems, Geothermal and tidal energy, Comparative study of renewable energy sources

Text Books:

1. Goswami, D., & Kreith, F.. Energy conversion. Publisher.
2. Ganesan, V. Fundamentals of internal combustion engines. Publisher.
3. Rajput, R. K. Power plant engineering. Laxmi Publications.
4. Singh, S. N. Non-conventional energy sources. Pearson.
5. Rajput, R. K. Engineering thermodynamics. Laxmi Publications.

Reference Books:

1. Nag, P. K.. Power plant engineering. Tata McGraw-Hill.
2. El-Wakil, M. M. Power plant technology. McGraw-Hill.
3. Tiwari, G. N., & Ghosal, M. K. Fundamentals of renewable energy systems. Publisher.
4. Lee, J. C. Nuclear reactor physics and engineering. Publisher.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Third Year B.TECH. (Mechanical Engineering)
Semester-VII
MECHMDM-05B: Marketing Management

***Teaching Scheme**
Lectures: 02 Hours/week, 02 Credits

***Examination Scheme**
ESE:70Marks
ISE: 30Marks

Course Introduction:
Marketing Management is the study of planning, organizing, and controlling marketing activities to satisfy customer needs and achieve organizational goals.
This course introduces key concepts such as market analysis, consumer behavior, product planning, pricing, promotion, and distribution strategies.
It helps students understand how businesses create value, build strong customer relationships, and compete effectively in dynamic markets**.**

Course Objectives:
During this course, student is expected to:

1. Understand the basic concepts, scope, and philosophies of marketing and differentiate marketing from selling.
2. Analyze the internal and external factors affecting marketing and their impact on managerial decisions.
3. Learn to segment markets, target customers, and position products effectively using the STP framework.
4. Understand and apply pricing strategies and distribution channel management to achieve organizational goals.
5. Gain knowledge of consumer behavior, decision-making process, and factors influencing buying behavior.
6. Learn to conduct marketing research and apply e-marketing strategies for effective market outreach.

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

1. Explain marketing concepts, philosophies, and key elements of marketing.
2. Analyze marketing environment factors and their influence on decision-making.
3. Apply the STP framework to identify and serve target markets effectively.
4. Develop and evaluate pricing and channel strategies for competitive advantage.
5. Analyze consumer behavior and decision-making models for product planning and marketing strategies.
6. Conduct marketing research and implement e-marketing strategies for improved market performance.

Section I

Unit-1: Introduction **No. of lectures- 5**

Introduction: Concept and Scope of Marketing, Key customer market, Elements of Marketing - Needs, Wants, Demands, Marketing concepts: Holistic Marketing , Relationship Marketing , Integrated Marketing, Performance Marketing, Marketing Vs. Selling

Unit-2: Marketing Environment **No. of lectures- 5**

Marketing Environment: Marketing Environment: Internal and External, Factors Affecting Marketing Environment, Functions of Marketing Management

Unit-3: Segmentation, Targeting and Positioning **No. of lectures-5**

The STP process, Concept of Market Segmentation, Benefits of Market Segmentation, Requisites of Effective Market Segmentation, Process of Market Segmentation, Bases for Segmenting Consumer Markets, Targeting strategies, Positioning concept and strategies.

Section II

Unit-4: Pricing and Channel **No. of lectures-5**

Pricing Objectives Pricing:- Pricing objectives – Setting and modifying the price – Initiating price changes and responding to price changes .Distribution Channel Management, the role of marketing channels, channel-design decisions, channel-management decisions, Types of conflict, causes of channel conflicts.

Unit-5: Consumer market & consumer Decision Process **No. of lectures- 5**

Various factors influencing consumer behavior: culture factors , social factors, personal factors. The buying decision Process: The Five-stage Model, Problem recognition; search and evaluating; purchasing processes; post purchase behaviour; consumer behaviour models

Unit-6: Marketing Research & E-Marketing **No. of lectures- 5**

Meaning and scope of Marketing Research, Marketing Research process, Meaning of e-marketing, Objectives, Importance and advantages of e-marketing, e-retailing practices, On-line merchandising, Marketing through Social Channels.

. **Text Books:**

1. Kotler Philip, Keller Kevin, Koshy Abraham & Jha Mithileshwar, MARKETING MANAGEMENT – A South Asian Perspective – Pearson Education
2. Ramaswamy V.S. & Namakumari S, MARKETING MANAGEMENT – Global Perspective, Indian context – MacMillan 4th edition
3. Rajan Saxena - MARKETING MANAGEMENT – Tata McGraw Hill – 4th edition
4. Kotler Philip & Armstrong Gary, Principles of Marketing – Pearson Prentice Hall

Reference Books:

1. Etzel, MJ, BJ Walkerand William J Stanton., Marketing (Fourteenth Edition). McGraw Hill, 2007.
2. Neelamegham, S., Marketing in India: Text and Cases (4/e). Vikas Publishing House, 2012.
3. Panda, Tapan K., Marketing Management: Text and Cases Indian Context. Excel Books India, 2009.

Final Year B.TECH. (Mechanical Engineering)
Semester-VIII

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Final Year B.TECH. (Mechanical Engineering)
Semester-VIII
MECHPCC-15: Energy Engineering

***Teaching Scheme**
Lectures: 04 Hours/week, 04 Credits

***Examination Scheme**
ESE:100Marks

Course Introduction:
This course on Energy Engineering introduces students to the fundamental concepts of energy resources, energy demand, and environmental considerations, with a focus on both renewable and non-renewable energy systems. It covers the global and Indian energy scenario, highlighting energy consumption patterns, resource availability, and the challenges of energy crises. Students will explore renewable sources such as biogas, solar, wind, and tidal energy, as well as conventional non-renewable sources including coal, oil, natural gas, and geothermal energy, and their relevance to sustainable engineering practices. The course also addresses the environmental impacts of energy generation, including global warming, pollution, and carbon footprint, and introduces Environmental Impact Assessment (EIA) methods for evaluating and mitigating these effects. Finally, students will learn energy audit and management techniques, gaining practical knowledge for optimizing energy use, improving efficiency, and planning sustainable energy systems in industrial and commercial applications.

Course Objectives:
During this course, student is expected to:

1. Understand global and Indian energy resources, consumption patterns, and challenges.
2. Learn the types, potential, and applications of renewable energy sources.
3. Understand conventional energy sources and their relevance to mechanical engineering.
4. Understand the environmental consequences of energy generation and sustainability concepts.
5. Learn the objectives, process, and application of EIA in energy projects.
6. Understand energy audit principles and energy management techniques for efficiency improvement.

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

1. Explain energy needs, consumption trends, and the energy crisis in India and worldwide.
2. Identify renewable energy systems and evaluate their suitability for practical applications.
3. Compare non-renewable energy sources and analyze their advantages, limitations, and environmental impact.
4. Explain key environmental impacts, including global warming, pollution, and carbon footprint, and suggest mitigation measures.
5. Apply EIA procedures to evaluate environmental impacts and propose mitigation measures for energy systems.
6. Conduct energy audits and apply energy management strategies to optimize energy use in mechanical systems.

Section I

Unit-1:Energy Overview and Indian Scenario **No. of lectures-06**

Global energy, Environmental resources, Energy needs, Indian scenario- Energy consumption, Needs and crisis

Unit-2: Renewable Sources of Energy **No. of lectures-08**

Biogas (types, factors affecting, community biogas plant); Solar Energy (introduction, utilization, merits & demerits, potential); Wind Energy (site selection, potential & scope); Tidal Energy (site suitability, types)

Unit-3: Non- Renewable Sources of Energy **No. of lectures-06**

Energy from Coal & Oil (introduction, merits & demerits); Natural Gas & Geothermal Energy (introduction, merits & demerits); Relevance to other branches, Green building

Section II

Unit-4: Environmental Impacts **No. of lectures-07**

Global warming, Greenhouse effect, Acid rain, Ozone depletion, Air and water pollution due to energy generation, Carbon footprint of energy sources, Environmental regulations and standards, Environmental sustainability concepts in power generation

Unit-5: Environmental Impact Assessment (E.I.A.) **No. of lectures-07**

Objectives, General EIA process, Screening, Scoping, Baseline data collection, Impact prediction and evaluation, Mitigation measures, Public consultation, EIA report preparation, Capability & limitations of EIA, Case studies of EIA in energy projects

Unit-6: Energy Audit and Management **No. of lectures-06**

Definition and objectives, Types and general guidelines for energy audit, Principles of energy management, Energy planning

Text Books:

1. Non-Conventional Energy Sources - G. D. Rai, Khanna Publishers, 5th Edition, 2014.
2. Solar Energy and Non-Conventional Energy Sources - Dr. V. M. Domkundwar, Dhanpar Rai & Co. Ltd., 1st Edition, 2010.
3. Non-Conventional Energy Sources - R. K. Singal, Katson Publication, 2nd Edition, 2009

Reference Books:

1. Renewable Energy Resources - John Twidell and Tony Weir, Routledge Publication, 2nd Edition,2005.
2. Solar Energy - Dr. S. P. Sukhatme, McGraw Hill Publication, 2nd Edition, 2005.
3. Non-Conventional Resources of Energy- G. S. Sawhney, PHI Publication, 5th Edition, 2010.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Last Year B.TECH. (Mechanical Engineering)
Semester-VIII
MECHPEC-05A: Marketing Management

***Teaching Scheme**
Lectures: 04 Hours/week, 04 Credits

***Examination Scheme**
ESE:100Marks

Course Introduction:
This course on Marketing Management introduces students to the principles, processes, and tools of modern marketing. It covers the basics of marketing, including core concepts, the marketing environment, and marketing planning. Students will learn about market segmentation, targeting, and positioning, and understand consumer behavior and factors influencing buying decisions. The course also addresses the marketing mix elements: product strategies including product mix, branding, and packaging; pricing policies and methods; distribution channels and strategies; and promotion techniques such as advertising and publicity. Through this course, students will develop analytical and managerial skills to design effective marketing strategies, make informed decisions, and understand the role of marketing in creating customer value and achieving competitive advantage.

Course Objectives:
During this course, students are expected to:

1. Understand the fundamental concepts of marketing and analyze the marketing environment.
2. Understand market segmentation, targeting, and positioning for effective marketing.
3. Understand factors influencing consumer behavior and decision-making.
4. Understand product strategies, branding, packaging, and product life cycle concepts.
5. Understand pricing and distribution strategies and their application in marketing.
6. Understand promotion tools including advertising and publicity for effective market communication.

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

1. Explain the core concepts of marketing, differentiate marketing from sales, and analyze the marketing environment.
2. Identify consumer and industrial market segments, select target segments, and analyze positioning strategies.
3. Analyze consumer buying roles, evaluate decision processes, and explain factors affecting purchases.
4. Evaluate product mix, analyze branding and packaging decisions, and apply PLC concepts in marketing strategies.
5. Apply pricing methods, select appropriate distribution channels, and analyze place and pricing strategies.
6. Design and analyze promotional plans using advertising, publicity, and media strategies.

Section I

Unit-1: Basics of Marketing **No. of lectures- 8**

Introduction: Nature & scope of marketing, the core concepts of marketing, marketing in 21st century, marketing environment: Micro and Macro marketing environment, Marketing Planning and Marketing Planning process, Differentiation between Sales and Marketing. Introduction to Services marketing

Unit-2: Market segmentation **No. of lectures- 6**

Market segmentation-Meaning and concept, benefits of segmentation, Bases for market segmentation consumer goods market segmentation; industrial goods market segmentation, Market targeting. Selection of segments, Product positioning.

Unit-3: Consumer Behaviour **No. of lectures- 6**

Consumer Behaviour-Meaning and definition of Consumer behaviour, importance, Different buying roles, Consumer buying decision process, factors influencing consumer behaviour

Section II

Unit-4: Product Mix, Branding and Packaging **No. of lectures-8**

Product Mix: concept of product, product characteristics, intrinsic and extrinsic, product life cycle (PLC) concept, product elimination, product diversification, new product development.
Branding and packaging, decisions-concept of branding and packaging, advantages and disadvantages of branding and packaging, features and functions of packaging

Unit-5: Price Mix and Place Mix **No. of lectures- 8**

Price mix: Meaning, elements, importance of price mix, Factors influencing pricing. pricing methods and recent trends, price determination policies.
Place mix: meaning and concept of channel of distribution. Types of channel of distribution or intermediaries, factors influencing selection of channels, types of distribution strategies, intensive, selective and extensive, recent changes in terms of logistics and supply chain management.

Unit-6: Promotion Mix **No. of lectures- 4**

Promotion mix: meaning, elements of promotion mix, advertising: definition, importance, limitations, types of media, 5 M's of advertising. Distinction between advertising and publicity

Text Books:

1. Marketing Management-Ramswamy V. S., Namakumari S., Macmillan Publishers India Ltd.
2. Marketing Management-Raj an Saxena, Tuta McGrawHill.
3. Marketing Management: Text and Cases-Tapan Panda, Excel Books. Marketing Etzel, Walker B., Stanton W., Pandit A., Tata McGraw Hill.
4. Marketing Management- Karunakam K-Himalaya Publication, New Delhi.

Reference Books:

1. Etzel, MJ, BJ Walker and William J Stanton., Marketing (Fourteenth Edition). McGraw Hill, 2007.
2. Neelamegham, S., Marketing in India: Text and Cases (4/e). Vikas Publishing House, 2012.
3. Panda, Tapan K., Marketing Management: Text and Cases Indian Context. Excel Books India, 2009.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Final Year B.TECH. (Mechanical Engineering)
Semester-VIII
MECHPEC–05B: Industrial Safety and Hazards

***Teaching Scheme**
Lectures: 04 Hrs/week, 04 Credits

***Examination Scheme**
ESE:100Marks

Course Introduction:
Industrial Safety and Hazards is a fundamental course designed to create awareness about safety practices, hazard identification, and risk prevention in industrial environments. The course introduces students to various types of industrial hazards such as mechanical, electrical, chemical, fire, and health hazards, along with their causes and preventive measures. Emphasis is given to accident prevention, use of personal protective equipment (PPE), fire safety, and safe handling of machines and materials**.**

Course Objectives:
During this course, student is expected to:

1. Understand the importance of industrial safety, causes of accidents, and the role of safety management in industries.
2. Identify mechanical and electrical hazards and apply appropriate safety devices and preventive measures.
3. Explain fire and explosion hazards and demonstrate knowledge of fire prevention and fire-fighting techniques.
4. Explain fire and explosion hazards and demonstrate knowledge of fire prevention and fire-fighting techniques.
5. Perform hazard identification and risk assessment using standard safety analysis methods.
6. Interpret industrial safety legislation and apply safety management practices to ensure a safe working environment.

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

1. Explain the fundamentals and importance of industrial safety and accident prevention.
2. Identify mechanical and electrical hazards and recommend suitable safety measures.
3. Describe fire and explosion hazards and apply appropriate fire-fighting techniques.
4. Analyze chemical and occupational health hazards and select appropriate personal protective equipment (PPE).
5. Conduct hazard identification and risk assessment using standard safety tools and techniques.
6. Apply industrial safety legislation and safety management principles to maintain a safe working environment.

Section I

Unit-1: Introduction to Industrial Safety **No. of lectures-06**
Importance of industrial safety, Accident: causes, types, and prevention, Safety organization and responsibilities, Safety rules, regulations, and standards, Role of safety engineer

Unit-2: Mechanical and Electrical Hazards **No. of lectures-07**
Mechanical hazards in machines and equipment, Types of machine guarding and safety devices, Electrical hazards, shocks, and burns, Earthing, insulation, and protective systems, Electrical safety practices

Unit-3: Fire and Explosion Hazards **No. of lectures-07**

Fire triangle and types of fire, Causes of industrial fires and explosions, Fire detection and alarm systems

Fire extinguishers and fire-fighting methods, Fire safety planning and evacuation

Section II

Unit-4: Chemical and Industrial Health Hazards **No. of lectures-07**

Chemical hazards and toxic substances, Exposure limits and health effects, Handling, storage, and disposal of chemicals, Personal Protective Equipment (PPE), Occupational diseases and prevention

Unit-5: Hazard Identification and Risk Assessment **No. of lectures-07**

Types of hazards (physical, chemical, biological, ergonomic), Hazard identification techniques, Risk assessment and risk control measures, Safety audits and inspections, Job Safety Analysis (JSA)

Unit-6: Industrial Safety Management and Legislation **No. of lectures-06**

Safety management systems, Safety training and safety culture, Accident investigation and reporting, Indian Factories Act and safety legislation, Role of government and regulatory bodies

Text Books:

1. Industrial Safety, Health and Environment Management Systems – R.K. Jain & Sunil S. Rao (Khanna Publishers)
2. al Safety Management: Hazard Identification and Risk Control – L. M. Deshmukh (McGraw-Hill)
3. Industrial Safety Engineering – Kailas Sree
4. Occupational Health and Safety at Work – Dr. A. M. Sarma (Himalaya Publishing House)
5. Industrial Health and Safety Management – Himalaya Publishing House

Reference Books

1. Lees' Loss Prevention in Process Industries – F. P. Lees
2. Safety at Work – John Ridley & John Channing
3. Techniques of Safety Management – Dan Petersen
4. Industrial Accident Prevention – Heinrich H.W.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Final Year B.TECH. (Mechanical Engineering)
Semester-VIII
MECHPEC-05C: Material Handling Systems

***Teaching Scheme**
Lectures: 04 Hours/week, 04 Credits

***Examination Scheme**
ESE:100 Marks

Course Introduction:
This course provides a comprehensive overview of material handling systems used in modern manufacturing and logistics. It covers fundamentals, equipment types, and mechanics-based design of handling systems, including load dynamics and power estimation. Students are introduced to automation and control using sensors, PLCs, and integrated systems, along with modern technologies such as IoT, AI, and Industry 4.0.

Course Objectives:

During this course, student is expected to:

1. Grasp the core principles, classifications, and operational roles of material handling systems
2. Identify and classify material handling equipment
3. Apply mechanics principles to analyze load dynamics, perform power calculations
4. Create control strategies for automated systems
5. Leverage IoT, AI, and Industry 4.0 principles to enhance and optimize material handling processes
6. Assess advanced technologies, sustainability practices, and emerging trends

Course Outcomes:

At the end of this course, student will be able to:

1. Explain the fundamentals, classifications, and principles of material handling systems and their role in industrial operations.
2. Identify, classify, and select appropriate material handling equipment based on load, environment, and operational needs.
3. Analyze and design material handling systems using mechanics principles, including load dynamics and power calculations.
4. Develop control strategies for automated material handling using sensors, PLCs, and integration tools.
5. Apply modern technologies like IoT, AI, and Industry 4.0 concepts to optimize material handling processes.
6. Evaluate advanced and sustainable material handling innovations, including future trends, for real-world implementation.

Section I

Unit-1: Introduction to Material Handling **No. of lectures-06**

Fundamentals of material handling: definitions, objectives, scope, and classification (manual, mechanical, automated). Role in manufacturing and logistics, basic principles of unit load and flow patterns.

Unit-2: Material Handling Equipment **No. of lectures-07**

Types and selection criteria for equipment: conveyors (belt, chain, screw, roller), elevators, cranes, hoists, trucks, and AGVs. Design considerations, capacity calculations, and performance evaluation.

Unit-3: Design Principles and Analysis **No. of lectures-07**

Load analysis, stress-strain in handling systems, power requirements, and efficiency metrics. Kinematics and dynamics of handling mechanisms, including force, torque, and energy calculations using basic mechanics.

Section II

Unit-4: Automation and Control Systems **No. of lectures-07**

Sensors, actuators, PLCs, and SCADA for material handling. Automated storage/retrieval systems (AS/RS), robotic arms, and integration with manufacturing execution systems (MES).

Unit-5: Modern Technologies in Material Handling **No. of lectures-06**

IoT-enabled systems, RFID/barcode tracking, AI for predictive maintenance, and machine learning for route optimization. Case studies on Industry 4.0 applications like smart warehouses.

Unit-6: Advanced Systems and Future Trends **No. of lectures-07**

Autonomous mobile robots (AMRs), drone-based handling, hyperloop logistics concepts, and sustainable practices (energy-efficient systems, recycling integration). Emerging tech like blockchain for supply chain traceability.

Text Books:

1. Introduction to Materials Handling" by Siddhartha Ray, New Age International Publishers, 2nd Edition, 2013.
2. Ergonomic Design for Material Handling Systems" by Karl H.E. Kroemer, CRC Press, 1997.
3. Materials Handling: Principles and Practice" by John M. Appleby, CBS Publishers, reprint.
4. Materials Management & Materials Handling" by S.C. Sharma, Khanna Publishers.
5. Automated Guided Vehicle in Material Handling for Industry 4.0 Plants", chapter in handbook, CRC Press, 2021.

Reference Books

1. Materials Handling Handbook" (2nd Edition) edited by Raymond A. Kulwiec, John Wiley & Sons, 1991.
2. Industry 4.0 for Manufacturing Systems: Concepts, Technologies, and Applications" by K. Ganesh Wankhede et al., CRC Press, 2025.
3. Design and Selection of Bulk Material Handling Equipment and Systems" (Volumes I & II) by Peter Hilgraf and Susan M. Moore, Society for Mining, Metallurgy & Exploration.
4. Materials Handling Equipment" by N.F. Rudenko, Peace Publishers.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Final Year B.TECH. (Mechanical Engineering)
Semester-VIII
MECHPEC–05D: Business Economics

***Teaching Scheme**
Lectures: 4 Hrs/week, 04 Credits

***Examination Scheme**
ESE: 100Marks

Course Introduction:

In today's world, knowledge of Economics is necessary for everybody in all walks of life. In the days of globalization and free economy, every engineer in any discipline and any businessman must have the knowledge of fundamental concepts of economics to take correct decisions for any firm or business. With this purpose, the course covers various concepts of demand, supply, cost and cost estimation, time value of money, make or buy decisions, elementary economic analysis, project management life cycle, value analysis and value engineering.

Course Objectives:

During this course, student is expected to:

1. Analyze factors affecting demand and supply
2. Determine various costs and total cost, apply break even analysis.
3. Calculate worth using different techniques in time value of money.
4. Take correct decisions regarding make or buy, process or design modifications based on elementary economic analysis.
5. Carry out better maintenance; take appropriate decisions regarding replacement of assets.
6. Prepare project appraisals and compare various alternatives on economic basis, apply value analysis and value engineering for a product.

Course Outcomes:

At the end of this course, student will be able to:

1. Analyze factors affecting demand and supply.
2. Determine various costs and total cost, apply break even analysis.
3. Calculate worth using different techniques in time value of money.
4. Take correct decisions regarding make or buy, process or design modifications based on elementary economic analysis.
5. Carry out better maintenance; take appropriate decisions regarding replacement of assets
6. Prepare project appraisals and compare various alternatives on economic basis, apply value analysis and value engineering for a product.

Section-I

Unit-1: Fundamentals of Business Economics **No. of lectures- 08**

Definition of Economics, Definition and scope of Business Economics, major topics in Engineering Economics, importance of economics in a business, concept of efficiency, Theory of Demand, Law of demand, determinants of demand, Price Elasticity of Demand, profit and loss, total revenue, average revenue, marginal revenue, Income Elasticity of Demand, Cross Price Elasticity of Demand, Supply and law of Supply, relationship between demand and supply, Market equilibrium, Indifference Curves, Welfare Analysis

Unit-2: Costs, Cost Estimation and Break Even Analysis **No. of lectures- 07**

Concept of Cost, difference between cost and price, types of costs, implicit and explicit costs in a business or a firm, historical and current costs, sunk and incremental costs, fixed and variable costs, long run and short run costs, Elements of cost, direct and indirect costs, material cost, labour cost, prime cost, overheads, factory cost, production cost, total cost, Break Even Analysis, Profit/Volume ratio, applications

Unit-3: Time Value of Money **No. of lectures- 05**

Time Value of Money, inflation, causes, consequences and control of inflation, interest formulae and their applications, cash flow diagram, present worth method, future worth method, annual equivalent or annuity method, E.M.I., rate of return method, applications of these to determine worth.

Section-II

Unit-4: Make or Buy Decision and Elementary Economic Analysis **No. of lectures- 08**

Make or Buy decisions, importance in a business, factors affecting make or buy decision, various aspects of make or buy decision, break-even point in make or buy decision, elementary economic analysis, material selection for a product, raw material selection and substitution, design selection and modification, process selection and modification, engineering and economic approach

Unit-5: Maintenance Management and Replacement **No. of lectures- 06**

Maintenance and its importance, objectives of plant maintenance, types of maintenance practices, cost of maintenance, types and causes of failure, strategies to prevent them, planned and unplanned maintenance, preventive and breakdown maintenance, routine maintenance, predictive maintenance, opportunistic maintenance, design out maintenance, condition based monitoring and modern techniques, need of replacement of an asset, defender and challenger, replacement decision, lives of an asset - economic life, useful life, physical life, ownership life

Unit-6: Project Management Life Cycle and Value Engineering **No. of lectures- 06**

Project, various definitions of project, features of a project, importance of projects in a firm or business, types of projects, project management life cycle and its block diagram, project appraisals - technical appraisal, financial appraisal, economic appraisal, social appraisal, market appraisal, ecological appraisal, value of a product, types of values, performance of a product, functions of a product, value analysis, phases of value analysis, value engineering, aims of value engineering, value engineering procedure, applications of value engineering and value analysis

Text Books:

1. Fundamentals of Engineering Economics: Pravin Kumar, Wiley India Pvt. Ltd., New Delhi.
2. Engineering Economics, R. Panneerselvam: PHI Learning Pvt. Ltd., Delhi.
3. Industrial Engineering and Production Management: MartandTelsang, S. Chand & Company Pvt. Ltd., Delhi.

Reference Books:

1. Managerial Economics: Varshney and Maheshwari, Sultan Chand & Sons, New Delhi.
2. Principles of Engineering Economic Analysis: John White, Kenneth Case, David Pratt, Wiley India Pvt. Ltd., New Delhi.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Final Year B.TECH. (Mechanical Engineering)
Semester-VIII
MECHOJT: On Job Training

Teaching Scheme
Practical : 24 Hours/week, 12 Credits

Examination Scheme
ICA: 200 Marks
OE: 100 Marks

Course Introduction:

The On-Job Training (OJT) course provides final-year Mechanical Engineering students with practical exposure to real-world industrial environments. It bridges the gap between theoretical knowledge and industrial practice, enabling students to understand manufacturing processes, production systems, design applications, and operational workflows. During this training, students observe, participate, and apply engineering principles in actual work scenarios, gaining hands-on experience in equipment, tools, and organizational processes. The course enhances professional skills such as problem-solving, teamwork, time management, and technical communication, preparing students for successful careers in mechanical engineering, design, production, and operations management.

Course Objectives:

During this course, student is expected to:

1. Understand real-world industrial operations, workflows, and production processes.
2. Apply theoretical mechanical engineering knowledge to practical industrial tasks.
3. Develop skills in observing, analyzing, and documenting industrial processes.
4. Gain hands-on experience with mechanical equipment, tools, and machinery.
5. Learn professional skills such as teamwork, communication, and problem-solving in an industrial environment.
6. Understand safety, quality standards, and efficiency practices in mechanical engineering operations.

Course Outcomes:

At the end of this course, student will be able to:

1. Explain the functioning and workflow of industrial processes observed during training.
2. Apply mechanical engineering principles to solve practical industrial problems.
3. Analyze and document industrial operations, processes, and improvements.
4. Demonstrate proficiency in using mechanical tools, equipment, and software in industrial applications.
5. Exhibit effective communication, teamwork, and professional behavior in an industrial setting.
6. Evaluate safety practices, quality measures, and efficiency standards, suggesting improvements where necessary.

Report Format as per AICTE Internship Policy:

Daily Diary / Log

Students must maintain a daily record during training. It should include:

Date & Duration of Work
Tasks Assigned
Processes/Tools Used
Observations & Learnings
Sketches / Process Flow / Photos where applicable

Final Training Report

The training report should contain:

- **Title Page**
  - Student name, roll number, department
  - Name of organization, period of training
- **Certificate of Completion**
  - Signed by Industry Supervisor
- **Acknowledgement**
- **Contents / Table of Contents**
- **Introduction**
  - About organization and department
  - Training objectives
- **Description of Work Assigned**
  - Tasks, tools, machines, software used
- **Learning & Outcomes**
  - Interpretation of learning vis-à-vis academic theory
- **Conclusion**
  - Summary of work, achievements
- **Appendix**
  - Daily Log pages (certified)
  - Attendance Record
  - Photos / Drawings / Data sheets

The report **must be signed by the supervisor, faculty mentor, and TPO** before submission.

Assessment Procedure:

Evaluation of internship is divided into **Continuous Internal Evaluation (CIE)** and **End-of-Training Evaluation**:

Continuous Assessment

f) **Log / Diary Maintenance** – Quality & completeness

g) **Industry Supervisor Evaluation**

- Discipline, technical ability, responsibility

h) **Faculty Mentor Visit Report**

- Periodic assessment of progress

Final Evaluation

5. **Final Training Report**
    a. Technical contents, clarity, organization
6. **Seminar / Viva-Voce**
    a. Presentation by student
7. **Final Supervisor Assessment**

Evaluation Criteria

d) Regularity of diary

e) Technical content & relevance

f) Practical application of theory

g) Quality of presentation / report

h) Professional skills demonstrated

A. Honors in Robotics Engineering

Semester	*Course Code*	*Name of the Course*	*Engagement Hours*			*Credits*	*FA*	*SA*			*Total*
			L	*T*	*P*		*ESE*	*ISE*	*ICA*	*OE/ POE*	
III	MechHon-01A	Industrial Robotics	3	-	2	4	70	30	25	-	125
IV	MechHon - 02A	Machine Vision	3	-	2	4	70	30	25	-	125
V	MechHon - 03A	Industrial Networks and Controllers	2	-	2	3	70	30	25	-	125
VI	MechHon - 04A	Advanced topics in Robotics	3	-	2	4	70	30	25	-	125
VII	MechHon - 05A	Mini Project	1	-	4*	3	-	-	50	-	50
		Total	-	-	-	**18**	**280**	**120**	**150**	-	**550**

* Indicates Contact Hours
Honors Course will be for the students of same Program

B. Honors in Electric Vehicle Engineering

Semester	*Course Code*	*Name of the Course*	*Engagement Hours*			*Credits*	*FA*	*SA*			*Total*
			L	*T*	*P*		*ESE*	*ISE*	*ICA*	*OE/ POE*	
III	MechHon - 01B	Introduction to Automobile Engineering	3	-	2	4	70	30	25	-	125
IV	MechHon - 02B	Introduction to Electric and Hybrid Vehicles	3	-	2	4	70	30	25	-	125
V	MechHon - 03B	Battery Technology and Charging Infrastructure	2	-	2	3	70	30	25	-	125
VI	MechHon - 04B	Advanced topics in Electric Vehicles	3	-	2	4	70	30	25	-	125
VII	MechHon - 05B	Mini project	1	-	4*	3	-	-	50	-	50
		Total				**18**	**280**	**120**	**150**		**550**

* Indicates Contact Hours
Honors Course will be for the students of same Program

Honors with Research

Semester	*Course Code*	*Name of the Course*	*Engagement Hours*	*Credits*	*SA*		*Total*
			P		*ICA*	*OE*	
VII	MECHRES-01	Research Project Phase-01	9 #	9	100	100	200
VIII	MECHRES-02	Research Project during OJT	9 ##	9	100	100	200
		Total	18	18	200	200	400

Along with 9 hours of engagement hours, 4.5 Hrs. activities for preparation for community engagement and service, preparation of reports, etc.

Along with 9 hours of engagement hours, 4.5 Hrs. activities for preparation for community engagement and service, preparation of reports, etc. and independent reading during On Job Training and preferably related to On Job Training activities

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
MechHon-05A: Mini Project

***Teaching Scheme**
Lectures: 01 Hour/week, 01 Credit
Practical : 04 Hours/week, 02 Credits

***Examination Scheme**
ICA: 50 Marks

Course Introduction:
The Mini-Project in Robotics Engineering is designed to provide students with hands-on exposure to the application of robotics and automation concepts through a small team-based project. The course enables students to identify a practical problem and develop a simple robotic or automation solution by integrating mechanical design, sensing, actuation, control and basic programming or simulation. It promotes learning through practical implementation, teamwork and technical documentation, preparing students to handle real-world challenges in the field of robotics and modern automation systems.

Course Objectives:
During this course, student is expected to:

1. Identify practical problems suitable for robotic or automation-based solutions.
2. Apply fundamental concepts of robotics, sensors, actuators and control in project work.
3. Develop skills in system planning, design and basic project management.
4. Implement and test a simple robotic system, model or simulation.
5. Analyze project results and understand system performance.
6. Prepare structured technical documentation and present project outcomes effectively.

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

1. Identify and define a problem that can be addressed using robotics and automation principles.
2. Apply appropriate robotic components and concepts to develop a mini-project solution.
3. Plan and execute a mini-project systematically as part of a team.
4. Analyze the performance of the developed system or model and interpret the results.
5. Prepare a comprehensive technical report and present the project work clearly.
6. Demonstrate awareness of practical issues such as safety, ethics and sustainability in robotics projects.

Section I

Unit-1: Introduction to Mini-Projects in Robotics **No. of lectures- 03**

Definition and significance of mini-projects, Role of mini-projects in enhanced learning of robotics engineering, Examples of simple robotics and automation projects, Overview of project life cycle: planning, execution and evaluation, Team formation and role allocation

Unit-2: Problem Identification and Scope Definition **No. of lectures- 04**

Techniques for identifying real-world problems in robotics and automation, Problem statement formulation, Defining objectives, scope and deliverables, Feasibility analysis: technical, economic and resource considerations, Selection and approval of project topic

Section II

Unit-3: System Design, Development and Implementation **No. of lectures- 04**

System design and block diagram of robotic projects, Selection of sensors, actuators, controllers and mechanical elements, Integration of mechanical, electrical and control aspects, Design of hardware / modeling / simulation approach, Implementation and prototyping methods, Testing, debugging and validation techniques

Unit-4: Project Analysis, Ethics and Documentation **No. of lectures- 03**

Analysis of results and system performance, Safety practices in robotics projects, Ethical and social issues in robotics and automation, Sustainability considerations, Structure and format of technical reports, Documentation of design, implementation and results, Effective presentation techniques, Basics of originality and intellectual property

Internal Continuous Assessment (ICA):

1. Students shall work in teams of 3 to 4 members to complete a mini-project in robotics engineering. The project may involve design, fabrication, modelling, simulation or analysis of a robotic or automation-based system. Assessment may be based on: Project proposal, Periodic progress reviews, Demonstration / implementation / results, Final report submission, Presentation
2. Project Report Contents: The mini-project report should include - Title Page, Certificate, Abstract, Acknowledgement, Table of Contents, List of Figures/ Tables, Introduction and Problem Statement, Literature Review / Background, System Design and Methodology, Implementation / Modeling / Simulation, Results and Discussion, Conclusion and Future Scope, References, Appendix (if any)
3. Suggested Project Areas: Line follower / obstacle avoidance robot, Pick-and-place robotic arm model, Automated sorting system, Mobile robot using basic sensors, Conveyor-based material handling model, Simple ASRS model, Vision-based inspection (demo/simulation), Robot work cell layout and safety analysis, , Low-cost automation system for small industry, etc.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Final Year B.TECH. (Mechanical Engineering)
Semester-VII
MechHon - 05B: Mini Project

***Teaching Scheme**
Lectures: 01 Hours/week, 01 Credit
Practical: 04 Hours/week, 02 Credits

***Examination Scheme**
ICA: 50 Marks

Course Introduction:

The mini-project is designed to help students develop practical skills and hands-on knowledge of tools and techniques required to solve real-life problems related to industry, academic institutions, and society. This course, Electric Vehicle (EV) technology is a rapidly evolving multidisciplinary field integrating mechanical systems, electrical drives, energy storage, and control. This mini project course aims to provide Final Year Mechanical Engineering students with hands-on exposure to EV subsystems, simulation, design, experimentation, and performance evaluation.

Course Objectives:
Upon completion of this course, students will be able to:

1. Identify and describe the major subsystems of electric vehicles and explain their functions.
2. Apply fundamental engineering principles to the design and modelling of selected EV components.
3. Analyse key performance parameters of EV systems using experimental methods or simulation tools.
4. Develop a functional prototype, model, or validated simulation related to electric vehicle technology.
5. Demonstrate effective teamwork, technical reporting skills, and adherence to professional ethics during project execution.

Course Outcomes:
By the end of this course, students will be able to:

1. Explain electric vehicle architecture, powertrain components, and energy storage systems.
2. Apply design calculations and modelling techniques to selected EV subsystems.
3. Analyse EV performance parameters such as efficiency, driving range, torque characteristics, and thermal behaviour.
4. Design and develop a mini-project prototype or simulation to address a real-world EV-related problem.
5. Propose and implement solutions that meet specified technical and functional requirements.
6. Present project outcomes effectively through proper documentation and collaborative teamwork.

Section-I

Unit 1: Introduction to Mini-Projects in Electric Vehicle Engineering

No. of lectures: 03

Definition and significance of mini-projects in EV engineering. Role of mini-projects in enhancing practical and problem-solving skills. Examples of simple EV systems and automation projects (e.g., battery management, regenerative braking). Overview of the project life cycle: planning, execution, and evaluation. Team formation, role allocation, and responsibilities.

Unit 2: Problem Identification and Scope Definition **No. of lectures:** 04

Techniques for identifying real-world EV problems (e.g., energy efficiency, motor control, battery optimization). Formulation of problem statements, defining objectives, and deliverables. Scope definition considering technical, economic, and resource constraints. Feasibility analysis for EV project topics. Selection and approval of project topics.

Section II

Unit 3: System Design, Development and Implementation **No. of lectures:** 04

System design and block diagrams of EV subsystems (powertrain, battery, motor controller, charging system). Selection of components: motors, batteries, controllers, sensors, and mechanical parts. Integration of mechanical, electrical, and control systems in EV design. Design approaches: hardware prototyping, modeling, or simulation. Implementation, testing, debugging, and validation techniques.

Unit 4: Project Analysis, Ethics and Documentation **No. of lectures:** 03

Analysis of results, performance evaluation, and efficiency assessment. Safety practices and standards in EV systems. Ethical, environmental, and sustainability considerations in EV projects. Documentation: structure, format, reporting design, implementation, and results. Effective presentation techniques and understanding intellectual property rights in engineering projects.

Steps to do a Successful Mini Project:

1. Project Proposal
Objective: Problem identification and feasibility assessment
Contents:

a. Title of the mini project
b. Background and motivation (EV relevance)
c. Problem statement and objectives
d. Scope and limitations
e. Expected outcomes
f. Block diagram / concept sketch

2. Literature Review Report
Objective: Understanding existing research and industry practices
Contents:

a. Review of minimum 8–10 technical papers / standards / patents
b. Summary table of reviewed literature
c. Research gaps identified
d. Relevance to selected mini project

3. Methodology & Design Calculations
Objective: Application of engineering principles
Contents:

a. System description and assumptions
b. Design calculations (mechanical, electrical, or thermal as applicable)
c. Material selection and justification
d. CAD models / system architecture
e. Flow chart or algorithm (for simulation-based projects)

4. Modeling / Simulation / Experimental Setup
Objective: System modeling and implementation
Contents (any one as applicable):

a. MATLAB/Simulink model with explanation
b. CAE analysis (structural, thermal, vibration, etc.)
c. Experimental setup description with instrumentation
d. Prototype fabrication details

5. Results, Analysis & Discussion
Objective: Interpretation and critical analysis of outcomes
Contents:

a. Simulation or experimental results
b. Performance parameters (efficiency, torque, range, temperature, etc.)
c. Comparison with theoretical or published results
d. Error analysis and limitations

6. Prototype / Model / Demonstration
Objective: Validation of concept
Contents:

- Working prototype / scaled model / validated simulation
- Demonstration of functionality
- Safety and ethical considerations

The mini-project shall be evaluated in two stages, Intermediate review and End Semester Review. The following points are considered for evaluation:

Sr. No.	**Evaluation Criteria**
1	Quality of the presentation
2	Quality and clarity of the project report
3	Extent and depth of the work carried out
4	Understanding of the selected subject
5	Ability to address and respond to questions effectively

Internal Continuous Assessment (ICA):

Guidelines for Mini-Project Content and Mark Distribution

7. A mini-project group shall consist of a maximum of four (04) students.
8. Each group must maintain a work diary and report progress to the project guide as per the prescribed contact hours.
9. The work diary should clearly reflect the efforts undertaken by the project group, including:
   a. Identification and search for a suitable mini-project topic.
   b. A brief review of relevant journals, research papers, conference papers, books, or other literature.
   c. Survey and analysis carried out to identify and finalize the mini-project area.
   d. A brief report on feasibility studies conducted to support the proposed solution.
   e. Preliminary sketches, design calculations, and related technical details.

10. The mini-project may involve software development, experimentation, analysis, or fabrication work.
11. Preference will be given to mini-project topics that are aligned with the students' proposed final-year project.
12. At the end of the semester, the group shall deliver a PowerPoint presentation before the departmental faculty members or evaluation panel and submit a spiral-bound project report limited to 25-30 pages.