PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY

FACULTY OF SCIENCE AND TECHNOLOGY

MECHANICAL ENGINEERING

Syllabus Structure for

FINAL YEAR B.TECH. MECHANICAL ENGINEERING

w.e.f.

ACADEMIC YEAR 2023-24

Choice Based Credit System

PUNYASHLOK AHILYADEVI HOLKAR
SOLAPUR UNIVERSITY
FACULTY OF SCIENCE & TECHNOLOGY
MECHANICAL ENGINEERING

Programme Educational Objectives and Outcomes

A. Program Educational Objectives (PEOs)

- **PEO1:** To make students competent for professional career in Mechanical and allied interdisciplinary areas
- **PEO2:** To build strong fundamentals required to pursue higher education and continue professional development in Mechanical and other fields
- **PEO3:** To imbibe professional ethics, develop team spirit and effective communication skills to be successful leaders with a holistic approach.
- **PEO4 :** To nurture students to be sensitive to ethical, societal and environmental issues while serving at their professional work

B. Program Outcomes (POs)

A Mechanical Engineering Graduate will be able to –

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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Faculty of Science and Technology

Credit System structure of Final Year B. Tech. Mechanical Engineering W.E.F. 2023-2024 [Semester VII]

Semester VII - Theory Courses

Course code	*Name of Theory Course*	*Hrs./week*				*Credits*	*Examination Scheme*			
		L	*T*	*P*	*D*		*ISE*	*ESE*	*ICA*	*Total*
ME 411	Refrigeration and Air Conditioning	3	-	-	-	3	30	70	-	100
ME 412	Automobile Engineering	3	-	-	-	3	30	70	-	100
ME 413	Automation and Robotics	3	-	-	-	3	30	70	-	100
ME 414 P	Professional Elective-V	3	-	-	-	3	30	70	-	100
ME 415 O	Open Elective-I	3	-	-	-	3	30	70	-	100
	Sub Total	**15**	**-**	**-**	**-**	**15**	**150**	**350**	**-**	**500**

Semester VII - Laboratory / Tutorial Courses

Course code	*Name of Laboratory / Tutorial Course*	*Hrs./week*				*Credits*	*ISE*	*Examination Scheme*			
		L	*T*	*P*	D			*ESE*		*ICA*	*Total*
								POE	*OE*		
ME 411	Refrigeration and Air Conditioning	-	-	2	-	1	-	-	25	25	50
ME 412	Automobile Engineering	-	-	2	-	1	-	-	25	25	50
ME 413	Automation and Robotics	-	-	2	-	1	-	-	-	25	25
ME 414 P	Professional Elective-V	-	-	2	-	1	-	-	-	25	25
ME 415 O	Open Elective-I	-	-	2	-	1	-	-	-	25	25
ME 416	Industrial Training	-	1	-	-	1	-	-	25	50	75
ME 417	Project Phase – I	-	-	4	-	2	-	-	-	50	50
	Sub Total	**-**		**14**	**-**	**08**	**-**	**75**		**225**	**300**
	Grand Total	**15**	**1**	**14**	**-**	**23**	**150**	**425**		**225**	**800**

Abbreviations: *L- Lectures, P –Practical, T- Tutorial, ISE- In-Semester Examination, ESE - End Semester Examination (University Examination for Theory & / POE & / Oral), ICA- Internal Continuous Assessment.*

Professional Elective – V: *A. Production and Operations Management, B. Artificial Intelligence & Machine Learning, C. Railway Systems Management D. Analysis and Synthesis of Mechanisms E. Business Economics*

Open Elective – I: *A. Entrepreneurship Development, B. Operations Research, C. Research Methodology D. Supply Chain Management E. Finite Element Method*

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science and Technology

Credit System structure of Final Year B. Tech. Mechanical Engineering W.E.F. 2023-2024 [Semester VIII]

Semester VIII – Courses

Course code	*Name of Course*	*Hrs./week*				*Credits*	*ISE*	*Examination Scheme*			*ICA*	*Total*
		L	*T*	*P*	D			*ESE*				
								Theory	*POE*	*OE*		
ME 421	A. Self-Learning Technical (Swayam / NPTEL)	-	-	-	-	4	-	-	-	-	100*	100*
	B. Self-Learning Technical Course offered by institute	-	-	-	-		-	-	-	-		
	C. Apprenticeship/Internship	-	-	-	-		-	-	-	-		
ME 422	Project Phase – II (Progress Presentation - I)	-	-	2	-	1	-	-	-	-	50	50
ME 423	Project Phase – III (Progress Presentation - II)	-	-	2	-	1	-	-	-	-	50	50
ME 424	Project Phase – IV (Report Submission & Final Presentation)	-	-	4	-	2	-	-	50	-	50	100
	Grand Total			**08**		**08**			**50**		**250**	**300**

Abbreviations: *L_ Lectures, P –Practical, T_ Tutorial, ISE_ In Semester Examination, ESE _ End Semester Examination (University Examination for Theory & / POE & / Oral), ICA_ Internal Continuous Assessment.*

* Students shall opt for any one of the two courses (i.e. out of ME 421-A, ME 421-B), and obtain 4 credits of 100 marks.

ME 422, ME423 & ME424 are compulsory.

* Students are encouraged to undergo Apprenticeship/internship (ME 421-C) in any industry for obtaining 4 credits of 100 marks and should complete a project sponsored by the Industry/Organisation **as a part of ME422, ME423 & ME424.** However such students should submit Internship and project report separately.

❖ **M421A-Self Learning Technical Course (Swayam/NPTEL**):

- **ICA** 100 Marks, Credits: 4, Assessment of the student based on assignment during the course / quiz conducted on selected course and evaluated as part of ICA.
- Student should complete certified self-learning technical course before end of Semester-VIII.

❖ **M421B Self Learning Technical Course offered by institute:**

- **ICA** 100 Marks, Credits: 4, Course shall be designed by the Institute and Assessment of the student based on assignment during the course / quiz conducted on selected course and evaluated as part of ICA.

Note for M421A& M421B: Student may select any one course of minimum eight weeks **or** two self-learning technical Courses of four weeks based on content in the following areas:

- Electric Vehicles
- Advanced Manufacturing Processes
- Renewable energy
- Automation and Robotics
- Artificial Intelligence
- Machine Learning
- CAD/CAM/CAE
- Thermal Engineering
- Design Engineering
- Industrial Engineering

❖ **M421C Apprenticeship/Internship:**

- **ICA** 100 Marks, Credits: 4, Students may opt for semester long internship/apprenticeship (minimum 60 days).
- Apprenticeship/Internship may be of the following type:
  - Offered by industry at their premises.
  - Offered by industry at the institute campus.
  - Offered by institute jointly with the research funded agency/ industry.

Punyashlok Ahilyadevi Holkar Solapur University
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
ME411 : Refrigeration and Air Conditioning

***Teaching Scheme**
Lectures : 03 Hours/week, 03 Credits
Practical : 02Hours/week, 01 Credit

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

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 refrigerantsand understanding of psychrometric chart 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	Learning the fundamental principles and different methods of refrigeration and air conditioning.
2	To understand basic refrigeration processes
3	Comparative study of different refrigerants with respect to properties, applications and environmental issues.
4	Understand the basic air conditioning processes on psychometric charts, calculate cooling load forits applications in comfort and industrial air conditioning.
5	To acquire the skills required to design and analyze refrigeration and air conditioning componentsand systems.

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

1	Evaluate performance of various types of refrigeration systems
2	Select appropriate refrigerant considering necessary properties
3	Use Psychrometric chart and tables and analyze psychrometric process for obtaining required air conditions.
4	Identify the factors of cooling load and its calculation
5	Describe comfort chart and compare duct design methods.

Section I

Unit-1: Basic Refrigeration Cycles and Refrigerants **No. of lectures-7**

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) Refrigerant: Classification, Desirable Properties, Nomenclature of Refrigerants, Selection of refrigerant, ASHRAE std. 34 for refrigerant safety classification, Secondary refrigerants, Effect on Ozone depletion and Global warming, Total equivalent warming impact (TEWI), Alternative Refrigerant.

Unit-2: Vapour Compression Refrigeration Systems **No. of lectures-8**

Working of simple vapour compression system, representation of different vapour compression cycle (VCC) on T-s and P-h diagram, Vapour compression cycle, Sub cooling, Superheating, Analysis and Performance calculations of above cycles. Effect of operating parameters on performance of VCC, actual VCC, methods of improving COP, Flash gas removal, Flash inter cooling, Compound compression with intercooling, Multiple evaporator systems (Numerical Treatment).

Unit-3: Vapour Absorption Refrigeration Systems and Cryogenics **No. of lectures-5**

A) Limitations of VCRS, Working of simple vapour absorption system (VAS), Practical vapour absorption system, desirable properties of binary mixture (aqua-ammonia), COP of an ideal Vapour Absorption Refrigeration System, Li-Br absorption system, three fluid system (Electrolux refrigeration), applications of VARS, comparison between VCRS and VARS.

B) Introduction to cryogenics Limitations of vapour compression systems for the production of low temperature, Cascade Refrigeration System, Linde System for liquefaction of air. Applications of Cryogenics. (Descriptive Treatment).

Section II

Unit-4: Psychrometry **No. of lectures-7**

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-8**

Enumeration and brief explanation of the factors forming load on refrigeration and air conditioning systems, Ventilation requirements according to ASHRAE std. 62.1, Inside and Outside Design conditions, U-value for different building materials, CLTD, SCL, Cooling load calculations using E20 format/ software, Load analysis by RSHF, GSHF **(Numerical Treatment).**

Unit-6: Air Conditioning and Air Distribution Systems **No. of lectures-5**

A) Room air conditioning, Chilled water systems, DX systems, Comparison between Chilled water and DX systems, Air handling unit, Fan coil unit, Desert coolers, Air-washer, Industrial applications

B) 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), grills, registers, diffusers.

Internal Continuous Assessment (ICA):

List of Experiments/Assignments/Case Studies, etc.

Group I (Study, Demonstration of any four assignments on following)

1. Study of Refrigeration methods
2. Study of Refrigeration Equipment's
3. Study of Refrigeration Systems–Domestic refrigerator, Split air conditioner, Ice Plant, Deep freezer etc.
4. Study of charging, leak testing of refrigeration systems
5. Case Study (Any One of the following)
    A. Refrigeration and Air-Conditioning systems used in Space Station/ Satellites/ Rockets/ Submarines/ Automobiles
    B. ASHRAE standards in Refrigeration and Air-Conditioning
    C. Application of Phase change materials in refrigeration

Group II (Any three experiments out of the following)

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

Group III(Any one out of the following)

1. Visit to Refrigeration plant or Central Air Conditioning plant
2. Usage of software for cooling load calculation

Text Books:

1. 'Refrigeration and Air Conditioning' by R.S. Khurmi & J.K. Gupta
2. 'Refrigeration & Air Conditioning' by C. P. Arora
3. 'Refrigeration & Air Conditioning' by Arora & Domkundwar
4. 'Refrigeration and Air-conditioning' by S. N. Sapali

Reference Books

1. Basic Refrigeration and Air Conditioning by P. N. Ananthnarayanan
2. Principles of Refrigeration 'by Roy J Dossat
3. Air Conditioning Applications & design' by W. P. Jones
4. Refrigeration & Air Conditioning by Stocker
5. Refrigeration & Air Conditioning by Manohar Prasad

Punyashlok Ahilyadevi Holkar Solapur University
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
ME412: Automobile Engineering

***Teaching Scheme**
Lectures:03 Hours/week, 03 Credits
Practical: 02Hours/week, 01 Credit

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

Course Introduction:

An automobile is a self-propelled vehicle which contains the power source for its propulsion and is used for carrying passengers and goods on the ground, such as cars, buses, trucks, etc.,

Automobile engineering plays a vital role in engineering and the day-to-day modern world. It gained so much recognition and importance since vehicles became a fundamental mode of transportation. People want their own mode of transportation. Public transportation is present as a mode of transportation, making automobile engineering an important and rapidly growing field of engineering. Automobile engineering has great career scope and broad scope in engineering. It offers wide opportunities for students who want to become automobile engineers and want to build successful careers in the field. It includes automobile components manufacturing industries, vehicle manufacturing companies, production plants, transport companies, research and development departments, service stations, motor vehicle departments, private transport companies and many more.

Course Objectives:

1) To understand the need and role of chassis construction in the function of an automobile.
2) To understand the function of various parts of the automobile.
3) To identify the merits and demerits of the various components of the transmission and suspension systems.
4) To understand the working of different braking and steering systems.

Course Outcomes:

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

1. Differentiate the types of vehicle chassis and transmission layouts.
2. Examine the various parameters influencing the vehicle's performance characteristics.
3. Select and explain the different transmission system components for efficient power transmission.
4. Analyse the different parameters influencing automobile steering systems.
5. Analyse the different parameters influencing automobile braking systems.
6. Compare the different suspension systems used in automobiles.

Section I

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

Broad classification of Automobiles, Major components, and their functions. Types of vehicle drive layouts, Front engine front wheel drive, Front engine rear wheel drive, Rear engine rear wheel drive, All wheel drive.

Unit-2: Performance of Automobiles **No. of lectures-06**

Resistance to vehicle motion, Air, Rolling and Gradient resistance, Acceleration, Grade ability and draw bar pull, Traction and Tractive effort, Power required for vehicle propulsion, (Numerical treatment).

Unit-3: Transmission System **No. of lectures-08**

Requirements of transmission system, Requirements of automobile clutch, functions of clutch, Types of clutches: single plate, multi-plate, centrifugal, electromagnetic. Types of automotive gearboxes: sliding mesh gearbox, constant mesh gearbox and synchromesh gearbox, Automatic transmission, Overdrive, Propeller shaft, Universal and slip joint, Final drive and its types, Differential, Construction, and types of rear axles.

Section II

Unit-4: Steering System **No. of lectures-06**

Function of steering, Steering system layout, Types of steering gearboxes, Steering Geometry: Camber angle, Caster angle, Kingpin inclination, included angle, Toe-in and Toe-out, Wheel alignment, slip angle, Under steer & Over steer, Types and working of power steering.

Unit-5: Braking System **No. of lectures-06**

Function of the automotive brake system, Types of braking mechanism: internal expanding & Disc brake. Types of braking systems: Mechanical, Hydraulic & Air brake systems, Power brakes, Anti-lock braking system (ABS), Braking force and stopping distance (numerical treatment).

Unit-6: Suspension System **No. of lectures-08**

Requirements of the suspension system, Sprung and Un-sprung mass, Leaf springs, Coil springs, Shock absorber, Types of automotive suspension systems: Conventional suspension and Independent, Types of independent suspension systems: Double wishbone and MacPherson strut-type suspension systems, Rear axle drives: Hotch-kiss and Torque tube drive, Reaction Members: Antiroll/Sway/ Stabilizer bar.

Internal Continuous Assessment (ICA):

List of Experiments/Assignments/Case Studies (Any eight).

1. Study and demonstration of four-wheeler drive layout (2WD & 4WD).
2. Study and demonstration of working of single plate automobile clutch.
3. Study and demonstration of synchromesh gearbox, final drive and differential.
4. Study and demonstration of hydraulic braking system.
5. Study and demonstration of steering system layout and types of steering gearbox.
6. Study and demonstration of suspension system of a four-wheeler.
7. Demonstration/Experiment on wheel balancing & front wheel alignment.
8. Visit to servicing station for study of vehicle maintenance, repairs and report.
9. Study of awareness and practice of Road Safety Rules

Text Books:

1. Automobile Engineering by Kripal Singh
2. Automobile Mechanics by N. K. Giri
3. Automobile Mechanics by S. K. Gupta

Reference Books

1. Motor Vehicle by T. K. Garrett, K. Newton, W. Steeds
2. Handbook of Automotive Engineering by Hans-Hermann Braess, Ulrich Seiffert
3. Automotive Mechanics by William H. Crouse
4. Automotive Mechanics by Joseph Heitner

Punyashlok Ahilyadevi Holkar Solapur University

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

ME413: Automation and Robotics

Teaching Scheme

Lectures: 03 Hours/week, 03 Credits

Practical: 02 Hours/week, 01 Credit

Examination Scheme

ESE: 70 Marks

ISE: 30 Marks

ICA: 25 Marks

Course Introduction:

This course is designed to give the student an in depth understanding of Automation and Robotics. It covers the following topics: Basics of Automation, Automation types, Material handling and Identification Technologies, introduction to industrial robotics, Anatomy of an industrial robot, robot history, AGVs, service robots, Cobots, configurations, sensors and actuators, end effectors. Kinematics of multi-degree-of-freedom systems, Jacobean matrices, kinematics, and dynamics. Robot trajectories.

Course Objectives:

During this course, student is expected to:

1. Understand the basic construction of an industrial robot.
2. Acquaint with existing market distribution and future trends.
3. Understand the technology behind a modern robot such as sensors, actuators, grippers, Controllers.
4. Understand and bridge the gap (regarding industrial robots) between text books & industry
5. Understand the scope and applications of modern machine vision systems.
6. Understand the scope of AGVs and other mobile robots for industrial applications

Course Outcomes:

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

1. Solve simple kinematics and dynamics problems on robot motion.
2. Select appropriate robot specifications for industrial applications.
3. Use suitable software toolboxes to demonstrate machine vision concepts.
4. Use any suitable software to simulate a robot and its work cell.
5. Select mobile configuration based on applications.
6. Evaluate and compare robots based on their specifications.

Section I

Unit 1: – Introduction to Robotics **No. of lectures – 06**

History and fundamentals of Industrial Robots, Definition as per ISO & IFR, components of industrial robots, classification of robots. Collaborative Robots, Service Robots, AGVs, classification, navigation techniques, applications, Mobile robots, wheeled and tracked robots

Unit 02: Sensors, Actuators & End Effectors **No. of lectures - 09**

Sensors: Sensor classification; Internal Sensors: Position Sensors, Velocity Sensors Acceleration sensors & Force sensors External Sensors: Non-contact type- Proximity sensor,

Actuators: Compare Hydraulic, Pneumatic and Electric drives; Linear Actuators; Stepper motors, DC Motors, DC Servo Motors, AC Motors, Variable Frequency Drives, Selection of Actuator for given Application

End Effectors: End effectors & grippers, classification, applications, design, and selection criteria for end effectors.

Unit-3: Kinematics, Dynamics & Control **No. of lectures – 05**

Forward kinematics, Inverse Kinematics for 2 DOF and 3 DOF planar manipulators; Dynamics: Velocity Jacobian, singularities; Control architecture of robots, Overview of advanced control techniques such as force control, PID control adaptive control,

Section II

Unit 4 – Robot Vision/Machine Vision **No. of lectures – 08**

Machine Vision definition and system components, lighting techniques, Image processing fundamentals: Edge detection, shape analysis, segmentation, object identification,template matching, Cameras (CCD, CMOS, Area Scan, Line Scan), camera specification and selection, camera calibration.

Unit 5 – Robot Workcells & Programming **No. of lectures - 06**

Robot cell layout, considerations in workcell design, workcell control, cell safety, human machineinterface, robot cell controller.

Lead through programming, walk through programming, offline programming.

Unit 6 – Industrial Robot Applications **No. of lectures – 06**

General considerations for selecting robots (including layout and workcell) for material handling, Pick and place robot and machine tending, spot welding, continuous welding, sealant application, spray painting, assembly,inspection, electronics assembly, ASRS System.

Internal Continuous Assessment (ICA):

List of Assignments

1. Assignment on Sensors, Actuators and grippers used in Robotics
2. Forward Kinematics of 2 DOF and 3 DOF supported by suitable software.
3. Assignment on Robot cell layout
4. Assignment on Automated Storage/Retrieval Systems (ASRS).
5. Assignment on Navigation Techniques of AGV
6. Assignment on Survey of different robots – specifications, manufacturers and applications used in Robotics
7. Assignment on Basic Elements of Machine Vision system.
8. Assignment on Applications of Robots for Spray painting, pick & place, Welding etc.

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
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
ME414P: Production and Operations Management

***Teaching Scheme**
Lectures:03 Hours/week, 03Credits
Practical :02 Hours/week, 01Credit

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

Course Introduction:
Strategic growth & competiveness 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. Develop knowledge about the principles of production and operations management.
2. Solve organizational problems related to production as well as operations management.
3. Empower students to handle case studies related to industrial problems.

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

1. Explain the scope and need of production and operation management and evaluate the future demands using different forecasting methods.
2. Apply the concept of capacity planning and aggregate planning to various types of manufacturing systems
3. Explain the importance and functions of production planning and control
4. Apply the inventory control models in production processes
5. Apply the concept of plant maintenance
6. To get acquainted with various advanced techniques such as Lean manufacturing, value engineering, six sigma, Kanban, Supply chain management

Section I

Unit-1: Introduction to Production and Operation Management and Forecasting **No. of lectures- 09**

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

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

Unit-2: Capacity Planning **No. of lectures- 05**

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-06**

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

Section II

Unit-4: Inventory Management **No. of lectures- 06**

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-06**

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.

Internal Continuous Assessment (ICA):

List of Experiments/Assignments/Case Studies, etc. (Any six)

1. A micro project on categorization of industries based on production type and production system (Categorize any (minimum) six industries by type of production and production system and justify the categorization. This micro project is based on the Industry, products of the industry and further their categorization)
2. Numerical treatment on different forecasting techniques by using suitable software tool
3. Numerical treatment on capacity planning by using suitable software tool.
4. Numerical treatment on inventory management
5. A Case study on plant maintenance or TPM preferably from the research paper from reputed peer reviewed journal
6. A Case study on value analysis
7. A Case study on Six Sigma
8. A Case study/online course (minimum 2 hrs.) on 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 "Supply Chain Management – Strategy, Planning, and Operation ",6th Edition, Pearson Education Asia , 2016.

Punyashlok Ahilyadevi Holkar Solapur University
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
ME 414 P : Artificial Intelligence and Machine Learning

***Teaching Scheme**
Lectures: 03 Hours/week, 03 Credits
Practical : 02 Hours/week, 01 Credit

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

Course Introduction:

This course is designed to give the students of Mechanical Engineering a flavor of the buzz words of present and applications of future viz. 'Artificial Intelligence' and 'Machine Learning'. The course covers fundamental branches of Artificial Intelligence such as Problem Solving, Fuzzy Logic, Expert Systems, Natural Language Processing, Vision Processing, Machine Learning and so on. It further focuses on the advancements of Machine Learning including Supervised, Un-supervised and Reinforcement Learning models, Artificial Neural Networks, etc. The course puts forth the relevance of these AI and ML techniques in Mechanical Engineering by encompassing the major application areas of these techniques in Mechanical Industries through its various units.

Course Objectives:

During this course, learners are expected to:

1. Understand fundamentals of AI, its types, and applications.
2. Define Artificial Intelligence and explain of AI
3. Explain Applications of fuzzy logic, expert systems, Language and Vision Processing
4. Outline steps involved in development of machine learning model
5. Familiarize with concepts of supervised, un-supervised and reinforcement learning.
6. Analyze Artificial Neural Network models used for different applications

Course Outcomes:

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

1. Describe need of Artificial Intelligence (AI) and problem-solving approaches in AI
2. Demonstrate fuzzy logic and expert systems
3. Outline the Language Processing and Vision Processing Systems
4. Describe Machine Learning (ML) and fundamental steps involved in ML.
5. Develop a machine learning model suitable to solve a given problem
6. Simulate an Artificial Neural Network to solve a particular problem

Section I

Unit-1: Fundamentals of Artificial Intelligence (AI) **No. of lectures- 07**

Introduction to Artificial Intelligence, History of AI, General Applications of AI, Need of Artificial Intelligence in Mechanical Engineering, Problem Solving Approaches in AI : General Problem Solving (Production Systems, State Space Search), Exhaustive Searching Methods (search space control - Depth First Search, Breadth First Search), Heuristic Approaches (Hill climbing, best-first search, branch and bound) [Approaches to be dealt with relevant practical examples]

Unit-2: Fuzzy Logic and Expert Systems **No. of lectures- 06**

Introduction to Fuzzy Logic: Basic concepts, history, and fuzzy set theory. Processes in a fuzzy logic system, Applications of Fuzzy Logic in Mechanical Engineering (Mechatronics)
Introduction to expert systems: Definition of expert systems, Inference mechanisms in expert systems, Case studies of expert systems in mechanical engineering, applications of expert systems in mechanical engineering

Unit-3 Natural Language Processing and Vision Processing **No. of lectures- 07**

Introduction to Natural Language Processing: Definition and goals of NLP, Applications of NLP (in Mechanical Engineering and in General), Text Preprocessing, Sentiment Analysis, Information Retrieval, Dialogue Systems, Chatbots.
Introduction to Vision Processing: Definition and goals of vision processing, Applications of Vision Processing (in Mechanical Engineering and in General), Image Processing Techniques steps and fundamentals, Case study in image processing.

Section II

Unit-4: Fundamentals of Machine Learning (ML) **No. of lectures- 06**

Introduction to Machine Learning, Types of Machine Learning, Applications of ML in Mechanical Engineering (Predictive Maintenance and Health Management, Fault Detection, Image based part classification, Process Optimization, Inspection, Improving control algorithms)
Data preprocessing in Machine Learning : Data cleaning and preparation, Feature selection and extraction, Data normalization and scaling

Unit-5: Supervised, Un-supervised and Reinforcement Learning **No. of lectures- 09**

Supervised Learning: Introduction to Supervised Learning, Classification and Regression (with examples)
Un-supervised learning : Introduction to Un-Supervised Learning, Clustering, Dimensionality reduction and Anomaly detection (with examples)
Reinforcement Learning : Introduction to Reinforcement Learning, Markov Decision Processes (MDPs), Policy Iteration, Value Iteration, Q-Learning (with examples)

Unit-6: Artificial Neural Networks **No. of lectures- 05**

Introduction to Artificial Neural Networks (ANNs) : Definition and history of ANNs, Basic architecture of ANNs, Definition and working of perceptron, Backpropagation algorithm Activation functions, Working of Multi Layered Perceptron, Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), Applications of ANNs in Mechanical engineering

Internal Continuous Assessment (ICA):

ICA shall include following assignments

1. Fundamentals of Artificial Intelligence and its Applications
2. Problem Solving Approaches in AI
3. Demonstration of Fuzzy Logic with relevant examples
4. Case Study on 'Chatbots used in any relevant application'
5. Steps in Vision Processing and Applications of Vision Processing
6. Pre-processing in Machine Learning
7. Demonstration of Supervised, Un-supervised and Reinforcement learning with suitable examples
8. Demonstration of different Artificial Neural Networks with suitable examples

** Suitable open source software, online tools and facilities like Virtual Labs may be used for demonstration of different techniques mentioned in above assignments*

Text Books:

1. Stuart Russel& Peter Norvig, Artificial Intelligence a Modern Approach.
2. E. Rich and K. Knight, "Artificial intelligence",TMH.
3. N.J. Nilsson, "Principles of AI", Narosa Publ. House, 2000.
4. Deisenroth, Faisal, Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
5. B Joshi, Machine Learning and Artificial Intelligence, Springer, 2020.

Reference Books

1. Robert Babuška, Fuzzy Modeling for Control, Springer.
2. Dan Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice-Hall.
3. Solanki, Kumar, Nayyar, Emerging Trends and Applications of Machine Learning, IGI Global, 2018.
4. Mohri, Rostamizdeh, Talwalkar, Foundations of Machine Learning, MIT Press, 2018.

Punyashlok Ahilyadevi Holkar Solapur University
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
ME414 P: Railway Systems Management

***Teaching Scheme**
Lectures : 03 Hours/week, 03 Credits
Practical : 02Hours/week, 01 Credit

***Examination Scheme**
ESE : 70 Marks
ISE : 30 Marks
ICA : 25 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, the student is expected to:

1. Differentiate between various suspension & Braking Systems used in railways.
2. Analyze 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 working of various Railway Management Systems

Course Outcomes:
At the end of this course, the 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 unsprang 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 Fibres, Laser Railhead Cleaner Systems, Catenary-Free Power Supply of Tramway Systems, Ground power supply systems: The APS system, The TramWave system, The PRIMOVE system,

Internal Continuous Assessment (ICA):
List of Experiments/Assignments/Case Studies, etc. (Any 8)

1. Assignment on Suspension & Braking System
2. Assignment on Coupling, Bogie Assembly and HVAC System
3. Assignment on Drive Train, Traction and Signal System
4. Assignment on Vehicle Maintenance and Management
5. Assignment on Vehicle Safety & Environment
6. Assignment on Cutting-edge technologies in railways
7. Case Study on Suspension & Braking System
8. Case Study on Coupling, Bogie Assembly and HVAC System
9. Case Study on Vehicle Safety & Environment
10. Industrial Visit Railway Workshop/Industry

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

Final Year B.TECH. (Mechanical Engineering)

Semester-VII

ME414 P : Analysis and Synthesis of Mechanisms

***Teaching Scheme**

Lectures : 03 Hours/week, 03 Credits

Practical : 02Hours/week, 01 Credit

***Examination Scheme**

ESE : 70 Marks

ISE : 30 Marks

ICA : 25 Marks

Course Introduction: Analysis and Synthesis of Mechanisms is very important in design of various mechanisms for different applications. It is an important mathematical tool for analytical and graphical analysis and synthesis of complex mechanisms. Advanced software's need insight into this concept for better utilization of them.

Course Objectives:

During this course, student is expected to:

1. Perform velocity & acceleration analysis of complex mechanisms.
2. Perform dynamic analysis of planar mechanisms.
3. Apply curvature theory for applications of mechanisms
4. Carry out graphical synthesis of planar mechanisms.
5. Carry out analytical synthesis of planar mechanisms.
6. Perform kinematic Analysis of Spatial Mechanisms

Course Outcomes:

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

1. Perform velocity & acceleration analysis of complex mechanisms.
2. Perform dynamic analysis of planar mechanisms.
3. Apply curvature theory for applications of mechanisms
4. Carry out graphical synthesis of planar mechanisms.
5. Carry out analytical synthesis of planar mechanisms.
6. Perform kinematic Analysis of Spatial Mechanisms

Section I

Unit-1: Kinematic Analysis of Complex Mechanisms **No. of lectures- 9**

Definitions and assumptions, planar and spatial mechanisms kinematic pairs, degree of freedom, velocity-acceleration analysis of complex Mechanisms by the normal acceleration and auxiliary point methods.

Unit-2: Dynamic Analysis of Planar Mechanisms **No. of lectures- 6**

Inertia forces in linkages, kinetic, static Analysisof Mechanisms by matrix method. Analysis of elastic mechanisms, beam element, displacementfields for beam element, element mass and stiffness matrices, system matrices, elastic linkage model, equations of motion.

Unit-3: Curvature theory **No. of lectures- 5**

Fixed and moving centrodes, inflection circle, Euler- Savary equation, Bobillier constructions, cubic of stationary curvature, Ball's point, Applications in dwell Mechanisms.

Section II

Unit-4: Graphical Synthesis of Planar Mechanisms **No. of lectures- 7**

Type, number and dimensional synthesis, function Generation, path Generation and rigid body guidance problems, accuracy (precision) points, Chebychev Spacing, types of errors, Graphical synthesis for function generation and rigid body guidance with two, three and four accuracy points using pole method, center pointand circle point curves, Bermester points, Synthesis for five accuracy points, Branch and order defects, Synthesis for path generation.

Unit-5: Analytical synthesis of Planar Mechanisms **No. of lectures- 7**

Analytical synthesis of four-bar and slider- crank mechanism, Freudenstein's equation, synthesis for four accuracy points, compatibility condition, synthesis of four-bar for prescribed angular velocities and accelerations using complex numbers. Complex numbers method of synthesis, the dyad, center point and circle point circles, ground pivot specifications, three accuracy point synthesis using dyad Method, Robert Chebychev theorem, Cognates

Unit-6: Kinematic Analysis of Spatial Mechanisms **No. of lectures- 6**

Denavit- Hartenberg parameters, matrix method of analysis of spatial mechanisms.

Internal Continuous Assessment (ICA):
Any eight assignments out of the following.

1. Velocity-acceleration analysis of complex Mechanisms by the normal acceleration method
2. Velocity-acceleration analysis of complex Mechanisms by the auxiliary point method.
3. Static analysisof mechanisms by matrix method
4. Applications of Euler- Savary equation,Bobillier constructions
5. Assignment on Graphical Synthesis of Planar Mechanisms
6. Graphical synthesis for function generation and rigid body guidance
7. Analytical synthesis of four-bar and slider- crank mechanism
8. Complex numbers method of synthesis
9. Application of Robert Chebychev theorem
10. Matrix method of analysis of spatial mechanisms.

Text Books:

1. Theory of Machines and Mechanisms, A. Ghosh and A. K. Mallik, Affiliate d East-West Press.
2. Mechanism Design - Analysis and Synthesis (Vol. 1 and 2), A. G. Erdman and G. N. Sandor, Prentice Hall of India.
3. Design of Machinery: An introduction to the Synthesis and Analysis of Mechanisms and Machines, Robert L. Norton, Tata McGraw-Hill, 3rd Edition.

Reference Books

1. Kinematic Synthesis of Linkages, R. S. Hartenberg and J. Denavit, McGraw Hill.
2. Theory of Machines and Mechanisms, J. E. Shigley and J. J. Uicker, 2nd Ed., McGraw-Hill.
3. Kinematics and Linkage Design, A. S. Hall, Prentice Hall of India.

Punyashlok Ahilyadevi Holkar Solapur University
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
ME414 P: Business Economics

***Teaching Scheme**
Lectures:03 Hours/week, 03 Credits
Practical: 02Hours/week, 01 Credit

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

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 decisionsfor 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 onelementary 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, applyvalue 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 analysisand 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 EngineeringEconomics, importance of economics in a business, concept of efficiency, Theory of Demand, Law ofdemand, determinants of demand, Price Elasticity of Demand, profit and loss, total revenue, averagerevenue, marginal revenue, Income Elasticity of Demand, Cross Price Elasticity of Demand, Supply andlaw 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 theirapplications, cash flow diagram, present worth method, future worth method, annual equivalent orannuity 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 ofmaintenance, types and causes of failure, strategies to prevent them, planned and unplanned maintenance, preventive and breakdown maintenance, routine maintenance, predictive maintenance, opportunisticmaintenance, design out maintenance, condition based monitoring and modern techniques, need ofreplacement of an asset, defender and challenger, replacement decision, lives of an asset - economiclife, 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

Internal Continuous Assessment (ICA):

List of Experiments/Assignments/Case Studies, etc.

1. Assignment on Fundamentals of Business Economics with a case study ondetermination of PED or IED.
2. Assignment on Costs, Cost Estimation and Break Even Analysis with a case study on determination of total cost of any part used in engineering practice.
3. Assignment on Time Value of Money with numerical problems on worth calculationand cash flow diagram.
4. Assignment on Make or Buy Decision and Elementary Economic Analysis.
5. Assignment on Maintenance Management and Replacement.
6. Assignment on Project Management Life Cycle and Value Engineering with a case study on value analysis of any product.

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
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
ME415 O: Entrepreneurship Development

***Teaching Scheme**

Lectures : 03 Hours/week, 03 Credits

Practical : 02Hours/week, 01 Credit

***Examination Scheme**

ESE : 70 Marks

ISE : 30 Marks

ICA : 25 Marks

Course Introduction:

Entrepreneurship education in India has gained relevance in today's context. Education in the area of entrepreneurship helps students to develop skills and knowledge, which could benefit them for starting, organizing and managing their own enterprises. Entrepreneurship education encourages innovation, fosters job creation, and improves global competitiveness. This course will focus on key attributes of Entrepreneurship: Qualities required to become a successful entrepreneur, Entrepreneurship DevelopmentProgrammers, Ideation Techniques, Business Plan Formulation and its Appraisal, Problems faced by Entrepreneurs and ways to get through, Different Government Agencies and Policies, Taxation, Accounting, Marketing, Export-Import and so on. To sum up, the course will make students to have an understanding of the complete entrepreneurial ecosystem.

Course Objectives:

During this course, student is expected to:

1. To familiarize with entrepreneurship and its significance in national development
2. To develop skills required to establish and run a successful enterprise
3. To acquaint with the options available with new entrepreneurs
4. To formulate business plan/project report for a startup
5. To acquaint with Government policies and agencies associated with entrepreneurial development

Course Outcomes:

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

1. Identify the qualities required to become a successful entrepreneur
2. Identify the business opportunities that fit the individual or the group
3. Explain factors influencing on entrepreneurial development
4. Analyze various options available for deciding entrepreneurial career
5. Explain various methods and sources for idea generation
6. Select financial institutions for establishing new enterprise and Develop a feasible project report suitable for individual or group.

Section I

Unit-1: Entrepreneurship **No. of lectures-10**

Concept, meaning and definitions of entrepreneur and entrepreneurship, Importance and significance of growth of entrepreneurial activity, History of entrepreneurship development in India, Corporate entrepreneurship (intrapreneurship), Social entrepreneurship, Characteristics and qualities of entrepreneurs, Factors influencing entrepreneurial development and motivation, Role of culture in entrepreneurial development, Classification and types of entrepreneurs.

Unit-2: Entrepreneurship Development **No. of lectures- 10**

Entrepreneurial development programmes (EDP): Introduction, Curriculum, Phases, Problemsfaced by EDPs, Managerial, marketing, financial & technological problems faced by new entrepreneurs and their probable solutions, Options available to entrepreneurs - ancillarisation, franchising and outsourcing (characteristics,advantages, limitations, suitability of each option).

Section II

Unit-3: Entrepreneurial Project Development **No. of lectures- 10**

Idea generation – sources and methods, Identification and classification of ideas, Environmental Scanning, SWOT analysis and Tools for Exploring Change, Business model formulation, lean canvas model, Preparation of a project report/business plan including: market plan, financial plan, operational plan, HR plan, Working capital management, Break Even Analysis, etc, Significance of project report, Project appraisal (feasibility study) – Aspects and methods: Economic oriented appraisal, Financial appraisal, Market oriented appraisal, Technological appraisal, Managerial competency appraisal

Unit-4: Small-Medium Enterprises and Support Systems **No. of lectures- 10**

Meaning and definition (evolution) of micro, small & medium enterprises, Steps in setting up a small unit, Ownership patterns : sole proprietorship, partnership, private limited company, Policies governing SMEs, Funding options available : angel investors, venture capitalists, commercial banks, financialinstitutions, Support agencies: SIDBI, SISI, NABARD, DIC, MCED, EDII, NIESBUD, EPC etc. – Their rolein the development of SMEs, Technology business incubation (TBI) centers, Export Potential of SMEs, Export procedure, Taxation benefits for SME sector, Prospects and Turnaround strategies for SMEs

Internal Continuous Assessment (ICA):

Students of a batch may be divided into groups (consisting of maximum four members) to carry out the following tasks:

A. Case studies

1. Case study on male entrepreneur
2. Case study on female entrepreneur
3. Case study on Product/Service and business model innovation
4. SWOT analysis of existing enterprises (minimum 2) and also used tools for exploring change and uncover the resulting commercial opportunities
5. Case Study on Managing risk in the entrepreneurial organization

B. Preparation of project report/business plan for starting a small unit and presentation on the same (includingdetails of business idea, market survey, business model, different plans, etc)

Text Books:

1. Management of small scale industries - J.C. Saboo, Megha Biyani, Himalaya Publishing House
2. Small-Scale Enterprises and Entrepreneurship - Vasant Desai, Himalaya Publishing House
3. Entrepreneurial Development, S. S. Khanka, SChand Publications

Reference Books

1. Dynamics of Entrepreneurial Development and Management - Dr. Vasant Desai, HimalayaPublishing House
2. Entrepreneurship - Robert D Hisrich, Michael P Peters and Dean A. Shepherd, McGraw HillEducation
3. Social Entrepreneurship For The 21st Century: Innovation Across The Nonprofit, Private, AndPublic Sectors - Georgia Levenson Keohane, McGraw Hill Education
4. Corporate Entrepreneurship and Innovation 4th Edition, Paul Burns, Macmillan International Higher Education ISBN 978-1-352-00879-1

Punyashlok Ahilyadevi Holkar Solapur University
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
ME415 O : Operations Research

***Teaching Scheme**
Lectures : 03 Hours/week, 03 Credits
Tutorial : 01Hours/week, 01 Credit

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

Course Introduction:

Industries across the globe are facing the problems of global unrest due to multiple reasons. Hence, they continuously try to adopt various optimization techniques in their organizations. Which help them to reduce the time and cost of production. This course covers different optimization techniques assisting the Organizations in managing their resources optimally had better decision making, transportation issues, effective planning, replacement policies and allied issues in conducting their activities. These optimization techniques are expected to offer maximum profit and reduced cost and time.

Course Objectives:

During this course, student is expected to:

1. Acquire knowledge of various techniques under operations research.
2. Study quantitative techniques in management decision-making and its applications.
3. Apply maximization and minimization techniques for real life problems.
4. Create awareness about preparation of Project Plan
5. Solve problems of waiting line and average time
6. Acquire knowledge of various financial terms.

Course Outcomes:

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

1. Apply LPP theory to solve the industrial problems
2. Apply the concept of Assignment models to maximize profit and minimize time for production.
3. Apply the concept of Transportation models to optimize available resources.
4. Apply the sequencing and waiting line theory to solve real life problems.
5. Determine project duration & different floats & probability of project completion
6. Apply the financial concept for real life problems.

Section I

Unit-1: Introduction to OR & LPP **No. of lectures- 08**

History and development of OR, methodology in operation research, O.R. models and their applications. Introduction to LPP, Formulation of problem, Graphical solution, Simplex method, Duality in LPP (No numerical problems).

Unit-2: Assignment Model **No. of lectures- 06**

Mathematical statement, Methods to solve balanced and unbalanced assignment problems,

Maximization problems, Assignment with restrictions,

Unit-3: Transportation Model **No. of lectures- 06**

Mathematical formulation, methods to obtain initial basic feasible solution (IBFS), NWCR, LCM, VAM method for balanced and unbalanced problem.

Section II

Unit-4: Job sequencing and Queuing or waiting line theory **No. of lectures- 06**

Job sequencing, Johnson's Rule for optimal sequence of n jobs on two machines, process Jobs on three Machines. Applications, Characteristics, Waiting Time and Idle Time costs, Single channel Queuing Problems for calculating average number of customers and average time in system and queue.

Unit-5: CPM & PERT **No. of lectures-08**

Fundamentals of CPM / PERT networks, CPM – construction of networks, critical path, forward and backward pass, floats & their significance. PERT – Time Estimates, Construction of Networks, Probability of completing projects by scheduled date.

Unit-6: Engineering Economics **No. of lectures-06**

Importance, demand and supply, types of costs, Interest- Simple, compound, continuous, and effective interest. Value of money - time and equivalence, tangible and intangible factors, Introduction to inflation. Cash flow diagram. Interest factors – Uniform series factors, derivations.

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

1. Numerical problems on LPP.
2. Numerical problems on Assignment model.
3. Numerical problems on Transportation model.
4. Case study of one of the application of waiting line theory.
5. Case study of one of the project report.
6. Case study of one of the financial report.

Text Books:

1. Hira and Gupta, "Operation Research", S. Chand and Co.
2. S. D. Sharma, "Operation Research", Kedarnath and Rannalt Pub.
3. Hamdy Taha, "Operations Research – An Introduction", 7th edition PHI (2003)
4. N. D. Vohra, "Quantitative Techniques in Management", TMGH

Reference Books

1. Operations Research by Hillier and Lieberman TMGH
2. R. Panneerselvam, "Operations Research", PHI (2002)
3. Swarop Kanti Gupta P.K. & Manmohan- OR - S.Chand & Sons, New Delhi
4. Shrinath L.S.: PERT & CPM –Affiliate East West Press

Punyashlok Ahilyadevi Holkar Solapur University
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
ME415 O: Research Methodology

***Teaching Scheme**

Lectures : 03 Hours/week, 03 Credits

Practical : 02Hours/week, 01 Credit

***Examination Scheme**

ESE : 70 Marks

ISE : 30 Marks

ICA : 25 Marks

Course Introduction:

Research is searching for and gathering information, usually to answer a particular question or problem. The word research is derived from the French word 'recherché' which means "to go about seeking". The word research consists of two syllables, "re" and "search". Research includes creative work which is undertaken on an organized basis in order to increase the bank of knowledge, including knowledge of humans, culture and society, and the use of this bank of knowledge to formulate new applications. It is used to create or confirm facts, reconfirm the results of previous work, solve new or existing problems, support theorems, or develop new theories. A research project may also be an extension on past work in the related field. Research is a continuous process and is useful in decision making.

Course Objectives:

During this course, student is expected to:

1. Develop an understanding of fundamental Research Process.
2. Identify the sources of information for literature review and data collection.
3. Develop an understanding of various Research Methods and its use.
4. Develop an understanding of various Research Design and its techniques.
5. Understand applications of statistical tools and methods.
6. Develop an ethical understanding and sense of technical writing.

Course Outcomes:

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

1. Understand the psychology of research which includes different perspectives and necessity of research.
2. Perform Literature Reviews using print and online databases.
3. Apply the research knowledge to formulate a suitable problem statement by adopting different research methods and models.
4. Apply different Research Design Techniques as per different applications.
5. Analyze the research outcome by using suitable statistical tool.
6. Write or present a scientific report and research proposal by adopting copyright based ethical values.

Section I

Unit-1: Introduction to Research Methodology **No. of lectures- 08**

Research - Meaning and Importance, Objectives, Motivation. Types of Research – Descriptive, Analytical, Applied, Fundamental, Quantitative, Qualitative, Conceptual, And Empirical. Research methods and Methodology. Selection and formulation of Research Problem. Research Design Motivation and objectives. Defining and formulating the research problem. Selecting the problem. Necessity of defining the problem.

Unit-2: Literature Review **No. of lectures- 04**

Importance of literature review in defining a problem. Primary and secondary sources - reviews, treatise, monographs, patents, web as a source, searching the web, Critical literature review. Identifying gap areas from literature review.

Unit-3: Research Methods **No. of lectures- 08**

Traditional Methods – Historical, Institutional, Legal, Philosophical, Comparative, Ethical methods. Modern Methods – Survey of Literature, Sampling method, Questionnaire, Schedule etc, Interview method and Focus Group discussion, Observation Method, Case Study method, Content analysis, Delphi method, Statistical Method, Experimental method, Brainstorming Techniques, Rating Scale. Ethnographic methods. Documentation methods.

Section II

Unit-4: Research Design **No. of lectures-06**

Basic Principles- Need of research design, features of good design important concepts relating to research design, Observation and Facts, Laws and Theories, Prediction and explanation, Induction, Deduction. Development of Models. The nature of research design, formulation of research design, classification of research designs - Descriptive, experimental, exploratory, diagnostic, correlative, action and evaluation. Developing a research plan. Determining experimental and sample designs. Pilot Study.

Unit-5: Statistical Tools & Methods **No. of lectures- 08**

Execution of the research, observation and Collection of data, diagrammatic & graphical presentation of data, sampling methods, tools & software, data Processing and analysis strategies, data analysis with statistical tools like mean, median, mode; dispersion: variance and deviation, analysis of variance: ANOVA and ANOCOVA, correlation, regression, hypothesis testing (Introductory Treatment)

Unit-6: Report and Technical Paper Writing **No. of lectures- 06**

Structure and components of scientific reports, types of report, Significance, Different steps in the preparation, layout, structure and language of typical reports, illustrations and tables, bibliography, Webliography, referencing, Appendices, plagiarism. Conference papers, Survey papers, Poster papers, Review papers Comparison, Structure of a survey, conference and journal paper. Research proposal: preparation, budgeting, presentation, funding agencies for engineering research.

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

1. Assignment on Introduction to Research Methodology
2. Assignment on Literature Review
3. A case study on Research Method
4. Assignment on Research Design
5. Assignment on use and applications of Statistical Tools
6. Assignment based on use of Statistical Methods (theory and simple numerical)
7. A case study on Regression Analysis
8. A case study on Report Writing and Research Proposal
9. Assignment on Introduction, requirement, type and importance of Intellectual Property rights in research.

Text Books:

1. Research Methodology: Methods and Techniques, Kothari C.R., 2011.. New Age International
2. An introduction to Research Methodology; Garg B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. RBSA Publishers.
3. Research Methodology; Panneerselvam R., PHI, Learning Pvt. Ltd., New Delhi - 2009
4. Research Methodology: Concepts and cases, Chawala D. and N. Sondhi ; Vikas Publishing House Pvt. Ltd.

Reference Books

1. Research Methods: A Process of Inquiry Anthony, M., Graziano, A.M. and Raulin, M.L., 2009, Allyn and Bacon.
2. Proposal Writing; Coley, S.M. and Scheinberg, C. A., 1990, Sage Publications.
3. Research Methodology: A practical and scientific Approach, Vinayak Bairagi and Mousami V Munot, CRC Press.

Punyashlok Ahilyadevi Holkar Solapur University
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
ME415 O : Supply Chain Management

***Teaching Scheme**
Lectures : 03 Hours/week, 03 Credits
Practical : 02Hours/week, 01 Credit

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

Course Introduction:

Supply chain management is a process that involves the planning, organizing, directing, and controlling of the flow of goods and services from the point of origin to the point of consumption. It is a vital process for companies that want to ensure that their products are delivered on time and in the right quantities. It is a complex process, and you may be wondering how to get started with it. It is not as difficult as you might think though. To begin, you will need to decide what your goals are in supply chain management, is your goal to learn supply chain management, or is it to be a successful supply chain manager? Both are great. The course will teach you the essentials of supply chain management and give you the tools for success. This course on supply chain management can teach you how to effectively manage their supply chains and improve their overall operations.

Course Objectives:

During this course, student is expected to:

1. To introduce students with basic concepts of Logistics and supply chain Management
2. To teach students practical application of the subject for enhancing business efficiency.
3. To expose students to contemporary business concepts.
4. To learn about the latest trends and developments in the field
5. To develop strategies for improving supplier relationships
6. To learn how to cut costs without compromising quality or delivery times

Course Outcomes:

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

1. Explain the basic concept of supply chain management.
2. Explain the importance of coordination in supply chain management.
3. Explain the global supply chain strategy
4. Solve the problems on inventory models.
5. Evaluate the Performance in global supply chains.
6. Explain the recent trends in supply chain management.

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.

Internal Continuous Assessment (ICA):

List of Experiments/Assignments/Case Studies, etc. (Any six)

1. Case study on problems in SCM
2. Case study on supply chain strategy
3. Assignment/ Case study on supply chain performance measurement and trends
4. Solve the problems related to inventory models
5. Case study on World Class Supply Chain Management
6. Case study on E-Commerce in Supply Chain Management
7. Case study on Green 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
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
ME415 O: Finite Element Method

***Teaching Scheme**
Lectures : 03 Hours/week, 03 Credits
Practical : 02Hours/week, 01 Credit

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

Course Introduction:

The Finite Element Method (FEM) or Finite Element Analysis (FEA) is a numerical technique to find approximate solutions of partial differential equations. FEM is an integral part of CAE and is extensively used in analysis and design of real life complex problems. Several sophisticated commercial and free FEM software are available in the market, but to use these effectively and to understand & analyze the results theoretical foundations of FEM are essential. This course is designed to cover both aspects (theory and software) of FEM. This course will enable the student to formulate and solve the mathematical equations for 1D, 2D and 3D finite by hand and using FEM software.

Course Objectives:

During this course, the student is expected to:

1. Understand general procedure involved in FEM as applied to structural & thermalproblems.
2. Apply direct method to formulate FEM equations for 1D, 2D and 3D elements.
3. Understand the use of variational formulation and method of weighted residuals insolving field problems.
4. Use the latest FEM software in solving problems for research and industry.

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

1. Implement general procedure of FEA for structural and thermal problems.
2. Write down shape functions for 1D, 2D and 3D elements.
3. Solve 1D, 2D and 3D problems using FEA procedure.
4. Solve boundary value problems using variational calculus and weighted residuals methods.
5. Analyze of 1D, 2D and 3D problems for static and dynamic loads in commercial or opensource FEA software.
6. Analyze of 1D, 2D and 3D problems for linear and non-linear responses in commercial oropen source FEA software.

Section I

Unit -1: FEA fundamentals, Mathematical Background **No. of lectures - 8**

History and fundamentals of FEA, General FEM procedure, direct formulation for uniaxial elements using matrix methods, applications of FEM, comparison to other computational techniques such as FDM, BEM, FVM and their applications, merits and demerits of FEM compared to exact solutions and experimentation. Types of elements, interpolation function definition. Variational calculus, Ritz method, methods of weighted residuals such as, Elimination Method, Penalty Method, (Simple numerical exercises on Ritz Method and Galerkin-Bubnov method only, simple problems on elimination and penaltymethod)

Unit -2 : Model Validity, Solvers, Software capability and comparison **No. of lectures - 6**

Model validity, mesh design & refinement, element distortion. Sub modelling and sub structuring. Overview of solvers, selection of solvers. Overview review of free and commercial software, comparison of capabilities, Preprocessors, Solvers, Post Processors, Comparison of capabilities of free and commercial software packages

Unit -3: Finite element formulation for 1D elements **No. of lectures - 6**

Types of 1D elements, interpolation functions for 1D elements such as truss, beams and thermal elements, shape functions for the same, formulation of system equations for trusses and beam elements, calculation of stresses and strains. Shape functions for 1D elements in global and natural coordinates. Applications of 1D elements.(Derivations using Lagrangian Polynomials and Simple Numerical Exercises)

Section II

Unit - 4: Finite element formulation for 2D elements **No. of lectures - 6**

2D Elements such as triangles and quadrilaterals, Pascal triangle for formulating interpolation functions, shape functions for 2D elements, LST, CST, linear and parabolic quads, axisymmetric elements, 2D shell elements. Shape functions for 2D elements for in global and natural coordinates. Applications of 2D elements.(Derivations using Lagrangian Polynomials and Simple Numerical Exercises)

Unit -5: Finite Element Formulation for 3D elements **No. of lectures - 6**

3D elements such as tetrahedrons and brick elements, Interpolation functions for 3D elements, Pascal Tetrahedron, shape functions, formulation of system equations, calculation of stresses and strains. Applications of 3D elements (Derivations using Lagrangian Polynomials and Simple Numerical Exercises

Unit - 6: Nonlinear and Dynamic Analysis **No. of lectures - 8**

Nonlinear elasticity problems: Material, geometric and boundary condition non-linearity, contact and gaps. Dynamic Problems: Modal Analysis, transient response analysis, harmonic analysis, spectrum analysis, transient thermal analysis. Introduction to explicit analysis, fatigue

Internal Continuous Assessment (ICA):

List of Experiments/Assignments/Case Studies, etc. (Any eight)

1. One assignment on FEA fundamentals and comparison with other techniques.
2. One assignment with numerical exercises on variational formulation and method of weighted residuals formulation
3. One software assignment supported by hand calculations on 1D structural and thermal analysis..
4. One software assignment (supported by hand calculations if applicable) on 3D Structural and thermal analysis.
5. One software assignment (supported by hand calculations if applicable) on 3D structural analysis.
6. One software assignment on non-linear FEA.
7. One software assignment on dynamic FEA.
8. One assignment on Natural Coordinates and Isoperimetric formulation
9. One assignment on FEA applications and future developments.
10. One software assignment on fatigue analysis using FEA

Text Books:

1. David V. Hutton, Fundamental of Finite Element Analysis, Tata McGraw-Hill Education Pvt.Ltd.
2. P. Seshu, Text book of Finite Element Analysis, PHI Learning Private Ltd., New Delhi.
3. U. S. Dixit, Finite Element Methods, Cengage Learning.
4. S.S Bhavikatti, Introduction to Finite Elements, New Age International Publications.
5. Daryl Logan, A First Course in the Finite Element Method, Cengage

Reference Books

1. R. D. Cook, et al., Concepts and Applications of Finite Element Analysis. Wiley, India
2. K. J. Bathe, Finite Element Procedures Prentice, Hall of India (P) Ltd., New Delhi.
3. O. C. Zienkiewicz, R. I. Taylor, The Finite Element Method, Butterworth - Heinemann
4. M. J. Fagan, Finite Element Analysis, Theory and Practice, Pearson Education Limited.

Punyashlok Ahilyadevi Holkar Solapur University
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
ME416: Industrial Training

***Teaching Scheme**

Tutorial: 01Hours/week, 01 Credit

***Examination Scheme**

OE : 25 Marks

ICA: 50 Marks

Course Introduction:

Industrial training is must for every engineering student. Students know the theoretical knowledge but practical application of same in industry need to be understood. Students should understand working of industry, machinery, quality process, manufacturing process etc for which training is important. Student has to undergo a training of minimum 15 days at core Mechanical Industry either in summer vacation after second year Part-II or Third year Part-I or after Third year Part-II, i. e in winter vacation/summer vacation. This will help student to understand industrial culture, working, role of an engineer in industry.

Course Objectives:

During this course, student is expected to:

1. Learn the basic concepts of Project & Production Management.
2. study the concept of Facility, Location & Layout & implement in their Industrial In-plant training Project work.
3. Expose the students to the real life working experience and expanding the knowledge in their specific field.
4. Understanding of the impact of engineering solutions and industrial safety in a global and social context.
5. Interact and build interpersonal skills

Course Outcomes:

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

1. Explain the basic concepts of Project & Production Management.
2. Implement Project Planning in their Industrial In-plant Training Project work.
3. Interact with industrial personnel and follow engineering practices and discipline prescribed in industry.
4. Develop awareness about general workplace behavior and build interpersonal and team skills.
5. Prepare professional work reports and presentations.

- **Procedure for Assessment of Industrial Training done by student**:
  1. Undergo Industrial Training of minimum 15 days.
  2. Prepare a report of training done in a prescribed format before end of Part I Semester of final year B.Tech. (Along with a certificate from the concerned industry).
  3. Format of the report will be decided by the concerned guide/institute.
  4. The report is to be comprehensive and presented in duplicate, typed on a standard A4 size sheet and bound.
  5. Deliver the presentation to project guide on industrial Training Report.

Punyashlok Ahilyadevi Holkar Solapur University
Final Year B.TECH. (Mechanical Engineering)
Semester-VII
ME417: Project Work Stage-I

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

***Examination Scheme**
ICA: 50 Marks

Course Introduction:

Project work is kept in the final year of engineering so that students' will apply their knowledge gained through previous classes to create and evaluate innovative things. In this it is expected to solve some pressing problem related to industry or society. While carrying out the work many qualities are developed in students such as problem solving ability, modern tool usage, leadership, ethics, communication, project management, finance and lifelong learning etc.

Course Objectives:

During this course, student is expected to:

1. Understand the basic concepts & broad principles of Industrial or social project ideas.
2. Study a sound technical knowledge of their selected project topic.
3. Locate and use technical information from multiple sources.
4. Identify the problem as per need of industry or society.

Course Outcomes:

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

1. Identify the problem which is related to industry or society.
2. Carry out state of the art related to the problem identified.
3. Plan the work for solving identified problem.
4. Apply basic engineering knowledge for solving the identified problem.

Guidelines for Project content & Mark Distribution:

a. Work diary and weekly reporting -05 marks
b. Synopsis- 10 marks
c. Progress report submission and presentation-10 marks

Project Term Work:

The term work under project submitted by students shall include:

a. Work diary and weekly reporting:

Work Diary maintained by group and countersigned by the guide weekly. The contents of work diary shall reflect the efforts taken by project group for:

1. Searching suitable project work

2. Brief report, preferably on Journals/ conference papers/ books or literature surveyed to select and bring out the project.

3. Brief report of feasibility studies carried to implement the project objectives.

4. Proposed diagram/ Design calculations, etc.

b. Synopsis:

The group should submit the synopsis (of 4-5 pages) in following form.

1. Title of Project

2. Names of Students

3. Name of Guide

4. Proposed work (Must indicate the scope of the work & weekly plan up to March end)

5. Approximate Expenditure (if any)

The synopsis of project is expected to approve by the guide and endorsed by the Head of the Department.

Note:- The project group consist not more than four students.

c. Progress report submission and presentation:

The group has to give a power point presentation in front of the faculty of department on the progress completed till end of first semester along with the progress report.

Punyashlok Ahilyadevi Holkar Solapur University
Final Year B.TECH. (Mechanical Engineering)
Semester-VIII
ME422 : Project Phase – II (Progress Presentation - I)

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

***Examination Scheme**
ICA : 50 Marks

Course Objectives:

During this course, student is expected to:

1. Review on project phase -I.
2. Collect sufficient information to provide solution of defined problem.
3. Apply the fundamentals of mechanical engineering for solving the project problem.
4. Plan, implement and execute the project.

Course Outcomes:

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

1. Communicate with various stakeholders and perform the work in team.
2. Formulation and possible solution for project problem
3. Develop model using suitable software.
4. Test the developed model.
3. Write effective technical report and demonstrate through presentation.

In project work stage-II following work is expected from the students:

1. Formulation and possible solution for project problem.
2. Design, develop model and simulate it using suitable software.
3. Development of virtual and physical model
4. Carry out testing using suitable testing instrument and technique.
5. Prepare technical report and presentation.

Punyashlok Ahilyadevi Holkar Solapur University
Final Year B.TECH. (Mechanical Engineering)
Semester-VIII
ME423 : Project Phase – III (Progress Presentation - II)

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

***Examination Scheme**
ICA : 50 Marks

Course Objectives:

During this course, students is expected to:

Apply the knowledge/concepts acquired in the project phase I and II to create/ design/ implement project relevant to the field of Mechanical Engineering.

Course Outcomes:

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

1. Design and develop the Project model.
2. Implement/Simulate/Test and deploy the project application.
3. Compile relevant data, interpret & analyze it.
4. Present and defend the project relevance/creation/design/implementation/simulation
5. Prepare project report in a standard format

In project stage-III, following work is expected from the students:

- Design and develop the project model.
- Simulate/Test and arrange the project application.
- Compile relevant data and do analysis
- Arrive at logical conclusions and defend the project work
- Report writing and preparing presentation.

a) Project Report format:

1. Front cover page: Containing title of the project, year, prescribed authority, names of students, guide name, department, institution name and address.

2. Certificate page: Certificate stating the completion of the Bonafide project, certified by guide, HOD, Principal and external examiner.

3. Acknowledgement and Abstract

4. List of contents/tables/figures

5.Body of the report: Body of the project should normally contain the following appropriate/relevant parts/chapters

- Introduction (History, Importance of Project Area, Problem identification, Objective of the Project)
- Literature survey
- Design/ Experimentation/ Fabrication/ Production/ simulation of Virtual/ physical model and implementation
- Assembly/Fabrication/User manual/Operational instructions
- Observation/ Analysis/ Findings/Results
- Discussion on Results and Conclusion
- Conclusion and Future Developments
- Reference/Bibliography: For Books: “Title of Book”; Authors; Publisher; Edition; For Papers: Authors, Year of Publication, “Title of Paper”; Conference Details/General Details;

6.Back cover page

7. Physical attributes: Project report should be of 25 to 50 pages (More pages can be used if needed). Back to back printing. Spiral binding.

8. Fonts and Page layout: A4 size with standard/default MS word page layout. Times New Roman font, Font size: 10 for captions, 12 for running text and sub-titles, 14 for paragraph titles and 16 for chapter titles, Line Spacing: 1.5 Lines, Top Margin: 1.00 Inches, Bottom Margin: 1.32 Inches, Left Margin: 1.5 Inches, Right Margin: 1.0 Inches Page Numbers: Right aligned at footer.

b) Presentation:

The group has to prepare a power point presentation on project report, project and present it in front of the faculty of department along with the demonstration of the project. One copy of the report should be submitted to Institute/ Department, One copy to Guide and one copy should remain with each student of the project group.

(Sample Format for Project Work Diary):

Project Progress Sheet

Activity Week: Date from…… to……..

Description of the Work Performed by the student:

(Literature Survey /Design/ Drawings / Purchase/ Manufacturing / Testing/Data Collection / Analysis/ Algorithm/ Flowchart/ Simulation)

……

Space for Drawings:

Constraint / Problem Found:

……

……

……

Activity to be carried out in next week:

……

……

Remarks by the Guide/ Co-Guide:

……

……

……

Date: Sign of Guide/Co-Guide:

Punyashlok Ahilyadevi Holkar Solapur University
Final Year B.TECH. (Mechanical Engineering)
Semester-VIII
ME424: Project Phase – IV
(Report Submission & Final Presentation)

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

***Examination Scheme**
POE: 50 Marks
ICA : 50 Marks

Course Objectives:

During this course, student is expected to:

1. Prepare Project report as per format given in Project Phase-III.
2. Communicate effectively both in verbal/non-verbal and written form.
3. Defend the completed project work in front of the experts.

Course Outcomes:

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

1. Prepare presentation and report as per prescribed format
2. Demonstrate project work in front of various stakeholders.
3. Develop lifelong learning skill.

In Project Work (Report Submission & Presentation), students are expected to complete the following work:

1. Submit the project report in the prescribed format.
2. Prepare the power point presentation and present it in front of examiners.