Walchand Institute of Technology, Solapur
(An Autonomous Institute)

Affiliated to
Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Choice Based Credit System (CBCS)

Structure and Syllabus
for
Final Year B.Tech. Mechanical and Automation Engineering
W.E.F. 2025-26

HEAD
Mechanical Engineering Deptt.
Walchand Institute of Technology,
Solapur.

Dr. Mrs. M. A. Nirgude
Dean, Academics

Department of Mechanical Engineering

Vision

- To produce world class globally competent distinguished graduates/ post graduates/ doctoral, Mechanical Engineers on the basis of their capabilities, dedication and work ethic and continuously strive towards societal development.

Mission

- **M1:** To impart quality Mechanical Engineering education in accordance with the needs of the society.
- **M2:** To produce globally competent Mechanical Engineers through research, industry institute interaction.
- **M3:** To help Mechanical Engineering graduates to implement their acquired engineering knowledge for society and community development.

Mechanical and Automation Engineering

Program Educational Objectives (PEOs)

- Graduate will excel in professional career in the field of Mechanical and Automation Engineering.
- Graduate will exhibit strong fundamentals required to pursue higher education and continue professional development in emerging technology in Mechanical and Automation Engineering.
- Graduate will adhere to ethics develop team spirit and effective communication skills to be successful leaders with a holistic approach to societal and environmental issues with professional conduct.

Knowledge and Attitude Profile (WK)

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

	mutual understanding and respect, and of inclusive attitudes.
Program Outcomes (POs)	
PO 1	**Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO 2	**Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO 3	**Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO 4	**Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
PO 5	**Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO 6	**The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
PO 7	**Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO 8	**Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO 9	**Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning difference
PO 10	**Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to

	manage projects and in multidisciplinary environments.
PO 11	**Life-long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)
Program Specific Outcomes (PSOs)	
1. Design high quality mechanical and automation engineering equipments for the modern industry and society. 2. Implement manufacturing processes for mechanical and automation engineering equipment.	

Department of Mechanical Engineering

Legends Used	
L	Lecture Hours / week
T	Tutorial Hours / week
P	Practical Hours / week
FA	Formative Assessment
SA	Summative Assessment
ESE	End Semester Examination
ISE	In Semester Evaluation
ICA	Internal Continuous Assessment
POE	Practical and Oral Exam
OE	Oral Exam
MOOC	Massive Open Online Course
HSS	Humanity and Social Science
NPTEL	National Programme on Technology Enhanced Learning
F.Y.	First Year
S.Y.	Second Year
T.Y.	Third Year
B. Tech.	Bachelor of Technology

Mechanical and Automation Engineering

Course Code Format

2	**2**	**M**	**A**	**U/P**	**2**	**C**	**C**	**1**	**T/L**
Year of Syllabus revision		Program Code		U-Under Graduate P-Post Graduate	Semester No./ Year 1/2/3/…8	Course Type		Course Serial No 1-9	Theory, L-Lab session P- Programming

Program Code	
MA	Mechanical and Automation Engineering
Course Type	
BS	Basic Science
ES	Engineering Science
HU	Humanities & Social Science
MC	Mandatory Course
CC	Core Compulsory Course
SN*	Self-Learning **N*** *indicates the serial number of electives offered in the respective category*
EN*	Core Elective **N*** *indicates the serial number of electives offered in the respective category*
ON*	Open Elective **N*** *indicates the serial number of electives offered in the respective category*
SK	Skill Based Course
SM	Seminar
MP	Mini project
PR	Project
IN	Internship

Sample Course Code	
22MAU7CC1T	Refrigeration and Air Conditioning

Mechanical and Automation Engineering

B. Tech. Semester VII

Course Code	Name of Course	Engagement Hours			Credits	SA		FA		Total
		L	T	P		Theory	OE/ POE	ISE	ICA	
22MAU7CC1T	Refrigeration and Air Conditioning	3			3	60		40		100
22MAU7CC2T	Robotics	3			3	60		40		100
22MAU7EN*T	Core Elective-III	3			3	60		40		100
22MAU7ON*T	Open Elective	3			3	60		40		100
	Subtotal	12			12	240		160		400
Laboratory Courses										
22MAU7CC1L	Refrigeration and Air Conditioning Lab			2	1		25		25	50
22MAU7CC2L	Robotics Lab			2	1				25	25
22MAU7EN*L	Core Elective-III Lab			2	1				25	25
22MAU7ON*L	Open Elective Lab			2	1				25	25
22MAU7PR4L	Capstone Project – Phase I			8	4		50		100	150
	Subtotal			**16**	**8**		**75**		**200**	**275**
	Grand Total	**12**		**16**	**20**	**240**	**75**	**160**	**200**	**675**

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Mechanical and Automation Engineering

B. Tech. Semester VIII

Course Code	Name of Course	Engagement Hours			Credits	SA		FA		Total
		L	T	P		Theory	OE/ POE	ISE	ICA	
22MAU8PR1L	Capstone Project – Phase II			4	2		50		50	100
22MAU8IN2L	Internship II			20	10		100		100	200
	Grand Total			**24**	**12**		**150**		**150**	**300**

Note:

- N* indicates the serial number of electives offered in the respective category
- ## indicates program code of offering Programme

List of Core Elective Courses:

N^*	Course Title	Course Code
C1	Industrial Engineering	22MAU7EC1T
C2	Finite Element Method	22MAU7EC2T
C3	Plastic Engineering	22MAU7EC3T
C4	Power Plant and Energy Engineering	22MAU7EC4T

List of Open Elective Courses:

N^*	Course Title	Course Code
A1	Entrepreneurship Development	22MAU7OA1T
A2	Production and Operations Management	22MAU7OA2T
A3	Supply Chain Management	22MAU7OA3T
A4	Research Methodology	22MAU7OA4T

- **Internship should be of minimum 60 days.**
- **Internship may be offered by**
  - Industry at their premises.
  - Industry at the institute campus.
  - Institute jointly with the research funded agency/ industry.

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WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
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Final Year B.Tech. (Mechanical and Automation Engineering), Semester-VII

22MAU7CC1T: Refrigeration and Air-Conditioning

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hours/week	**ESE**	60 Marks
Practical	2 Hours/week	**ISE**	40 Marks
Credits	4	**ICA**	25 Marks
		OE	25 Marks

Introduction:

The course consists of different refrigeration cycles such as Air refrigeration cycle, Vapour Compression cycle, Vapour absorption cycle. It also covers properties of refrigerants and various alternative refrigerants and understanding of psychrometric 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 Prerequisite:

Applied Thermodynamics, Heat Transfer

Course Objectives:

1. To study the fundamental and different methods of refrigeration and air conditioning.
2. To compare different refrigerants with respect to properties, applications and environmental issues.
3. To understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.
4. To acquire the skills required to design and analyze refrigeration and air conditioning components and systems.

Course Outcomes:

After completing the course, students 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

Unit – I	**Basic Refrigeration Cycles and Refrigerants**	**6 Hours**

A) Basic refrigeration cycles, refrigeration, units of refrigeration, applications of refrigeration, reversed Carnot cycle with vapour as refrigerant, refrigerator and heat pump, calculation of cop
b) Refrigerant classification, desirable properties, nomenclature of refrigerants, selection of refrigerant, secondary refrigerants, Ozone Depletion Potential (ODP) and Global Warming Potential (GWP), Total Equivalent Warming impact (TEWI), alternative refrigerant

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Unit – II	**Vapour Compression Systems**	**6 Hours**
Working of simple vapour compression system, representation of different Vapour Compression Cycle (VCC) on T-S and p-h diagram, sub cooling, superheating, liquid-suction heat exchanger, analysis and performance calculations of above cycles, effect of operating parameters on performance of VCC, actual VCC, methods of improving coefficient of performance, multi-pressure systems: flash gas removal, flash inter cooling, compound compression with intercooling, multiple evaporator systems		
Unit – III	**Vapour Absorption Systems**	**5 Hours**
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		
Unit – IV	**Cryogenics**	**3 Hours**
Introduction to cryogenics, limitations of vapour compression systems to produce low temperature, cascade refrigeration system, Linde system for liquefaction of air, applications of cryogenics		
Unit – V	**Psychrometry**	**6 Hours**
Dalton's law of partial pressure, psychometrics properties of moist air, enthalpy of moist air, use of psychometric tables and charts, psychometrics processes, combinations and calculations, shf, bpf, adp, coil condition line		
Unit – VI	**Comfort Conditions**	**5 Hours**
Human comfort condition, thermodynamics of human body, comfort and comfort chart, factors affecting human comfort, concept of infiltration and ventilation, indoor air quality requirements		
Unit – VI	**Heating and Cooling Load Calculations**	**6 Hours**
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, cooling load calculations, load analysis by RSHF, GSHF, and ESHF		
Unit – VI	**Air Conditioning and Air Distribution Systems**	**3 Hours**
A) Air conditioning systems: 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) Air distribution systems: 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, grills, registers, diffusers		
ICA consists of minimum 8 practical/assignments from the below list 1. Study of refrigeration methods 2. Study of charging, leak testing of refrigeration systems 3. Trial on refrigeration test rig. 4. Trial on heat pump test rig.		

5. Trial on vapour absorption system
6. Trial on air conditioning tutor
7. Calculation of cooling load for given space drawing
8. Visit to refrigeration plant or central air conditioning plant
9. Study of ASHRAE codes
10. Study of green building/net zero building.

Text Books

1. C. P. Arora, Refrigeration & Air Conditioning, McGraw Hill
2. Manohar Prasad, Refrigeration & Air Conditioning, New Age International Publications

Reference Books

1. Stocker, Refrigeration & Air Conditioning, McGraw Hill
2. Roy J Dossat, Principles of Refrigeration, Pearson Publications
3. W. P. Jones, Air Conditioning Applications & design, B. H. Publications

e-Resources

https://archive.nptel.ac.in/courses/112/105/112105129/

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

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Final Year B.Tech. (Mechanical and Automation Engineering), Semester-VII

22MAU7CC2T: Robotics

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hours/week	**ESE**	60 Marks
Practical	2 Hours/week	**ISE**	40 Marks
Credits	4	**ICA**	25 Marks

Introduction:

This course offers a comprehensive overview of industrial robotics, covering history, fundamentals, kinematics, dynamics, and programming. Students will learn about robot components, motion planning, and control systems. By the end of the course, students will be equipped with essential skills and knowledge to design and implement robotic systems.

Course Prerequisite:

Engineering Mechanics, Mechatronics, Control Engineering

Course Objectives:

1. To provide students with a foundational understanding of industrial robotics, including history, components, configurations, actuators, sensors, and end effectors.
2. To equip students with the ability to understand and apply the principles of forward and inverse kinematics in robotic systems.
3. To introduce students to the fundamental concepts of robot dynamics and motion planning.
4. To familiarize students with linear control techniques and programming languages used in robotics.

Course Outcomes:

After completing the course, students will be able to

1. Identify key components and configurations of industrial robots, and select appropriate actuators, sensors, and end effectors for various applications.
2. Analyze the forward and inverse kinematics of various robotic arms, including planar, SCARA, PUMA, and KUKA robots.
3. Model robot dynamics using various formulations and develop motion planning strategies for different robotic applications.
4. Implement control system for robotic systems and develop robot programs using various programming languages and methods.

Unit – I	**Introduction to Robotics**	**4 Hours**

History and fundamentals of industrial robots, definitions of robot, classification and applications, laws of robotics, flexible automation vs robotics technology, robot anatomy and configurations, cartesian, cylindrical, polar, articulated, SCARA, pendulum arm, multiple joint arm, parallel manipulator, work envelope/volume, degree of freedom associated with robot arm & wrist, joints & joint notification scheme

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Unit – II	**Actuators, Sensors & End Effectors**	**4 Hours**
Actuators: classification, working and selection of electric, hydraulic and pneumatic actuators, sensors, classification, working, selection and design considerations of internal sensors, position sensors, velocity sensors, acceleration sensors & force sensors, external sensors: contact and non-contact type-proximity sensor, end effectors, classification, construction, working, applications, design, and selection criteria for end effectors.		
Unit – III	**Forward Kinematics**	**6 Hours**
Robot architecture-links and joints, kinematic chain, degrees of freedom, pose of a rigid body, homogenous transformations, introduction to D-H parameters, forward kinematics of planar arms (2 DOF and 3 DOF), SCARA robot, puma robot, KUKA KR-5 robot		
Unit – IV	**Inverse Kinematics**	**6 Hours**
Difference between forward and inverse kinematics, inverse kinematics of planar arm (2 DOF and 3 DOF), Jacobian matrix of a two-link and three-link revolute arm		
Unit – V	**Introduction to Robot Dynamics**	**6 Hours**
Inertia properties, Euler–Lagrange formulation, Newton Euler formulation, dynamic modeling, analytical expressions		
Unit – VI	**Introduction to Motion Planning**	**6 Hours**
Joint space planning, cartesian space planning, path primitives, cartesian trajectories, point-to-point vs continuous path planning		
Unit – VII	**Linear Control of Robot**	**4 Hours**
Control techniques, dynamic systems, transfer function and state-space representation performance and stability of feedback control, joint controllers, Proportional Integral Derivative (PID) control, selection of PID controller gains		
Unit – VIII	**Robot programming and languages**	**4 Hours**
Robot programming, methods of robot programming, wait, signal and delay commands, subroutines, programming languages, generations of robotic languages, introduction to various types such as VAL, RAIL, AML, Python, ROS etc., development of languages since wave till ROS		
ICA consists of minimum 8 practical/assignments from the below list 1. Survey assignment on robot classification, applications, robot anatomy and configurations. 2. Use CAD software to model different robot configurations and label their components, joints, and work envelopes 3. Survey assignment on actuator, sensors, and grippers 4. Design a simple gripper using 3D modeling software for a suitable application. 5. Forward kinematics supported by suitable software 6. Inverse kinematics supported by suitable software 7. Develop the dynamic model of a simple 2 DOF robotic arm using the Euler–Lagrange formulation 8. Derive the dynamic equations for a 2 DOF robot arm and simulate its motion		

9. implement and compare different path planning algorithms (point-to-point vs. continuous path planning) for a robotic arm
10. Design a PID controller for a single joint of a robotic arm and simulate its performance using suitable software
11. Write and execute a simple robot program using wait, signal, and delay commands on a simulation platform.
12. Set up a basic ROS environment and write a simple program to control a simulated robot using ROS

Text Books

1. Groover M. P, Automation, Production Systems, and Computer-integrated Manufacturing, Pearson Education
2. Deb S. R., Deb, S., Robotics Technology and Flexible Automation, McGraw Hill Education
3. Sandler B. Z., Robotics: Designing the Mechanisms for Automated Machinery, Academic Press/Prentice Hall
4. Tsai L. W., Robot Analysis: The Mechanics of Serial and Parallel Manipulators, Wiley Inter science
5. Nagarajan R., Introduction to Industrial Robotics, Pearson Education India
6. Gupta A. K., Arora S. K., Westcott J. R., Industrial Automation and Robotics: An Introduction, Mercury Learning & Information, Mercury Learning & Information

Reference Books

1. Saha S. K., Introduction to Robotics, McGraw-Hill Education,
2. Ashitava G. Robotics: Fundamental Concepts and Analysis, Oxford Press
3. Niku S. B., Introduction to Robotics, Analysis, Control, Applications, Wiley Publications
4. Schilling R. J. Fundamentals of Robotics: Analysis and Control, Prentice Hall India.

e-Resources

https://archive.nptel.ac.in/courses/112/105/112105249/

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

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Final Year B.Tech. (Mechanical and Automation Engineering), Semester-VII

22MAU7EC1T: Core Elective III - Industrial Engineering

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hours/week	**ESE**	60 Marks
Practical	2 Hours/week	**ISE**	40 Marks
Credits	4	**ICA**	25 Marks

Introduction:

Industrial Engineering is concerned with the design, improvement and installation of integrated system of people, material, information, equipment and energy. Its draws upon specialized knowledge and skill in the mathematical, physical and social science together with the principles and methods of engineering analysis and design, to specify, predict and evaluate the results to be obtained from such systems. This course includes, basic concepts of industrial engineering and its applications to improve productivity for manufacturing and service sector. Method study, work measurement, Job evaluation and merit rating for improving overall productivity is also addressed. Plant layout, facility location, safety and ergonomic consideration for improving productivity are also dealt in this course.

Course Prerequisite:

Manufacturing Processes and Technology

Course Objectives:

1. Understand the principles and evolution of Industrial Engineering, including productivity factors, work study techniques, and their role in process improvement.
2. Study methods of work measurement, ergonomics, and safety standards to design efficient, safe, and human-centric workplaces aligned with legal and industrial norms.
3. Study optimal facility layouts and evaluate job roles and performance, using tools for facility location, job evaluation, and merit rating to enhance operational efficiency.
4. Understand quality control and assurance practices, and explore recent trends such as TQM, Six Sigma, Kaizen, and ISO standards to improve product and process reliability.

Course Outcomes:

After completing the course, students will be able to

1. Identify key principles and tools of Industrial Engineering and their role in productivity improvement.
2. Apply work study, ergonomics, and safety principles to design efficient and safe work systems.
3. Select plant layouts and job evaluation methods to improve facility planning and resource allocation.
4. Use quality control techniques for performance enhancement.

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Unit – I	**Introduction to Industrial Engineering**	**4 Hours**
Definitions and meaning of i.e., contribution by F.W. Taylor, Gilbreth, objectives of I.E., productivity - factors affecting productivity and ways to improve productivity, work study – definitions, objectives, importance of work study procedure, relation of work study with – work simplification, human relation		
Unit – II	**Method Study.**	**6 Hours**
Definition, objective, scope of method study, basic procedure symbols and recording of facts, charting conventions, charts – operation process chart, flow process chart, multiple activity chart, two handed process charts, diagrams – flow and string diagram, travel chart templets and models, micro motion study. Therbligs simo chart, critical examination and selection, implementation method		
Unit – III	**Ergonomics and Industrial Safety**	**6 Hours**
Definition, man machine system, types of display, types of control, manual material handling, anthropometry, design of work place and working conditions, ILO norms, definition of accident, cause of accident, prevention of accident, safety measures factor acts, minimum wages act, employers state insurance act		
Unit – IV	**Work Measurements**	**6 Hours**
Definition, objective and techniques of work measurement, time study, stop watch method, performance rating, allowance, relaxation interference contingency, policy, calculation of standard time, work sampling its need and procedure, Predetermined Motion Time Study (PMTS)		
Unit – V	**Facility Locations and Plant Layout**	**6 Hours**
A) Factors affecting site selection: - intangible factors for facility location, tangible factor for facility location, advantages and disadvantages of facility location in urban and rural areas B) Plant layout: - characterization of an efficient layout objectives of plant layout, principles of plant layout, procedure in planning layout, types of plant, layout product/line layout, process/functional layout, fixed position/static layout, cellular/group technology layout, selection of material handling equipment		
Unit – VI	**Job Evaluation and Merit Rating**	**4 Hours**
Job evaluation, objectives, advantages and procedure, job analysis, job description, job specification, methods of evolution, merit rating, objectives and method of merit rating		
Unit – VII	**Quality Assurance**	**4 Hours**
Definition of quality, Quality Control (QC), Quality Assurance (QA), Statistical Quality Control (SQC) and reliability. importance of quality, difference between reliability and quality control, factors affecting and improving reliability, QA tools, concept of total quality cycle, quality of design, quality of performance, quality of conformity and total quality. difference between inspection and quality control		

Unit – VIII	Recent trends in industrial engineering	4 Hours
International organization for standardization and its role, iso standard series and quality managements system, Total Quality Control (TQC) and Total Quality Management (TQM), philosophical concepts, concept of Six Sigma and its applications, concept and applications of Kaizen, definition, objectives and applications of ergonomics, normal and maximum work area, environmental requirements of work place		
ICA consists of minimum 8 practical/assignments from the below list 1. Prepare Operation Process Chart (OPC) for given assembly. 2. Prepare flow process chart and flow diagram for given assembly for OPC. 3. Prepare man-machine chart for the given situation 4. Calculate co-efficient of correlation for time study person using performance rating technique. 5. Calculate standard time for given job 6. Case study on plant layout using suitable software. 7. Review of existing layout of a workstation with respect to controls and displays and suggesting improved design from ergonomic viewpoint 8. Conduct process capability study for a machine in the workshop 9. Assignment on quality assurance 10. Assignment on recent trends		
Text Books		
1. Martand Telsang, Industrial engineering and Production management, S. Chand Publications 2. A. K. Gupta, Engineering management, S. Chand Publications 3. O. P. Khanna, Industrial Engineering and Management, Khanna Publishing House 4. O. P. Khanna, Work Study, Dhanpat Rai and Sons Publications		
Reference Books		
Introduction to work study by ILO., Universal Publication		
e-Resources		
https://nptel.ac.in/courses/112107142		

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

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Final Year B.Tech. (Mechanical and Automation Engineering), Semester-VII

22MAU7EC2T: Core Elective III - Finite Element Method

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hours/week	**ESE**	60 Marks
Practical	2 Hours/week	**ISE**	40 Marks
Credits	4	**ICA**	25 Marks

Introduction:

The Finite Element Method (FEM) is a numerical technique to find approximate solutions of partial differential equations. FEM is an integral part of Computer Aided Engineering (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 equationsfor1D, 2D and 3D finite by hand and using FEM software. Hands-on approach on FEM is included in this course.

Course Prerequisite:

Fundamentals of mechanics, elementary solid mechanics (SOM), elementary fluid mechanics, and principles of heat transfer, basic engineering mathematics

Course Objectives:

1. To introduce the fundamental principles and historical development of the Finite Element Method (FEM) and its distinction from other computational techniques.
2. To enable students to formulate and solve structural and thermal problems using 1D, 2D, and 3D finite elements.
3. To impart knowledge of the mathematical foundation of FEM through variational methods, shape functions, and numerical approximation techniques.
4. To familiarize students with nonlinear, dynamic FEM problems and commercial software tools used in industry for analysis.

Course Outcomes:

After completing the course, students will be able to

1. Demonstrate the fundamentals and significance of FEM
2. Formulate and solve 1D and 2D finite element problems using interpolation and shape functions with relevant boundary conditions.
3. Develop mathematical models using variational principles and weighted residual methods for simple engineering problems.
4. Solve structural and thermal problems using FEM software tools considering aspects like mesh quality, nonlinear behaviour, and dynamic conditions.

Unit – I	**FEA Fundamentals**	**5 Hours**
History and fundamentals of FEA, general FEM procedure, direct formulation for uniaxial elements using matrix methods, applications of FEM, comparison other computational techniques such as FDM, BEM, FVM and their applications, merits and demerits of fem compared to exact solutions and experimentation, overview of free and proprietary computational software		
Unit – II	**Finite element formulation for1D elements**	**5 Hours**
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 2D and, 3D trusses and beam elements, calculation of stresses and strains		
Unit – III	**Finite element formulation for 2D elements**	**5 Hours**
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 element		
Unit – IV	**Finite Element Formulation for 3D elements**	**5 Hours**
Interpolation functions for 3D elements, Pascal tetrahedron, shape functions, formulation of system equations, calculation of stresses and strains		
Unit – V	**Mathematical Foundations of FEA**	**5 Hours**
Variational calculus, RITZ method, methods of weighted residuals such as collocation, least squares, Galerkin-Bubnov, boundary conditions and general comments, elimination method, penalty method, Newton Raphson method, decomposition method		
Unit – VI	**Natural Coordinates and Higher order Elements**	**5 Hours**
Shape functions in natural coordinates, derivation of shape functions of 1D, 2D and 3D elements in natural coordinates, Lagrangian polynomials, iso-parametric elements, mapping and transformation in higher order elements, Jacobian, completeness and convergence of solution		
Unit – VII	**Nonlinear and Dynamic FEM**	**5 Hours**
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, sub modeling and sub structuring		
Unit – VIII	**Computational Techniques**	**5 Hours**
Review of free and commercial software, comparison of capabilities, pre-processing, solvers, post processing, commercial finite element software, model validity, mesh design & refinement, element distortion		
ICA consists of minimum 8 practical/assignments from the below list 1. Numerical exercise on method of weighted residuals formulation 2. Numerical problem on 1D element 3. Assignment on natural coordinates and isoperimetric formulation 4. Software assignment supported by hand calculations on a 1D problem 5. Software assignment supported by hand calculations on a 2D problem		

6. Software assignment on a 3D problem
7. Software assignment on dynamic problems
8. Assignment on FEA applications and available commercial packages
9. Determination of mode shapes and natural frequencies in vibration problems
10. Simulation of heat conduction through plane slab with convective boundary conditions

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 Publications
4. S. S Bhavikatti, Introduction to Finite Elements, New Age International Publications

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 Publications
4. M. J. Fagan, Finite Element Analysis, Theory and Practice, Pearson Education Ltd.
5. Daryl Logan, A First Course in the Finite Element Method, Cengage Publications

e-Resources

1. https://archive.nptel.ac.in/courses/112/105/112105308/
2. https://archive.nptel.ac.in/courses/112/104/112104193/

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
(An Autonomous Institute)
Final Year B.Tech. (Mechanical & Automation Engineering), Semester-VII

22MAU7EC3T: Core Elective III - Plastic Engineering

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hours/week	**ESE**	60 Marks
Practical	2 Hours/week	**ISE**	40 Marks
Credits	4	**ICA**	25 Marks

Introduction:

This course provides a comprehensive overview of plastic materials, their processing, design, and applications. It covers polymer chemistry, molding and welding processes, as well as mold design and cooling systems. Students will also explore advanced plastics and their role in various industrial sectors.

Course Prerequisite:

Material Science and Metallurgy, Manufacturing Processes, Engineering Drawing, Design of Machine Elements, Basic Thermodynamics

Course Objectives:

1. To introduce plastic materials, their classifications, and properties.
2. To provide knowledge about plastic processing, welding techniques, and mold design.
3. To develop skills in designing plastic components.
4. To acquaint students with advancements in plastic materials and their industrial applications.

Course Outcomes:

After completing the course, students will be able to

1. Classify plastic materials based on their properties and industrial applications.
2. Apply appropriate plastic processing and welding techniques in manufacturing scenarios.
3. Design plastic components and molds considering allowances, tolerances, and thermal effects.
4. Evaluate emerging plastic technologies such as biodegradable and composite plastics for industrial use.

Unit – I	**Fundamentals of Plastics and Polymer Science**	**8 Hours**

Definition and classification of plastics, properties and applications, additives in plastics, testing methods for plastics, monomers and polymers, types of polymerizations

Unit – II	**Processing and Welding of Plastics**	**7 Hours**

Injection moulding, extrusion, blow moulding, sheet forming, calendaring, compression & transfer moulding thermosetting plastics processing, welding techniques, hot gas, ultrasonic, laser, induction, friction

Unit – III	**Design Principles for Plastic Parts and Molds**	**7 Hours**
Tolerances and allowances in plastic parts, design considerations, corners, undercuts, wall thickness, ribs, curing time and inserts, core and mould material selection		
Unit – IV	**Compression, Transfer & Injection Mould Design**	**7 Hours**
Parts and layout of compression moulds, transfer mould types, automation, injection moulds: single, multi-cavity, automatic feed, temperature control, and ejection systems		
Unit – V	**Cooling System Design in Plastic Injection Molds**	**6 Hours**
Heat generation and dissipation, natural cooling techniques, mean temperature and thermal resistance, cooling channel design and dimensioning		
Unit – VI	**Advanced Plastics and Industrial Applications**	**5 Hours**
Composite and biodegradable plastics, polymer degradation, applications in agriculture, packaging, transport, medical, furniture, electronics		

ICA consists of minimum 8 practical/assignments from the below list

1. Introduction to plastic materials and processing techniques
2. Injection mould drafting for a simple component using suitable software
3. Design of blow mould for hollow plastic part
4. Design of compression mould for a thermoset component
5. Case study on mould manufacturing
6. Simulation of cooling system in injection mould
7. Defect analysis in plastic moulded components
8. Design of transfer mould (manual or using suitable software)
9. Research assignment – advanced plastics in industrial applications
10. Industrial visit report – plastic industry (thermoplastics & thermosets)

Text Books

1. Plastic Engineering Handbook – Society of the Plastics Industry, Springer-Verlag New York Inc.
2. J.A. Brydson, Plastic Materials, Butterworth-Heinemann Ltd.
3. D.V. Rosato, Injection Molding Handbook, Springer-Verlag New York Inc.

Reference Books

1. Ferdinand Rodriguez, Principles of Polymer Systems, CRC Press
2. Paul D. Potter, Plastics Product Design, Scrivener Publishing
3. Charles A. Harper, Modern Plastics Handbook, McGraw-Hill

e-Resources

1. http://onlinecourses.nptel.ac.in/noc25_me66/preview
2. https://ocw.mit.edu/courses/3-064-polymer-engineering-fall-2003/

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

(An Autonomous Institute)

Final Year B.Tech. (Mechanical and Automation Engineering), Semester-VII

22MAU7EC4T: Core Elective III - Power Plant and Energy Engineering

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hours/week	**ESE**	60 Marks
Practical	2 Hours/week	**ISE**	40 Marks
Credits	4	**ICA**	25 Marks

Introduction:

Availability of power is the one key area where most of the Indian industry is facing problems. In India, even today, short fall of power generation is about 30 percent. Fuel supply and distribution is also an area where country is still developing smooth lines of supply. Since power and energy is required by every sector of economy, the growth in this sector is must if Indian economy grows in any sector. Many of the job opportunity in private as well as public sector are therefore waiting for students in this field. Hence, this course attempts to provide them basic knowledge of the technologies available at plant level and would also acquaint them with the latest technological advances taking place in this sector.

Course Prerequisite:

Basic Mechanical Engineering, Engineering Physics, Thermal Power Engineering, Thermodynamics

Course Objectives:

1. To introduce students to conventional and renewable energy sources and their environmental impacts.
2. To familiarize students with the design, classification, and economic considerations of various power plants including base load and peak load systems.
3. To provide an understanding of solar and wind energy technologies, their components, measurement methods, and practical applications.
4. To equip students with knowledge of energy audit and conservation practices, including industrial and domestic energy-saving measures and the regulatory framework in India.

Course Outcomes:

After completing the course, students will be able to

1. Identify different renewable and non-renewable energy sources, explaining their characteristics, applications, and environmental impacts.
2. Analyze the operational aspects and economic considerations of various power plants, including cost estimation, depreciation methods, and tariff structures.
3. Explain the working principles and design considerations of solar, wind, and other non-conventional energy systems, including energy conversion techniques.
4. Conduct basic energy audits and recommend conservation strategies in both industrial and domestic settings.

Unit – I	**Introduction of Energy Sources**	**4 Hours**
Forms & characteristics of energy sources, organization of power sector in India, impact of energy sources (coal, oil, natural gas, solar, wind, biomass, hydro, geothermal, tidal, wave, ocean thermal and nuclear) on environment, role of private sector in energy management		
Unit – II	**Loads on Power Plant**	**5 Hours**
Introduction, different load curves and load factors, effect of variable load on power plant, design & operation, comparison of the various power plants		
Unit – III	**Peak Load & Base Load Power Plants**	**5 Hours**
Introduction & classification, requirement of peak load plant, types, pumped storage plants, compressed air storage plants, load sharing between base load & peak load power stations		
Unit – IV	**Economic Analysis of Power Plants**	**6 Hours**
Introduction, cost of electric energy, fixed and operating cost, methods of determining depreciation, selection of site for power station (thermal, hydro, nuclear), selection of generation equipment, tariff methods		
Unit – V	**Solar Energy**	**5 Hours**
a) Solar radiation outside the earth's atmosphere & at the earth's surface, solar radiation measurement – pyranometer & pyrheliometer, solar radiation geometry, LAT & SCT, solar concentrators-method and classification, types of concentrators b) Liquid flat plate collector – general, performance analysis, effects of various parameters		
Unit – VI	**Wind Energy**	**5 Hours**
Introduction, power of wind, basic components of 'WECS', classification of WEC systems, horizontal axis machines, vertical axis machines, advantages & disadvantages of WECS, application of wind energy		
Unit – VII	**Other Non- Conventional Energy Sources**	**5 Hours**
A) Geothermal energy – introduction, types of geothermal resources, methods of harnessing. tidal energy components of tidal power plant, single basin system, double basin system, advantages & disadvantages of tidal energy B) Ocean thermal energy – introduction, open & closed systems C) Wave energy – wave energy, energy conversion devices- high pressure accumulator, wave machines, dolphin type wave machine, dam atoll wave machine		
Unit – VIII	**Energy Audit & Energy Conservation**	**5 Hours**
A) Energy audit - definition & objective of energy audit, energy flow diagram, energy audit instruments, duties and responsibilities of energy auditors, duties and responsibilities of energy managers B) Energy conservation- introduction, Energy Conservation Act 2001 & its feature, energy conservation in industries, chemical industry, cement industry & sugar industry, energy conservation in house hold & commercial sectors		

ICA consists of minimum 8 practical/assignments from the below list

1. Test on solar water heater
2. Study of components of windmill
3. Identifying & measuring the parameters of a solar PV module in the field.
5. Study of solar collectors
6. Study of solar thermal applications- solar water heating, space heating, power
7. Study of solar pond / solar photovoltaic
8. Study of biogas plants
9. Study of instruments of power plant water purity, ph meter, gas analysis, measurement of smoke & dust.
10. Study of various pollution control devices
11. Study of various energy storage devices.

Text Books

1. B. R. Gupta, Generation of electrical energy, S. Chand & Co. Ltd.
2. Arora Domkundwar, A course in Power Plant Engineering, Dhanpat Rai & Co.
3. S. P. Sukhatme, Solar Energy, Tata McGraw hill Publishing Co.
4. G. D. Rai, Solar Energy, Khanna Publications
5. S. Rao & Dr. B. B. Purulekar, Energy Technology, Khanna Publications
6. P. K. Nag, Power Plant Engineering, Tata McGraw hill Publishing Co.
7. R. K. Rajput, Power Plant Engineering, Laxmi Publications

Reference Books

1. M. M. El Wakil, Power Plant Technology, McGraw Hill Education
2. Bureau of Energy efficiency Manual
3. G. D. Rai, Non-conventional Energy Sources, Khanna Publications

e-Resources

https://archive.nptel.ac.in/courses/112/107/112107291/

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
(An Autonomous Institute)
Final Year B.Tech. (Mechanical and Automation Engineering), Semester-VII

22MAU7OA1T: Open Elective - Entrepreneurship Development

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hours/week	**ESE**	60 Marks
Practical	2 Hours/week	**ISE**	40 Marks
Credits	4	**ICA**	25 Marks

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 Development. Programmers, 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 Prerequisite:

No special prerequisite is needed for this course

Course Objectives:

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 start-up
5. To acquaint with Government policies and agencies associated with entrepreneurial development

Course Outcomes:

After completing the course, students will be able to

1. Identify the qualities required to become a successful entrepreneur
2. Select the proper type of Entrepreneurship Development Programmes
3. Identify the business opportunities that fit the individual or the group & prepare a business plan
4. Select a proper funding option for establishing new enterprise

Unit – I	**Entrepreneurship**	**10 Hours**
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 – II	**Entrepreneurship Development**	**10 Hours**
Entrepreneurial Development Programmes (EDP): introduction, curriculum, phases, problems faced 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)		
Unit – III	**Entrepreneurial Project Development**	**10 Hours**
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 – IV	**Small-Medium Enterprises and Support Systems**	**10 Hours**
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, financial institutions, support agencies: SIDBI, SISI, NABARD, DIC, MCED, EDII, NIESBUD, EPC etc., their role in the development of SMES, Technology Business Incubation (TBI) centres, export potential of SMES, export procedure, taxation benefits for SME sector, prospects and turnaround strategies for SMES		
ICA consists of assignments from below list 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 6. Case study on managing risk in the entrepreneurial organization 7. Preparation of project report/business plan for starting a small unit and presentation on the same (including details of business idea, market survey, business model, different plans, etc)		
Text Books		
1. J.C. Saboo, Megha Biyani, Management of small-scale industries, Himalaya Publishing House 2. -Vasant Desai, Small-Scale Enterprises and Entrepreneurship, Himalaya Publishing House 3. S. S. Khanka, Entrepreneurial Development, S. Chand Publications		

Reference Books
1. Dr. Vasant Desai, Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House 2. Robert D Hisrich, Michael P Peters and Dean A. Shepherd, Entrepreneurship, McGraw Hill Education 3. Georgia Levenson Keohane, Social Entrepreneurship for the 21st Century: Innovation Across the Non-profit, Private, and Public Sectors, McGraw Hill Education 4. Paul Burns, Corporate Entrepreneurship and Innovation 4th Edition, Macmillan International Higher Education
e-Resources
https://archive.nptel.ac.in/courses/127/105/127105007/

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
(An Autonomous Institute)
Final Year B.Tech. (Mechanical and Automation Engineering), Semester-VII

22MAU7OA2T: Open Elective - Production and Operations Management

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hours/week	**ESE**	60 Marks
Practical	2 Hours/week	**ISE**	40 Marks
Credits	4	**ICA**	25 Marks

Introduction:

This course provides an in-depth understanding of Production and Operations Management (POM) principles essential for managing manufacturing and service operations. It covers topics such as forecasting, capacity planning, inventory control, and modern manufacturing practices. The course aims to equip students with practical tools to optimize productivity and operational efficiency.

Course Prerequisite:

Engineering Mathematics, Industrial Engineering, Manufacturing Processes

Course Objectives:

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

1. Understand the fundamental concepts and scope of Production and Operations Management in manufacturing and service environments.
2. Study forecasting, capacity planning, and inventory control techniques for effective resource utilization.
3. Study production planning, control processes, and maintenance strategies to enhance operational efficiency.
4. Understand advanced manufacturing systems and value engineering practices for quality improvement and cost reduction.

Course Outcomes:

After completing the course, students will be able to

1. Describe the principles, objectives, and functions of production and operations management.
2. Apply forecasting techniques, capacity planning, and inventory models to production-related scenarios.
3. Analyze production planning, scheduling, and maintenance strategies used in manufacturing systems.
4. Evaluate modern tools such as Lean Manufacturing, JIT, Six Sigma, and Value Engineering for improving operational efficiency.

Unit – I	**Introduction to Production and Operations Management & Forecasting**	**6 Hours**

Introduction to Production and Operations Management (POM), definitions, objectives, scope, and history, overview of manufacturing systems and their types, introduction to forecasting, need and types, statistical forecasting methods, moving average method, exponential smoothing method, least squares method, regression and correlation methods

Unit – II	**Capacity Planning and Production Planning & Control**	**7 Hours**
Capacity planning, concept, measurement and measures of capacity, factors affecting capacity, capacity planning procedure, aggregate planning, investment decision and replacement analysis, production planning and control (PPC), objectives and functions coordination of PPC with other departments, routing, scheduling, loading, and sequencing, line balancing, production control, dispatching, functions and documents, follow-up, evaluation		
Unit – III	**Inventory Management**	**6 Hours**
Inventory concepts, objectives and types of inventories, inventory costs, inventory models, Economic Order Quantity (EOQ), Economic Batch Quantity (EBQ), inventory control techniques, ABC analysis, material requirements planning (MRP), fixed period and fixed quantity systems		
Unit – IV	**Plant Maintenance and Reliability**	**6 Hours**
Introduction to plant maintenance, definition, need, importance, functions and scope of maintenance department, types of maintenance, preventive and breakdown, breakdown analysis, fishbone diagram, Total Productive Maintenance (TPM), reliability and life testing concepts		
Unit – V	**Value Engineering and Advanced Manufacturing Systems**	**7 Hours**
Value engineering and value analysis, definition, objectives, and applications, reasons for unnecessary costs, value analysis procedure, advanced manufacturing systems, lean manufacturing basics, Just-In-Time (JIT), Kanban system, Kaizen, zero defect manufacturing, six sigma, basics of supply chain management		
Unit – VI	**Integrated Operations Strategy**	**4 Hours**
Strategic role of operations management, linking operations strategy with corporate strategy, contemporary trends in POM, integrated view, from forecasting to delivery, role of technology and data analytics in modern operations		
ICA consists of 6 practicals / assignments from the below list 1. Forecasting methods, comparative analysis study 2. Capacity planning case study 3. Production planning using Gantt charts case study 4. EOQ and EBQ calculations numerical 5. ABC analysis and MRP simulation case study 6. fishbone diagram for breakdown analysis case study 7. Value analysis assignment 8. Lean and JIT simulation case study		
Text Books		
1. Martand Telsang, Industrial Engineering and Production Management, S. Chand Publications 2. Samuel, Elements of Production Planning and Control, Universal Publications 3. Buffa Sarin, Modern Production/Operation Management, Wiley Publications 4. O. P. Khanna, Industrial Engineering and Management, Khanna Publishing House 5. S.N. Chary, Production and Operations Management, McGraw Hill Education Publications 6. Jay Heizer and Barry Render, Operations Management, Pearson Education Publications 7. K. Aswathappa & K. Shridhara Bhat, Production and Operations Management, Himalaya Publishing House		

Reference Books

1. Lee J. Krajewski, Manoj K. Malhotra, Larry P. Ritzman, Operations Management: Processes and Supply Chains, Pearson Publications
2. Buffa and Sarin, Modern Production/Operations Management, Wiley Publications
3. Introduction to Work Study, International Labour Office (ILO), Oxford & IBH Publications
4. R. C. Mishra, K. Pathak, Maintenance Engineering and Management, PHI Learning Publications

e-Resources

1. https://onlinecourses.nptel.ac.in/noc22_mg74/preview
2. edx.org+15onlinecourses.nptel.ac.in+15onlinecourses.nptel.ac.in+15
3. https://www.coursera.org/learn/operations-management-quality-and-supply-chain coursera.org+1coursera.org+1
4. https://ocw.mit.edu/courses/15-760b-introduction-to-operations-management-spring-2004/ coursera.org+10ocw.mit.edu+10ocw.mit.edu+10

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
(An Autonomous Institute)
Final Year B.Tech. (Mechanical and Automation Engineering), Semester-VII

22MAU7OA3T: Open Elective - Supply Chain Management

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hours/week	**ESE**	60 Marks
Practical	2 Hours/week	**ISE**	40 Marks
Credits	4	**ICA**	25 Marks

Introduction:

Supply Chain Management (SCM) is a critical discipline encompassing the strategic coordination and integration of activities across organizations to improve and optimize the flow of goods, services, information, and finances from raw material suppliers through production to the end customer. This course provides a comprehensive overview of SCM principles, strategies, and practices essential for effective management of modern supply chains.

Course Prerequisite:

No special prerequisite is needed for this course

Course Objectives:

1. To understand the fundamentals and advance concept of supply chain management
2. To describe the key components of supply chains: manufacturing and operations management, distribution and logistics, and inventory management.
3. To study the importance of coordination and integration for supply chain performance
4. To understand the role of metrics in evaluating supply chain effectiveness and efficiency.
5. To study sustainability and risk management within supply chains.

Course Outcomes:

After completing the course, students will be able to

1. Analyze the components and drivers of a supply chain and their impact on organizational performance.
2. Apply quantitative models such as EOQ and inventory control systems to solve real-world materials management and logistics problems.
3. Evaluate supply chain performance using key performance indicators (KPIs) and propose improvements in supply chain coordination and integration.
4. Demonstrate the use of IT tools such as ERP, SCM software, or data analytics to enhance supply chain visibility and efficiency.

Unit – I	**Introduction to SCM**	**5 Hours**

Definitions of supply chain management and logistics, evolution of supply chain management, objectives of SCM, importance of SCM, activities of supply chain management, process view in supply chain, supply chain network and flow of materials and information, supply chain drivers, decision phases in supply chain

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Unit – II	**Supply Chain components and strategy**	**5 Hours**
Supply chain components, manufacturing and operations management, distribution and logistics, inventory management, supply chain strategy-differentiation vs cost leadership global supply chain considerations, risk management and resilience		
Unit – III	**Materials Management**	**5 Hours**
Definition and scope of materials management, importance of materials management in supply chains, classification of materials, procurement, purchasing policies, vendor development and evaluation. inventory control systems of stock replenishment, cost elements, EOQ and its derivative modules		
Unit – IV	**Logistics and Transportation**	**4 Hours**
Modes of transportation (road, rail, sea, air), routing and scheduling, third-party logistics (3PL) and fourth-party logistics (4PL), procurement and supplier relationship management, supplier selection and evaluation, supplier collaboration and partnerships		
Unit – V	**Supply Chain Coordination and Integration**	**5 Hours**
Definition and scope of supply chain coordination and integration, importance of coordination and integration for supply chain performance, information sharing in supply chains, Collaborative Planning, Forecasting, and Replenishment (CPFR) process integration in supply chains, supply chain collaboration platforms		
Unit – VI	**Supply Chain Performance Metrics**	**6 Hours**
Definition and significance of supply chain performance metrics, role of metrics in evaluating supply chain effectiveness and efficiency, types of performance metrics, operational, financial and strategy, Key Performance Indicators (KPIS) in supply chains, operational performance metrics, financial performance metrics, customer service metrics supply chain risk management metrics, sustainability metrics in supply chain		
Unit – VII	**IT in Supply Chain**	**4 Hours**
Importance of it in supply chain efficiency and effectiveness, evolution of it in supply chain management, supply chain information system- Enterprise Resource Planning (ERP) systems Supply Chain Management (SCM) software Warehouse Management Systems (WMS) Transportation Management Systems (TMS), data analytics and supply chain visibility		
Unit – VIII	**Emerging Trends in Supply Chain**	**6 Hours**
Introduction to emerging trends in supply chain management, digital transformation in supply chains Internet of Things (IOT) in supply chains, blockchain technology in supply chains, artificial intelligence (ai) and Machine Learning (ML) in supply chains, sustainable supply chain management circular economy in supply chains, supply chain collaboration and partnership		
ICA consists of minimum 8 practical/assignments from the below list 1. A real-world case study regarding the evolution and strategic importance of supply chain management 2. Draw and explain the supply chain network and process flow for a selected manufactured product 3. Calculate EOQ, reorder point, and safety stock for a given inventory management scenario		

4. Classify materials using ABC analysis and develop a vendor evaluation matrix for supplier selection
5. Solve a vehicle routing or scheduling problem using optimization techniques or routing software
6. Apply a multi-criteria decision-making method to select the most suitable supplier from a given dataset
7. Analyze Key Performance Indicators (KPIS) of a supply chain and suggest improvements
8. Simulate the Collaborative Planning, Forecasting, and Replenishment (CPFR) process for a product line
9. Demonstrate the use of ERP or SCM software to track and manage supply chain operations
10. Prepare a report on the role of it and data analytics in enhancing supply chain visibility and decision-making

Text Books

1. Sunil Chopra and Peter Meindl, Supply Chain Management: Strategy, Planning, and Operation, Pearson Publications
2. Garg B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002, An introduction to Research Methodology, RBSA Publishers
3. Mr. Ishanka Saikia, Mr. V. Anandaraj, Dr. S. Ramachandran, S. Kumaran, Supply Chain & Logistics Management, Airwalk Publications

Reference Books

1. Sunil Sharma, Supply Chain Management- Concepts, Practices, and Implementation, Oxford University Press.
2. F. Robert Jacobs and Richard B. Chase, Operations and Supply Chain Management, McGraw Hill Education
3. Cecil C. Bozarth and Robert B. Handfield, Introduction to Operations and Supply Chain Management, Pearson Publications

e-Resources

https://archive.nptel.ac.in/courses/110/ Pearson106/110106045/

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

(An Autonomous Institute)

Final Year B.Tech. (Mechanical and Automation Engineering), Semester-VII

22MAU7OA4T: Open Elective - Research Methodology

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hours/week	**ESE**	60 Marks
Practical	2 Hours/week	**ISE**	40 Marks
Credits	4	**ICA**	25 Marks

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 Prerequisite:

No pre-requisites required

Course Objectives:

1. To develop an understanding of fundamental research Process
2. To identify the sources of information for literature review and data collection.
3. To impart an understanding of various Research Methods and its use.
4. To develop an understanding of various Research Design and its techniques.
5. To develop an ethical understanding and sense of technical writing.

Course Outcomes:

After completing the course, students will be able to

1. Perform Literature Reviews using print and online databases.
2. Apply the research knowledge to define a suitable problem statement by adopting different research methods and models.
3. Apply different Research Design Techniques as per different applications.
4. Write a scientific report and research proposal by adopting copyright based ethical values

Unit – I	**Introduction to Research Methodology**	**5 Hours**

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

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Unit – II	**Literature Review**	**5 Hours**
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 – III	**Research Methods**	**5 Hours**
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, developing method, statistical method, experimental method, brainstorming techniques, rating scale, ethnographic methods, documentation methods		
Unit – IV	**Research Design**	**5 Hours**
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 – V	**Statistical Tools & Methods**	**5 Hours**
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		
Unit – VI	**Interpretation of Data and Paper Writing**	**5 Hours**
Layout of a research paper, when and where to publish, journals in life-sciences, impact factor of journals indexing: Scopus, Web of Science etc, ethical issues related to publishing, plagiarism and self-plagiarism		
Unit – VII	**Application of Results and Ethics**	**5 Hours**
Environmental impacts, ethical issues, ethical committee, commercialization, copy right, royalty, intellectual property rights and patents law, trade related aspects of intellectual property rights, reproduction of published material, citation and acknowledgement, reproducibility and accountability		
Unit – VIII	**Reporting and Thesis Writing**	**5 Hours**
Structure and components of scientific reports, types of report, technical report and thesis, different steps in the preparation, layout, structure and language of typical reports, illustrations and tables, bibliography, referencing and footnotes, oral presentation, planning, preparation, practice, making presentation, use of visual aids, importance of effective communications		
ICA consists of minimum 8 practical/assignments from the below list 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. Kothari C.R., Research Methodology: Methods and Techniques, New Age International
2. Garg B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., An introduction to Research Methodology; RBSA Publishers.
3. Panneerselvam R., Research Methodology; PHI, Learning Pvt. Ltd., New Delhi - 2009
4. Chawala D. and N. Sandhi, Research Methodology: Concepts and cases, Vikas Publishing House Pvt. Ltd.

Reference Books

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

e-Resources

https://archive.nptel.ac.in/courses/127/106/127106227/

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
(An Autonomous Institute)
Final Year B.Tech. (Mechanical and Automation Engineering), Semester-VII

22MAU7PR4L: Capstone Project Phase-I

Teaching Scheme		**Examination Scheme**	
Lectures	----	**ICA**	100 Marks
Practical	8 Hours/week	**OE**	50 Marks
Credits	4		

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 Prerequisite:

Basic knowledge of all the core subjects completed during the previous semesters

Course Objectives:

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:

After completing the course, students will be able to

1. Identify and define real-world engineering problems by applying fundamental concepts of mechanical and automation engineering.
2. Analyze the problem statement and define clear project objectives and methodology.
3. Design the initial system or process using appropriate engineering tools, techniques, and standards.
4. Prepare a detailed project proposal and present the design plan effectively in written and oral formats.

Guidelines for Project content:

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. The group has to submit the report on the progress of project work at the end of first semester.

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

(An Autonomous Institute)

Final Year B.Tech. (Mechanical and Automation Engineering), Semester-VIII

22MAU8PR1L: Capstone Project Phase-II

Teaching Scheme		**Examination Scheme**	
Lectures	----	**ICA**	50 Marks
Practical	4 Hours/week	**OE**	50 Marks
Credits	2		

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 Prerequisite:

Basic knowledge of all the core subjects completed during the previous semesters

Course Objectives:

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

Course Outcomes:

After completing the course, students will be able to

1. Implement the proposed design or system using modern engineering tools and techniques
2. Evaluate the performance of the developed solution against defined objectives and constraints
3. Demonstrate professional ethics, teamwork, and project management skills during project execution
4. Compile a comprehensive technical report and present the project outcomes

The group has to complete the project work and submit the hard bound copy of the report of the same at the end of this semester

WALCHAND INSTITUTE OF TECHNOLOGY WIT SOLAPUR