WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

(AN AUTONOMOUS INSTITUTE)

Affiliated to

Punyashlok Ahilyadevi Holkar Solapur University,Solapur

CHOICE BASED CREDIT SYSTEM (CBCS)

Structure and Syllabusfor

B. Tech. in Mechanical & Automation Engineering

T.Y. B.Tech. Mechanical and Automation Engineering W.E.F. 2024-25

(Dr. S. B. Tuljapure)
Chairman
Board of Studies in Mechanical Engineering

Mechanical Engineering Department

Department 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.

Department Mission

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

Mechanical and Automation Engineering

Under Graduate Program

Program Educational Objectives (PEOs)

1. Graduate will excel in professional career in the field of Mechanical and Automation Engineering.
2. Graduate will exhibit strong fundamentals required to pursue higher education and continue professional development in emergingtechnology in Mechanical and Automation Engineering.
3. 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.

Program Outcomes (POs)

The program outcomes of B. Tech. Mechanical and Automation Engineering Program are summarized as following:

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 lifelong learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

1. Design high quality mechanical and automation engineering equipment for the modern industry and society.
2. Implement manufacturing processes for mechanical and automation engineering equipment.

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

Course Code Format:

2	**1**	**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	T-Theory, L-Lab session

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*
SK	kill Based Course
SM	Seminar
MP	Mini project
PR	Project
IN	Internship

Sample Course Code:

21MAU1BS1T	Engineering Physics (Group A)

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

Structure of T. Y. B. Tech. Mechanical and Automation Engineering

(W.E.F. 2024-25)

Semester V

Course Code	*Name of the Course*	*Engagement Hours*			*Credits*	*FA*		*SA*		*Total*
		L	T	*P*		*ESE*		*ISE*	*ICA*	
22MAU5CC1T	Design of Machine Elements	3	-	-	3	60		40	-	100
22MAU5CC2T	Mechatronics-II	3	-	-	3	60		40		100
22MAU5ES3T	Material Science & Metallurgy	3	-	-	3	60		40	-	100
22MAU5CC4T	Additive Manufacturing	3	-	-	3	60		40	-	100
22MAU5EN*T	Core Elective-I	3	-	-	3	60		40	-	100
22MAU5ES6P	Advanced Programming Concepts (Java)	1	-	-	1	-		25	-	25
22ALU5SN*T	Self-Learning– HSS	-	-	-	2	50		-	-	50
22MAU5CC1L	Design of Machine Elements	-	-	2	1	-	-	-	25	25
22MAU5CC2L	Mechatronics-II	-	-	2	1	-		-	25	25
22MAU5ES3L	Material Science & Metallurgy	-	-	2	1	-	25	-	25	50
22MAU5CC4L	Additive Manufacturing	-	-	2	1	-		-	25	25
22MAU5EN*L	Core Elective-I	-	-	2	1	-	-	-	25	25
22MAU5ES6P	Advanced Programming Concepts (Java)	-	-	2	1	50	-	-	25	75
22MAU5SK7L	Workshop Practice-I			2	1	-	-	-	25	25
22MAU3IN8L	Internship #			-	1		25			25
	Grand Total	**16**	**-**	**14**	**26**	**450**		**225**	**175**	**850**

N should be taken as given in the table below with reference to the elective offered.*

#: Internship done during /after Second year is to be evaluated in this semester.

List of Core Elective –I Courses

*N**	Course Title	Course Code
A1	Automobile Engineering	22MAU5EA1T
A2	Tool Engineering	22MAU5EA2T
A3	Fluid Machinery and Fluid Power	22MAU5EA3T
A4	Internet of Things	22MAU5EA4T

List of Self Learning -HSS Courses

N*	Course Title	Course Code
A9	Economics	22ALU5SA9T
B9	Intellectual Property Rights for Technology Development and Management	22ALU5SB9T
C9	Introduction to Sociology	22ALU5SC9T
D9	Stress and Coping	22ALU5SD9T
E9	Professional Ethics and Human Values	22ALU5SE9T

WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR

Structure of T. Y. B. Tech. Mechanical and Automation Engineering

(W.E.F. 2024-25)

Semester VI

Course Code	*Name of the Course*	*Engagement Hours*			*Credits*	*FA*		*SA*		*Total*
		L	**T**	**P**		*ESE*		*ISE*	*ICA*	
22MAU6CC1T	Design of Transmission Systems	3	-	-	3	60		40		100
22MAU6CC2T	Metrology and Quality Control	3	-	-	3	60		40	-	100
22MAU6CC3T	Heat Transfer	3	-	-	3	60		40	-	100
22MAU6EN*T	Core Elective-II	3	-	-	3	60		40	-	100
22MAU6CC5T	Instrumentation and Control Engineering	3	-	-	3	60		40	-	100
	Sub Total	**15**	**-**	**-**	**15**	**300**		**200**		**500**
22MAU6CC1L	Design of Transmission Systems	-	-	2	1	-	25	-	25	50
22MAU6CC2L	Metrology and Quality Control	-	-	2	1	-	25	-	25	50
22MAU6CC3L	Heat Transfer	-	-	2	1	25		-	25	50
22MAU6EN*L	Core Elective-II	-	-	2	1	-	-	-	25	25
22MAU6CC5L	Instrumentation and Control Engineering	-	-	2	1	-	-	-	25	25
22MAU6MP6L	Mini-Project	-	-	2	1	-		-	25	25
22MAU6 SK7L	Workshop Practice -II			2	1				25	25
	Grand Total	**15**	**-**	**14**	**22**	**375**		**200**	**175**	**750**

N indicates the serial number of elective offered in the respective category*

List of Core Elective –II Courses:

N*	Course Title	Course Code (Theory)	Course Code (Practical)
C1	Industrial Product Design	22MAU6EC1T	22MAU6EC1L
C2	Mechanical Vibrations	22MAU6EC2T	22MAU6EC2L
C3	Artificial Intelligence and Machine Learning (AI/ML)	22MAU6EC3T	22MAU6EC3L
C4	Computer Integrated Manufacturing	22MAU6EC4T	22MAU6EC4L

Walchand Institute of Technology, Solapur
T.Y. B. Tech. (Mechanical and Automation Engineering)
Semester-V
22MAU5CC1T DESIGN OF MACHINE ELEMENTS

Teaching Scheme	**Examination Scheme**
Lectures– 3 Hours/week, 3 Credits	**ESE** - 60 Marks
Practical – 2 Hours/week, 1 Credit	**ISE** - 40 Marks
	ICA - 25 Marks

The goal of this course is to introduce machine design by going over different processes, specifications, and design techniques. The many types of irons, steels, and alloys utilized in engineering design using IS Codes are described, along with an introduction to engineering materials. A further content explains in details the manufacturing consideration in design. The course material also covers component design processes for designing against static and fluctuating loads. Design considerations are provided in order to clarify the characteristics and types of threaded and welded connections. The course material also covers the design of couplings, springs, shafts, and keys with IS codes, as well as the selection of belt drives from manufacturer catalogs.

Course Prerequisite:
Student shall have knowledge of function of machine elements such as keys, couplings, pulleys, joints etc. A sound background of analysis of mechanical element is essential for successful completion of this course.

Course Objectives:
1. To design machine elements such as springs, shafts, joints, lever etc.
2. To design mechanical component subjected to fluctuating loads
3. To implement standardization in design of machine elements.

Course Outcomes:
After completing this course, student shall be able to –
1. Apply the fundamental procedures of machine design, while integrating design considerations for casting, forging, machined parts.
2. Design machine elements such as shafts, key, lever etc.
3. Design mechanical component subjected to fluctuating loads.
4. Select the proper type of belt, Joints, by using standard manufacturers' catalogue

Unit 1 - Fundamentals of machine design. No of lectures – 03
Procedure of machine design, Procedure of design of machine element, Types of loads, Factor of safety, Theories of elastic failure.

Unit 2 - Design against static load No of lectures – 06
Design of Socket and Spigot Cotter joint, Design of knuckle joint, Design of levers (lever loaded safety valve).

Unit 3 – Design against fluctuating loads No of lectures – 06

Stress concentration causes and remedies, fatigue failure, endurance limit, notch sensitivity, Goodman and Soderberg diagram, modified Goodman diagram, design for finite and infinite life under reversed and fluctuating stresses.

Unit 4 – Selection of Belt. No of lectures – 05

Selection of flat and V belt from standard manufacturers' catalogue/Design data book.

Unit 5 – Manufacturing considerations in Design No of lectures – 03

Design considerations for casting, Design considerations for forging, Design considerations for machined parts, Design for manufacture and assembly.

Unit 6 –Design of shafts, keys and couplings. No of lectures – 06

Materials for shaft, Design of solid and hollow shaft on strength basis (maximum principal stress theory and Maximum shear stress theory) and on basis of torsional rigidity. ASME code for shaft design. Design of square and flat keys. Design of rigid and flexible couplings.

Unit 7 – Design of springs. No of lectures – 05

Types of springs and their applications, terminology of helical spring, styles of end, spring materials, stress and deflection in helical spring, series and parallel springs. Introduction to leaf springs.

Unit 8 - Design of Joints No of lectures – 06

Bolted Joint - Simple analysis, eccentrically loaded bolted joint in shear, eccentric load perpendicular to axis of bolt.

Welded Joints - Strength of butt welds, transverse fillet welds, axially loaded unsymmetrical lap joint, eccentrically loaded welded joint in shear.

Riveted joints- Types of failure and strength equations.

- **Internal Continuous Assessment (ICA):**

  ICA consists of minimum 8 Assignment based on curriculum.:

  1. Selection of material for engineering application.
  2. Selection of belts.
  3. Design of helical springs subjected to static load.
  4. Design of bolted joints.
  5. Design of welded joints.
  6. Design of shaft using ASME codes.
  7. Manufacturing Considerations in Design
  8. Design, Model and Analysis of Cotter joint (Suitable software may also be used).
  9. Case study on Design of Mechanical component using Generative Design.

- **Textbooks**
  1. V. B. Bhandari, “Design of Machine Elements”, 4th edition, McGraw Hill.
  2. V. B. Bhandari, “Machine Design Data Book”, 2nd edition.

- **Reference Books**
  1. J. F. Shigley, Design of Machine Element McGraw Hill Publications
  2. M. F. Spotts, Design of Machine Element Pearson Education Publication
  3. Design Data: Data Book of Engineers by PSG College Kalaikathir Achchagam Coimbatore

Walchand Institute of Technology, Solapur
Third Year B. Tech (Mechanical and Automation Engineering)
Semester-V
22MAU5CC2T MECHATRONICS-II

Teaching Scheme
Lectures– 3 Hours/week, 3 Credits
Practical – 2 Hours/week, 1 Credit

Examination Scheme
ESE - 60 Marks
ISE - 40 Marks
ICA - 25 Marks

The course is an introductory course aimed at designing mechatronic systems, which require integration of the mechanical, electrical, electronic, and computing engineering disciplines within a unified framework. This course covers technologies involved in developing intelligent electro-mechanical systems and techniques used to apply this technology to mechatronic system design. Contents
covered in this course include microprocessor, microcontroller, PLC, computer network and communication.

Course Prerequisite: Mechatronics-I, Basics of digital electronics and computer

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Course Objectives:

1. To describe core features and peripheral features of Microprocessor and Microcontroller.
2. To provide an introduction to microcontroller families and details of RISC and CISC microcontrollers.
3. To equip students with advanced knowledge in programmable logic controller technology to solve problems related to mechatronic systems.
4. To gain the basic knowledge of data communication and computer network

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Course Outcomes:

After completing this course, student shall be able to -

1. Program microcontrollers in assembly/and or C/C++/Python/Java to demonstrate interfacing with sensors and actuators.
2. Program PLCs using ladder logic (both on simulators and actual hardware).
3. Build and program a mechatronic system which will accept data from input and sensors and control an output/actuator using any microprocessor/ microcontroller board (Arduino or Raspberry Pi can also be used)
4. Explain computer networks and their applications

Unit-1: Introduction to Microprocessors and Microcontrollers No. of lectures – 05

Introduction, Microprocessor, Microcomputer, Architecture of Microprocessors, History of Microprocessors, Evolution of Microprocessors, Microprocessor Applications, Evolution of Microcontrollers, Applications of Microcontrollers

Unit-2: Architecture of the 8085 Microprocessor No. of lectures – 05

Introduction, Block Diagram of the 8085 Microprocessor, Pin Diagram of 8085 Microprocessor

Unit-3 Instruction Set and Addressing Modes of 8085 Microprocessor

No. of Lectures -05

Addressing Modes, Instruction Set, Instruction and Data Formats, Symbols and Abbreviations, 8085 Instructions, Instruction Timing Diagram, Timing Diagram

Unit-4 Introduction to 8051 Microcontroller No. of Lectures- 05

Architecture of 8051 Microcontroller, Memory Organization, Pin Diagram of 8051, Microcontroller, Timers/Counters, Serial Communication, Interrupts

Unit 5 - Instruction Set and Programming of the 8051 Microcontroller

No of lectures – 05

Addressing Modes, 8051 Instruction Set, Simple Examples in Assembly-Language Programs of 8051 Microcontroller, Assembly-Language Programs

Unit-6 Programmable logic controllers No. of Lectures- 05

Controllers, Hardware, internal architecture, PLC systems, Input devices, Output devices, Examples of applications, Ladder diagrams, Logic functions, Latching

Unit-7 Ladder and functional block programming No. of Lectures- 05

Jump, subroutines, Types of timers, Programming timers, Off-delay timers, Pulse timers, Programming examples, Forms of counter, Programming, Up and down counting, Timers with counters

Unit-8 Data communication and Computer networks No. of Lectures- 05

Serial and Parallel communications, bit and baud rate, protocols, data flow, handshaking, signal transmission, Computer Networks, Network topologies, OSI model, TCP/IP Model, Difference between OSI and TCP/IP models, Internet terminology, LAN, WAN, MAN

- **Internal Continuous Assessment (ICA) :**

  ICA consists of minimum 8 practical based on curriculum. Recommended practicals:

  1. Demonstration of serial communication using Arduino UNO
  2. Demonstration of I2C communication using Arduino UNO
  3. Interfacing of IR sensor module with Raspberry Pi 400
  4. Interfacing of sound sensor module with Raspberry Pi 400
  5. 8085 Microprocessor programming using simulator
  6. 8051 Microcontroller programming using simulator
  7. PLC programming using ladder logic on a simulator and hardware
  8. Speed control of DC motor using Raspberry Pi and Arduino
  9. Interfacing of ultrasonic sensor module with Raspberry Pi 400
  10. Interfacing of servo motor with Raspberry Pi 400

- **Textbooks**

  1. W. Bolton, Mechatronics, Pearson Publishing, 4th Edition
  2. Shetty & Kolk, Mechatronics System Design, Cengage Learning, 2nd Edition
  3. Mazidi, 8051 Microcontroller, Prentice Hall, 3rd Edition
  4. Banzi, Getting Started with Arduino, McGraw Hill

- **Reference Books**

  1. Bishop et.al, Handbook of Mechatronics, CRC Press, 2nd Edition
  2. Gaonkar Ramesh, The 8085 microprocessor, Penram International Publishing, 2nd Edition
  3. W. Bolton, Programmable Logic Controllers, Pearson Publishing, 3rd Edition
  4. Tanenbaum & Weterhall, Computer Networks, Prentice Hall, 4th Edition

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Walchand Institute of Technology, Solapur
T.Y. B. Tech (Mechanical and Automation Engineering)
Semester-V
22MAU5ES3T MATERIAL SCIENCE & METALLURGY

Teaching Scheme	**Examination Scheme**
Lectures– 3 Hours/week, 3 Credits	**ESE** - 60 Marks
Practical – 2 Hours/week, 1 Credit	**ISE** - 40 Marks
	ICA - 25 Marks
	OE - 25 Marks

This course provides a comprehensive overview of ferrous and non-ferrous alloys, their properties, and applications. Students will explore advanced materials, heat treatment processes, surface hardening treatments, and both destructive and non-destructive testing methods. The course also covers the fundamentals and applications of powder metallurgy.

Course Prerequisite:

A basic understanding of materials science and engineering principles is required. Prior knowledge of thermodynamics, general chemistry and physics will be beneficial for grasping the concepts discussed in this course.

Course Objectives:

1. To impart a thorough understanding of ferrous metals and alloys, enabling students to analyze and apply these materials in engineering.
2. To equip students with knowledge of non-ferrous alloys and advanced materials, focusing on their classifications, properties, and engineering applications.
3. To familiarize students with the principles and techniques of Heat Treatment and surface hardening processes for steels, including their purposes, methods, and applications.
4. To introduce students to both Destructive and Non-Destructive testing methods and fundamentals of Powder Metallurgy.

Course Outcomes:

After completing this course, student shall be able to -

1. Identify and classify different ferrous metals and alloys, understand their microstructures, and predict their behavior and performance in practical engineering contexts.
2. Analyze and explain various non-ferrous alloys and advanced materials, evaluating their properties and determining suitable engineering applications.
3. Understand and apply various heat treatment and surface hardening techniques, assessing their effects on the properties and performance of steel in engineering applications.
4. Perform and interpret various testing methods to evaluate material properties and understand the processes and applications of powder metallurgy.

Unit 1 – Introduction to ferrous alloys No of lectures – 06

Brief classification of Metals, Crystal Structure, Bravais Crystal Systems, Concept of alloying, Classification of cooling curves, Types of equilibrium diagram, Lever rule, phase rule, Solid solution & its types, Intermetallic compounds, allotropy.

Unit 2 – Ferrous metals and alloys No of lectures – 08

Fe-Fe3C equilibrium diagram, critical temperatures, Plain carbon steels: composition, applications & properties, Effect of alloying elements on steels, Eutectic, Eutectoid and Peritectic transformations, Plain carbon steels, classification, composition, properties & applications, Types of cast irons, composition, properties, applications. Alloy steels, alloying elements added to steels and their purpose.

Study of alloying steels: Stainless steels and its types, High Speed Steels (HSS), Silicon steels, etc.

Unit 3 – Non-ferrous alloys No of lectures – 03

Copper alloys: brass and bronze, Aluminum alloys: Al-Si alloy and Al-Cu alloy, Steps in precipitation hardening (Steps only), Pb-Sn alloys, Babbitt's. Ni alloys.

Unit 4 – Advanced Materials No of lectures – 03

Composite materials: Classification, properties and Applications Nano materials – Concept, effect of particle size on mechanical properties

Unit 5 – Heat treatment of steel No of lectures – 06

Objectives of Heat Treatment, TTT and CCT diagram for eutectoid Steel (Introductory treatment only) Annealing - purposes, types, applications, limitations. Normalizing- purposes, types, applications, limitations. Hardening & Tempering: purposes, types, applications. Types of Tempering, structural changes during tempering, Subzero treatment. Methods of hardening such as Austempering, Martempering, limitations of these process

Unit 6 - Surface hardening treatments No of lectures – 03

Carburising – types, Nitriding, Cyaniding and carbonitriding – Purposes, chemistry of process, applications, limitations. Induction hardening -, Flame hardening – Concept process, advantages, limitations and applications.

Unit 7 – Destructive and Non-Destructive testing No of lectures – 06

Destructive testing methods: test procedure in brief, significance of Tensile testing, Hardness testing, Impact testing, Creep Testing, Fatigue testing.

Non-Destructive Testing methods (NDT): Dye penetrant test, Magnetic Particle test, Ultrasonic test, Radiography test, Eddy current test and Introduction to advanced NDT methods.

Unit 8 – Introduction to powder metallurgy No of lectures – 05

Significance, steps in powder metallurgy process, Applications, Methods of powder manufacture, mixing / blending, compaction methods, sintering processes & types, advantages & limitations, Typical powder metallurgy applications and their flow chart: - Self lubricated bearings, cemented carbide cutting tools, friction materials, etc

- **Internal Continuous Assessment (ICA):**
  ICA consists of minimum 8 practical based on curriculum. Recommended practical list is as follows:
  1. Study of Metallurgical Microscope.
  2. Metallography.
  3. Macroscopy.
  4. Microstructure of steels.
  5. Microstructure of Cast Iron.
  6. Microstructure of Non-ferrous alloys.
  7. Grain Size measurement.
  8. Heat treatment of EN8 steel.
  9. Non-destructive Testing Methods.
  10. Destructive testing: Tensile and Compressive Test.
  11. Microstructure of heat-treated steel.
  12. Microstructure of surface hardened steel.

- **Textbooks**
  1. Dr. Kodgire, Material Science and Metallurgy, Everest, Pune.
  2. A. S. Gholap & M. S. Kulkarni, Engineering Metallurgy I & VI, Nirali Prakashan.
  3. B. K. Agarwal, Introduction to Engg. Materials, McGraw Hill Education.

- **Reference Books**
  1. Rajan Sharma & Sharma, Heat treatment principles and technique, PHI Learning Private Limited.
  2. Sidney Avner, Introduction to Physical metallurgy, McGraw Hill Education.
  3. R. A. Higgins, Engineering Metallurgy Vol. I & VI, ELBS Publication.
  4. E. C. Rollason, Engineering Metallurgy, ELBS Publication. 5. Lakthin, Engineering Metallurgy, MIR Publishers.

Walchand Institute of Technology, Solapur
T.Y. B. Tech (Mechanical and Automation Engineering)
Semester-V
22MAU5CC4T - ADDITIVE MANUFACTURING

Teaching Scheme
Lectures– 3 Hours/week, 3 Credits
Practical – 2 Hours/week, 1 Credit

Examination Scheme
ESE - 60 Marks
ISE - 40 Marks
ICA - 25 Marks

Additive manufacturing, often referred to as 3D printing, involves creating objects by adding material layer by layer, offering unparalleled design freedom, customization, and efficiency. Throughout this course, students will explore various additive manufacturing technologies, such as Stereolithography (SLA), Selective Laser Sintering (SLS), Fused Deposition Modeling (FDM), and more. Students will engage in hands-on projects, learning to design, model, and print complex structures. Real-world case studies will highlight the transformative impact of additive manufacturing in industries like aerospace, healthcare, automotive, and consumer products.

Course Prerequisite:
Students should have a foundational understanding of manufacturing processes, including traditional methods like machining and casting. Knowledge of material science, covering metals, polymers, ceramics, and composites, is essential. Proficiency in computer-aided design (CAD) software, such as SolidWorks or AutoCAD, is required for creating and manipulating 3Dmodels.

Course Objectives:
1. To understand basics of Additive Manufacturing.
2. To understand various types of Additive Manufacturing.
3. Be familiar with the characteristics of various materials that are used in additive manufacturing.
4. To understand various hardware and software for Additive Manufacturing.
5. To understand various applications of Additive Manufacturing

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Course Outcomes:
After completion of the course, the students will be able to: -
1. Compare different additive manufacturing processes and its applications.
2. Explain the additive manufacturing Process.
3. Develop 3D model using any CAD software.
4. Identify the material used for different 3D additive manufacturing processes.

Unit 1 : Introduction to Additive Manufacturing No of lectures – 05

Industry 4.0 and Additive Manufacturing, Need for Additive Manufacturing, Additive Manufacturing vs. Subtractive Manufacturing, Classification of Additive Manufacturing Processes, Applications of Additive Manufacturing.

Unit 2: Additive Manufacturing Processes -I No of lectures – 05

Stereo Lithography (SLA), Selective Laser Sintering (SLS), Fused Deposition Modeling (FDM), Digital Light Processing (DLP), Multi Jet Fusion (MJF).

Unit 3: Additive Manufacturing Processes -II No of lectures – 05

Direct Metal Laser Sintering (DMLS), Electron Beam Melting (EBM), Binder Jetting Laminated Object Manufacturing (LOM).

Unit 4: 3D Modeling Software Used in Additive Manufacturing No of lectures – 05

Introduction to CAD, Geometric Modeling and Its Types, TinkerCAD: Introduction, features, and basic operations, Fusion 360: Comprehensive guide to using Fusion 360 for 3D modeling, CATIA: Overview, key features, and advanced modeling capabilities.

Unit 5: Materials Used in Additive Manufacturing No of lectures – 05

Classification of Materials by Technology, Polymers in AM, Metals in AM: Common metals used, their properties, and applications, Composites in AM: Advantages of composite materials, typical applications.

Unit 6: Various Forms of Additive Manufacturing Materials No of lectures – 05

Forms of Raw Materials: Overview of different material forms (liquid, solid, wire, powder) used in AM, Polymers and Their Properties: Detailed exploration of polymer materials and their uses in AM.

Unit 7: Techniques of Powder Preparation and Their Desired Properties

No of lectures – 05

Introduction to Powder Preparation: Overview of techniques used for powder preparation, Atomization process and its types.

Unit 8: Application of Additive Manufacturing Processes No of lectures – 05

Applications of 3D Printing in Aerospace, Automotive, Manufacturing, Medical and Architectural Engineering.

- **Internal Continuous Assessment (ICA) :**

  ICA consists of minimum 8 practical based on curriculum.

  1. Introduction to 3D CAD modelling
  2. Introduction to Additive Manufacturing
  3. Types of additive manufacturing Processes
  4. Types of additive manufacturing Machines
  5. Materials Used in Additive Manufacturing
  6. Application of Additive Manufacturing (AM)
  7. Techniques of Powder Preparation for AM.
  8. Virtual Lab Experiment – I
  9. Virtual Lab Experiment – II
  10. Development of prototype by 3D Printer

- **Textbooks**

1. Gebhardt A., “Rapid prototyping”, Hanser Gardener Publications, 2003.
2. Chua C.K., Leong K.F., and Lim C.S., “Rapid prototyping: Principles and applications”, Third Edition, World Scientific Publishers, 2010.

- **Reference Books**

1. Liou L.W. and Liou F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press, 2007.
2. Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006.
3. Hilton P.D. and Jacobs P.F., “Rapid Tooling: Technologies and Industrial Applications”, CRC press, 2000.
4. Dougles Bryden, “CAD and Prototyping for Product Design”, 2014.

Walchand Institute of Technology, Solapur.

T.Y. B. Tech (Mechanical & Automation Engineering Engineering)

Semester-V

Core Elective-I

22MAU5EA1T AUTOMOBILE ENGINEERING

Lecturers: 3 Hrs/ Week, 3 Credits
Practicals: 2 Hrs/ Week, 1 Credit

ESE: 60 Marks
ISE: 40 Marks
ICA: 25 Marks

This course is a comprehensive course that delves into the intricate systems and cutting-edge technologies driving modern vehicles. Students will explore topics such as advanced powertrain design, automotive electronics, vehicle dynamics, and materials engineering. Emphasis will be placed on understanding the integration of these systems to enhance performance, safety, and sustainability. Through a blend of theoretical concepts and practical applications, the course aims to equip students with the knowledge and skills necessary to innovate in the rapidly evolving automotive industry.

Course Prerequisite:

To learn the subject "Advanced Automobile Engineering," students must have successfully completed foundational courses in Mechanical Engineering, including "Introduction to Mechanical Engineering," "Fundamentals of Thermodynamics," "Fluid Mechanics," and "Material Science." Additionally, a thorough understanding of "Engineering Mechanics" is required. Proficiency in mathematics, particularly in calculus and differential equations, as well as a solid grasp of physics, especially mechanics and dynamics, is essential. Prior exposure to basic knowledge of manufacturing processes will be beneficial for comprehending the advanced concepts discussed in this course.

Course Objectives:

1. To provide students with a comprehensive understanding of advanced automotive systems and technologies, enabling them to analyse and evaluate the performance, safety, and sustainability aspects of modern vehicles.
2. To equip students with the knowledge of advanced powertrain design, automotive electronics, vehicle dynamics, and materials engineering, fostering their ability to innovate in the automotive industry.
3. To enhance students' understanding of the integration of various automotive systems and their impact on vehicle performance, leading to the development of skills necessary for system-level design and optimization.
4. To familiarize students with the latest trends and advancements in automobile engineering, such as electric and hybrid vehicles, ADAS, and other emerging technologies, preparing them for the future of the industry.

Course Outcomes:

1. Students will analyse and compare different automobile types, including components, layouts, and materials, evaluating safety device impacts. They will understand vehicle performance factors and calculate gear and axle ratios for optimal performance.
2. Students will understand automotive electrical systems, including batteries, lighting, starting, charging, and instrumentation circuits, describing the principle operation and application of different battery types in automotive (Hybrids & EV) and analysing

electrical systems for functionality and efficiency.

3. Students will gain knowledge of transmission systems and final drives, including clutches, gearboxes, and differentials, explaining the operation of automatic transmission, CVT, DCT, and DSG, and analysing rear axle components and construction for different automotive applications.
4. Students will demonstrate an understanding of steering, braking, and suspension systems, describing steering system functions and layout, analysing steering geometry and wheel alignment, evaluating braking mechanisms and advanced systems like ABS, ESP, and EBD, and gaining knowledge of suspension requirements, types, and components, including modern trends in automobile technology.

Unit 1 - Introduction to Automobiles: No. of Lectures: - 04

Broad classification of Automobiles. Major Components and their functions. Types of vehicle layouts, Types of bodies and their materials, safety devices, various department involved in complete vehicle development e.g. Styling, Vehicle integration, NVH, Emission development etc.

Unit 2 - Performance of Automobiles No. of Lectures: - 06

Types resistances to vehicle motion, Acceleration, Grade ability and draw bar pull, Traction and Tractive effort, Distribution of weight, Power required for vehicle propulsion, Selection of gear ratio, Rear axle ratio (Numerical).

Unit 3 - Automotive Electrical Systems No. of Lectures: - 04

Automotive batteries, Types of battery in Automotive (Hybrids & EV) with their principle operation and application. Automotive lighting system, Starting system, charging system, Electric horn, Electric fuel Gauge- thermostatic & balancing coil type, Wiper & side indicator circuit, electric Speedo meter.

Unit 4 - Transmission System and Final drives No. of Lectures: -06

Requirements of transmission system, Automobile clutches- requirements, types & functions, Fluid flywheel. Types of automotive gearboxes, Overdrive, Principle of operation of automatic transmission, Continuously Variable Transmission (CVT), Dual clutch transmission (DCT), Direct Shift Gear Box (DSG), Torque converter, Propeller shaft, Hotch-kiss and Torque tube drive, Final drive and its types, Differential, Construction and types of rear axles, Introduction to wheels and tyres.

Unit 5 - Steering System: No. of Lectures: -06

Function of steering, Steering system layout, Ackerman steering mechanism (Numerical), Types of steering gear boxes, Condition for true rolling, Steering geometry-Camber, Caster, King pin inclination, Included angle, Toe-in and Toe-out, Wheel alignment, Slip angle, Under steer & over steer, Power assisted system : Electric assisted, hydraulic assisted.

Unit 6 - Braking System No. of Lectures: -06

Function of automotive brake system, Types of braking mechanism, Power brakes, Anti lock braking system(ABS), ESP (Electronic Stability Programme), EBD (Electronic Brake force Distribution) etc.

Unit 7 - Suspension System No. of Lectures: -04

Suspension requirements, Sprung and Unsprung mass, Types of automotive suspension systems. Conventional and Independent, Shock absorber, Types of springs, Reaction members-Radius rod, Stabilizer bar, Air suspension system.

Unit 8 - Modern trends in Automobiles No. of Lectures: -04

Introduction to Sensors and actuators used in automobile controls, Electronic Control Unit, traction control unit, fuel cells Electric & Hybrid vehicles and its major components, ADAS (Advance driver assisted system) etc.

- **Internal Continuous Assessment (ICA):**

ICA consists of minimum 8 assignments based on curriculum.

Recommended assignments:

1. Research and classify different types of automobiles based on their powertrain, body type, and purpose.
2. Calculate the power required for vehicle propulsion under various conditions (e.g., acceleration, gradeability).
3. Design an automotive lighting system, considering the type of bulbs, placement, and intensity required for optimal visibility.
4. Compare and contrast different types of automotive gearboxes, such as manual, automatic, CVT, and DCT, in terms of efficiency and performance.
5. Calculate the steering geometry parameters (e.g., Ackerman steering mechanism) for a given vehicle, ensuring proper wheel alignment and manoeuvrability.
6. Analyze the components and operation of an anti-lock braking system (ABS), including the role of sensors and actuators.
7. Design a suspension system for a specific vehicle, considering the types of springs, shock absorbers, and stabilizer bars required.
8. Research and present on a modern automotive trend, such as electric vehicles, hybrid powertrains, or autonomous driving technologies.
9. Investigate the use of advanced materials in automotive engineering, such as composites or high-strength steels, and their impact on vehicle performance and safety.
10. Develop a project plan for the integration of a new automotive technology into an existing vehicle platform.

- **Text books-**
  1. Kripal Singh - Automobile Engineering – Standard publisher.
  2. Automobile Mechanics -.N. K. Giri
  3. Automobile Electrical Equipment -P. S. Kohali
- **Reference Books:**
  1. K. Newton and W. Seeds, T.K. Garrett,Motor Vehicle, Elsevier publications
  2. Hans Hermann Braess, Ulrich Seiffen, handbook of Automotive Engineering, SAE Publications
  3. William H. Crouse. Automotive Mechanics - Tata McGraw Hill Publishing House
  4. Joseph Heitner, Automotive Mechanics -C.B.S Publishers And Distributors
  5. SAE Manuals and Standard

Walchand Institute of Technology, Solapur

T. Y. B. Tech. (Mechanical & Automation Engineering) Semester-V

Core Elective -I

22MAU5EA2T TOOL ENGINEERING

Teaching Scheme
Lecture: 3 Hours/ Week, 3 Credits
Practical: 2 Hours/ Week, 1 Credit

Examination Scheme
ESE: 60Marks
ISE: 40 Marks
ICA: 25 Marks

This course seeks to provide an introduction to tool engineering and discusses various procedures, requirements, tooling methods. It introduces engineering materials and describes the different kinds of tools, jigs & fixtures used in industries. A further content explains in detail the design of press tool, draw tool, jig & fixture as well as tool nomenclature and geometry.

Course Prerequisite:
Mechanics, Material properties, Degree of freedom.

Course Objectives:

1. Analyze the geometric characteristics and tool signatures of single point cutting tools.
2. IMPART the knowledge different type of tool geometry & tool life.
3. Understand sheet metal forming operations and die design procedure.
4. Understand & design Jigs and Fixtures for variety of operations component.

Course Outcomes:
After completing this course, student shall be able to -

1. Analyze the impact of different tool geometries & their angles on cutting performance.
2. Proficient in assessing the machinability of materials, predicting tool life, and recommending suitable cutting tool materials and coolants.
3. Demonstrate press working operations and APPLY the basic principles to DESIGN dies and tools for forming and shearing operations
4. Select appropriate jigs/fixtures and to draw the process plan for a given component.

Unit 1- Single Point Cutting Tools No of lectures-04

Geometry & Tool Signature: ASA (American Standards Association) system, ORS (Orthogonal Rake System), Effect of geometry on: Tool life, Cutting force, Surface finish.

Unit 2- Metal Cutting Processes No of lectures-05

a) **Types of Metal Cutting Processes:** Orthogonal cutting, Oblique cutting, Force analysis for orthogonal cutting (Analytical)
b) **Chip Formation and Analysis:** Types of chips, Chip thickness ratio, Shear angle, Tool dynamometers, Merchant circle of forces (Graphical)

Unit 3- Multi-Point Cutting Tools No of lectures-05

a) **Geometry and Nomenclature:** Drill , Milling cutter, Broaches, Reamers
b) **Cutting Tool Materials**: Types, Composition, Properties, Applications

Unit 4- Machinability & Tool Life No of lectures- 06

a) **Machinability Index**: Factors affecting machinability
b) **Tool Life**: Flank wear, Crater wear, Effect of variables on tool life, Taylor's equation of tool life (Numerical on Taylors tool life)
c) **Coolants**: Heat generation, Types of coolants

Unit 5-Press Tools No of lectures- 05

a) **Elements of Press Tools**: Types of dies, Types of operations
b) **Design of Die for Cutting Operation**: Mechanics of shearing, Cutting force estimation, Punch & die clearance, Stock strip layout, Design of punches & die block functioning & placement of other elements (Analytical)

Unit 6- Drawing and Bending Dies No of lectures- 05

a) **Design of Drawing Dies**: Determination of blank size, Number of draws, Stage-wise component drawing, Drawing radii, Clearance, Estimation of drawing force. (Numerical on drawing die design)
b) **Types of Bending Dies**: Types & Applications.

Unit 7- Locating & Clamping Devices for Jig and Fixture No of lectures- 05

a) **Definition and Concept**: Locating and clamping
b) **Types of Devices**: Locating devices: Clamping devices
c) **Advanced Techniques**: Types of redundant locations, Fool proofing and indexing techniques

Unit 8- Design of Jigs & Fixtures No of lectures-05

a) **Design of Jigs**: Principles of jig design, Types & applications, Types of bushes & selection, Use of standard parts, Design procedure & drawing
b) **Design of Fixtures**: Principles of fixture design, Standard elements & types of fixtures, Design of milling fixtures.
c) **Problems on Jigs & Fixture**

- **Internal Continuous Assessment (ICA) :**

  ICA consists of minimum 8 practical based on curriculum.

  Recommended practicals:

  1. Draw and label the tool geometry according to both (ASA & ORS) systems (Use CAD Software)
  2. Assignment on Force analysis for orthogonal cutting
  3. Graphical representation of Force analysis for orthogonal cutting.
  4. Machinability Index and Tool Life Calculation.
  5. Locating and Clamping Devices Study.
  6. Design of JIG (Use CAD Sofware)
  7. Design of fixture ((Use CAD Sofware)
  8. Assignment on drawing die design.
  9. Industrial Visit any machining shop
  10. Study different types industrial jigs & fixture for different component.

- **Text Books:**

  1. P.C.Sharma,Text Book of Production Engineering,S.Chand Publication

2. G.R. Nagpal, Machine Tool Engineering, Khanna Publication
3. P.H.Joshi, Press Tools, S.Chand Publication
4. P.H.Joshi,Jigs & Fixtures, S.Chand Publication

- **Reference Books:**
  1. Mr. Arshinnov,Metal cutting Theory& tool design, MIR Publication
  2. Fundamentals of Tool design-ASTME Publication
  3. Donaldson,Tool design, TMH Publication
  4. Kempster,Jig & Fixture Design, ELBS Publication

Walchand Institute of Technology, Solapur
T. Y. B. Tech. (Mechanical & Automation Engineering)
Semester-V
Core Elective -I
22MAU5EA3T FLUID MACHINERY AND FLUID POWER

Teaching Scheme	**Examination Scheme**	
Lecture: 3 Hours/ Week, 3 Credits	**ESE**	-60Marks
Practical: 2 Hours/ Week, 1 Credit	**ISE**	-40 Marks
	ICA	-25 Marks

The course introduces to different types of turbines & pumps. It deals with the water turbine & pumps in details. It also gives basic knowledge of steam turbines & gas turbines. It also deals with the fluid power systems – hydraulics & pneumatics. It covers construction & working of different system elements. Hydraulic & Pneumatic circuits for different applications are also dealt in this course.

Prerequisite: Basic knowledge of Fluid Mechanics

Course Objectives:

1. To understand the construction & working of water turbines & centrifugal pumps
2. To evaluate the performance of water turbines & centrifugal pumps
3. To become familiar with the construction and function of the different hydraulic & pneumatic components
4. To select various fluid power components & prepare circuits.

Course Outcomes:

At the end of course, students will be able to

1. Select or design water turbines & centrifugal pumps
2. Choose a steam turbine or gas turbine for a certain application
3. Choose hydraulic & pneumatic systems for proper applications
4. Prepare hydraulic & pneumatic circuits for various applications

Unit 1 – Impulse Water Turbines No of lectures – 05

Euler's equation for rotodynamic machines, Classification of water turbines, Pelton wheel, Work done and efficiencies of Pelton wheel, working proportions of Pelton wheel, Design of Pelton Turbine runner, governing of Pelton turbine.

Unit 2 – Reaction Water Turbines No of lectures – 05

Construction and Working of Francis, Kaplan turbine. Work done and efficiencies of Francis & Kaplan turbine, Working Proportions of Francis & Kaplan turbine, Draft tube, Types and function, governing of reaction turbines.

Unit 3 – Centrifugal Pumps No of lectures – 06

Working principle, construction, types, various Heads, multistage pumps, Velocity triangles, Minimum starting speed, Maximum Suction Height & Net Positive Suction Head, Methods of priming, Calculations of efficiencies, Discharge, blade angles, Heads, Power required, impeller dimensions, specific speed of pumps, Performance characteristics of pumps.

Unit 4 – Steam turbines & Gas turbines No of lectures – 04

Gas turbines: General aspects, Classification of gas turbines, merits & demerits of gas turbines, uses of gas turbine, gas turbine fuels

Steam turbines: General aspects, Classification of steam turbine, compounding of steam turbines, Losses in steam turbine

Unit 5 – Hydraulic system elements No of lectures – 06

Fluid Power systems- Introduction, Types, advantages, limitations & applications, Basic components of Hydraulic system, Hydraulic Actuators- Linear & Rotary, Types, Working, Construction, Cushioning effects, Calculation of velocity & force, Seals & Packing- Types, materials, applications, Pumps, Accumulators, Intensifiers & Valves Classification, construction, operation, advantages, applications, Symbols of above components/ devices

Unit 6 – Hydraulic circuits No of lectures – 04

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

Unit 7 – Pneumatic system elements No of lectures – 06

Pneumatic system: Advantages, limitations, Applications of pneumatic system, Comparison of hydraulic & pneumatic system, Pneumatic cylinders, Air motors- types, construction and working, different types of pneumatic valves, Air compressors, types, working, selection criteria, FRL unit, construction and working

Unit 8 – Pneumatic circuits No of lectures – 04

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

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- **Internal Continuous Assessment (ICA) :**

ICA consists of minimum 8 practical based on curriculum.

Recommended practicals

1. Trial on a Pelton wheel.
2. Trial on a Francis/ Kaplan turbine.
3. Trial on a centrifugal pump.
4. Symbols for different components of Hydraulic and Pneumatic system
5. Demonstration of Hydraulic speed control circuits
6. Demonstration of Traverse & feed circuit
7. Demonstration of sequencing circuit
8. Demonstration of pneumatic circuits
9. Trial on Gear pump
10. Software use for hydraulic & pneumatic circuit design
11. Visit to Service station of Earth Moving equipment (Note: Students should write visit report based on the observations made during the visit)

- **Textbooks**

1. Dr. P.N. Modi and Dr. S.M. Seth - Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Book House.
2. Dr. R.K. Bansal - Fluid Mechanics and Hydraulic Machines - , Laxmi Publication Pvt. Ltd., New Delhi.
3. Dr. R. Yadav, Steam and Gas Turbines and Power Plant Engineering, Central Publishing House
4. S. R. Majumdar, Oil Hydraulics- Principle & Maintenance, Tata McGraw Hill
5. Pneumatics- Principle & Maintenance, S. R. Majumdar, Tata McGraw Hill•
6. H.L.Stewart, Hydraulics and Pneumatics – Industrial Press

- **Reference Books**
  1. S. K. Som, G. Biswas- Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill publications
  2. Gas Turbines, V. Ganeshan, McGraw Hill Education
  3. Steam Turbine Theory and Practice, William J. Kearton, CBS Publication
  4. Eaton-Vickers Industrial Hydraulics Manual
  5. Festo's Manual on Pneumatic Principle, applications

Walchand Institute of Technology, Solapur
T. Y. B. Tech. (Mechanical & Automation Engineering) Semester-V
Core Elective -I
22MAU5EA4T INTERNET OF THINGS

Teaching Scheme
Lecture: 3 Hours/ Week, 3 Credits
Practical: 2 Hours/ Week, 1 Credit

Examination Scheme
ESE: 60Marks
ISE: 40 Marks
ICA: 25 Marks

The Internet of Things (IoT) refers to the systems in which different devices, equipped with sensors and signal processing, are connected through a network to communicate with each other with/without central servers. This course provides a thorough introduction to the different components of an IoT system. The course also introduces cloud platforms of IoT and different communication protocols. Introduction to Cortex M Series ARM architecture is also a part of this course.

Course Prerequisite: Basics of computer and internet.

Course Objectives:
The course aims to:

1. To make student aware of different components of an IoT System and IoT privacy, security profiles & protocols
2. To make student understand the architecture of ARM Cortex M3 series microcontroller.
3. To make student learn interfacing of different peripherals with microcontroller.
4. To make student learn different communication & application protocols used in IoT.
5. To introduce to student different cloud platforms of IoT.

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

1. Explore different components of an IoT System and IoT privacy, security profiles & protocols
2. Relate the architecture of Cortex M3 series ARM microcontroller for the development of IoT
3. Categorize different communication and application-level protocols used in IoT
4. Signify different IoT cloud platforms for different applications

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Unit 1- Introduction to Internet of Things No of lectures – 06

Introduction to IoT, IoT-a reference architecture, conceptual framework, architectural view, M2M communication, IoT system layers and design standardization, data enrichment & consolidate, device management at gateway, prototyping the embedded systems for IoT: embedded computing basics, Linux based embedded systems, IoT use cases.

Unit 2- IoT Privacy, Security and Vulnerabilities Solutions No of lectures – 04

Introduction to security and privacy, vulnerabilities, security requirements and threat analysis, layered attacker model, security models, profiles and protocols for IoT.

Unit 3- Introduction to ARM Cortex Microcontroller No of lectures – 10

Introduction to ARM architecture, cortex series classification (A, R, M series), ARM Cortex-M series family, ARM Cortex-M3 processor overview, block diagram, registers, memory map, instruction set: data accessing, processing, arithmetic, program flow control etc., exception handling, low-power features, requirements, sleep mode, development of low-power applications, basic embedded C programs for on-chip peripherals, interfacing I/O devices like led's, switch's etc., serial communication, analog interfacing and data acquisition, concepts of application programming interface (API).

Unit 4- Communication Technologies for IoT No of lectures – 07

Basics of the communication technologies like Bluetooth Low Energy (BLE), Zigbee, Wifi, RFID, their architecture, characteristics, limitation, power consumption parameters and applications

Unit 5- Application Protocols for IoT No of lectures – 06

Basics of application protocols like MQTT and CoAP, their features, framework, message formats, implementations and applications

Unit 6- Cloud Platforms for IoT No of lectures – 07

Cloud architecture for IoT, cloud characteristics, delivery & deployment models, survey of various IoT cloud platforms, cost metrics & pricing models for cloud services, service quality metrics for cloud platforms, and introduction to Node-RED tool from the IBM Watson IoT Platform

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- **Internal Continuous Assessment (ICA)**

Minimum 8 assignments/experiments based on above syllabus

Recommended list of practicals are as follows.

1. Choose a research paper on IoT architecture or a specific IoT use case. Write a summary and critical review of the paper.
2. Design a basic IoT system for a specific application (e.g., smart home, health monitoring). Create a block diagram and describe each component and its role.
3. Develop a simple embedded system using a Raspberry Pi or Arduino that can collect data from a sensor and send it to a gateway.
4. Implement a basic security protocol (e.g., SSL/TLS) for an IoT communication system.
5. Write and test basic embedded C programs for the ARM Cortex-M3 processor, including GPIO control, timer usage, and interrupt handling.
6. Interface an LED and a switch with the ARM Cortex-M3 microcontroller. Write a program to control the LED based on the switch state.
7. Develop a simple application using Bluetooth Low Energy (BLE) to send sensor data to a mobile app.
8. Implement an RFID-based access control system.
9. Compare MQTT and CoAP protocols in terms of their features, performance, and use cases. Write a detailed comparison report.
10. Conduct a cost and quality analysis for deploying an IoT solution on a cloud platform. Consider factors like data storage, processing, and service reliability.

- **Text Books:**

1. Raj Kamal, Internet of Things: Architecture and Design Principles
2. Perry Lea, Internet of Things for Architects
3. Joseph Yiu, The Definitive Guide to the ARM Cortex-M3
4. Perry Xiao, Designing Embedded Systems and the Internet of Things with the ARM Mbed

- **Reference Books:**

1. Arvind Ravulavaru, Enterprise Internet of Things Handbook
2. Dimitrios Serpanos, Marilyn Wolf, Internet-of-Things (IoT) Systems: Architectures, Algorithms, Methodologies
3. Thomas Erl, Ricardo Puttini, Zaigham Mahmood, Cloud Computing: Concepts, Technology & Architecture
4. Peter Waher, Learning Internet of Things

Walchand Institute of Technology, Solapur

T.Y. B. Tech (Mechanical & Automation Engineering)

Semester-V

2MAU5ES6P ADVANCE PROGRAMMING CONCEPTS (JAVA)

Teaching Scheme	**Examination Scheme**
Lectures– 1 Hours/week, 1 Credit	**ISE - 2**5 Marks
Practical – 2 Hours/week, 1 Credit	**ICA** - 25 Marks
	POE - 50 Marks

This syllabus is designed for beginner mechanical engineers with no prior programming experience. It aims to provide a foundation in Java programming with a focus on applications relevant to mechanical engineering..

Course Objectives:

1. Understand the basic concepts of programming and object-oriented programming (OOP).
2. Write simple Java programs using fundamental syntax and data structures.
3. Apply control flow statements for decision making and loops for repetitive tasks.
4. Work with functions for code reusability and modularity.
5. Utilize arrays for data organization and manipulation relevant to mechanical engineering problems.
6. Introduce basic concepts of classes and objects for building simulations or models.

Course Prerequisite:

This course requires that the students are familiar with programming language such as C/C++ and data structures, algorithms.

Course Outcomes:

After completing this course, student shall be able to -

1. Demonstrate proficiency in Java fundamentals, including setting up a development environment and applying object-oriented programming principles to solve engineering problems.
2. Apply object-oriented programming principles to design and implement solutions for engineering problems, utilizing concepts such as classes, inheritance, and polymorphism.
3. Effectively manage data using arrays and methods, and demonstrate competency in handling exceptions and performing file I/O operations for engineering applications.
4. Integrate Java libraries to solve complex engineering problems and develop interactive graphical user interfaces (GUIs) using JavaFX for simulations and applications.

Unit 1 - Introduction to Java Programming No of lectures – 01

Overview of Java and its applications in engineering, Setting up the development environment, Writing and executing your first Java program, Basic program structure.

Unit 2 – Basic Java Syntax No of lectures – 02

Variables, data types, and operators, Control structures: if-else, switch-case, Loops: for, while, do-while.

Unit 3 – Methods and Arrays No of lectures – 02
Defining and calling methods, Method overloading, Arrays and their applications in engineering problems.

Unit 4 – Object-Oriented Programming - Part 1 No of lectures – 02
Classes and objects, Constructors and methods, Encapsulation and access modifiers.

Unit 5 – Object-Oriented Programming - Part 2 No of lectures – 02
Inheritance and polymorphism, Abstract classes and interfaces, Case study: Designing a mechanical component hierarchy.

Unit 6 - Exception Handling and File I/O No of lectures – 02
Introduction to exceptions, Try-catch blocks, Creating custom exceptions, Reading from and writing to files, handling different file formats (text, CSV).

Unit 7: Java Libraries for Engineering Applications No of lectures – 02
Overview of useful Java libraries (e.g., Apache Commons Math), Implementing mathematical functions and simulations.

Unit 8: Graphical User Interfaces (GUI) and Final Project No of lectures – 01
Introduction to JavaFX, Creating simple GUI applications, Application: Building a basic simulation interface, Final project: Solving a mechanical engineering problem using Java.

- **Internal Continuous Assessment (ICA) :**
  ICA consists of minimum 8 practical based on curriculum.
  Recommended Practicals:
  1. Introduction to Java Programming.
  2. Programs based on Basic Java syntax.
  3. Programs based on Methods and Arrays.
  4. Programs based on Object Oriented programming (Classes & Objects, Using Constructors, Encapsulation, Object Interactions and Method in class.)
  5. Programs based on Object Oriented programming (Inheritance, Polymorphism, Abstract class. Interface Implementation and Hierarchy Design.)
  6. Programs based on Exception Handling and File I/O.
  7. Programs based on Engineering Application using Java libraries.
  8. Programs based on GUI and Final Project.

- **Textbooks**

1. E. Balaguruswamy, Programming with JAVA: A Primer (4th Edition), TMH.
2. Herbert Scheldt, JAVA: The Complete Reference (5th Edition), TMH.
3. Malan and Hahn, Essential JAVA for Scientists and Engineers, Butterworth-Heinemann Ltd.

- **Reference Books**

1. P. Radhakrishna, Object Oriented Programming through JAVA, University Press.
2. Motwani, Java Programming for Beginners, Shroff Publication.
3. Yeshwant Kanetkar, Let us JAVA, BPB.
4. Mike McGrath, JAVA in Easy Steps, TMH.

Walchand Institute of Technology, Solapur
T.Y. B. Tech (Mechanical & Automation Engineering)
Semester-V
21MAU5SK7L WORKSHOP PRACTICE-I

Teaching Scheme
Practical – 2 Hours/week, 1 Credit

Examination Scheme
ICA - 25 Marks

This course is important to understand fundamentals of machine shop starts from safety measures, practical use of measuring tools, use of all conventional machine tools, operations of all conventional machines, use of tolerances, fits and finally their practical use and applications.

Course Prerequisite:
This course is important to understand fundamentals of machine shop starts from safety measures, practical use of measuring tools, use of all conventional machine tools, operations of all conventional machines, use of tolerances, fits and finally their practical use and applications.

Course Objectives:
1. To learn and understand different machining operations practically studied in theory subjects.
2. To get hands on experience of machining operations such as grinding, drilling, shaping, turning etc.
3. To develop skills to operate different machine tools.
4. Apply tolerances on job.

Course Outcomes:
After completing this course, student shall be able to -
1. To operate different machine tools such as grinders, lathes, milling, drilling machines etc.
2. To machine the component as per specified dimensions by considering the tolerances.

- **Internal Continuous Assessment (ICA):**
  1. Tool Grinding Demonstration and actual grinding to understand the tool geometry.
  2. One Composite job in M.S. consisting of one component and inclusive of following operation shall be performed by students (facing, Turning, Step Turning, Chamfering, Grooving, Knurling)
  3. At least on dimension of job shall carry close tolerance.
  4. Preparation of process sheet for the above job.

Note: Students shall prepare a work book involving brief write up regarding machine/machines
employed for job. Students should prepare a work book which involves a process sheet for each job and inspection report of the job. Based on the job performed, attendance record, work book, internal viva, faculty may carry internal assessment.

- **Textbooks**
  1. Workshop Technology by Raghuvanshi
  2. Workshop Technology by Hajara Chowdhari
  3. Workshop Technology by W.A.J. Chapman
- **Reference Books**
  1. Manufacturing Processes & systems by Phillip F. Ostwald, Jairo Munoz-Wiley India.
  2. Fundamentals of modern Manufacturing by Mikel P. Groover-Wiley India.

Walchand Institute of Technology, Solapur

(An Autonomous Institute)

T. Y. B. Tech. (Mechanical and Automation Engineering)

Semester V

22ALU5SA9T Economics (Self Learning - HSS)

Teaching Scheme:	**Examination Scheme**
Credits: 2 Credits	ESE-50 Marks

Course Objectives:

1. To explain to students various theories of economics such as demand supply, production and cost.
2. To acquaint students with fundamentals of microeconomics.
3. To introduce to students concept of inflation with their causes, consequence and remedies.
4. To acquaint students with basics of international trade, foreign exchange.

Course Outcomes:

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

1. Identify the basic economic problems, resource constraints
2. Apply various theories of economics for explaining economic growth
3. Identify causes of inflation, consequence and can explain remedies
4. To assess the impact of international trade and foreign exchange on Indian economy

Unit 1: Introduction

History of Economic thought, Basic Economic problems, Resource Constraints and Welfare maximization, Nature of Economics: Positive and Normative Economics, Micro and Macro Economics, Basic concepts in Economics, The role of State in economic activity, Market and Government failures, New economic Policy in India.

Unit 2: Theories of Economics

Theory of utility and consumer's choice, Theories of Demand, supply and market equilibrium, Theories of firm, production and costs, Market structures, Perfect and imperfect competitions, oligopoly, monopoly.

Unit 3: Macroeconomics

An overview of Macroeconomics, measurement and determination of national income, Consumption, saving and investment

Unit 4: Banking & Inflation.

Commercial and Central Banking, Relationship between money, output and prices, Inflation causes, consequences and remedies

Unit 5: International Influences on Economics

International Trade, foreign exchange and balance payments, stabilization policies, Monetary, Fiscal and exchange rate policies

Textbooks:

1. Economics: P.A. Samuelson & W.D Nordhaus, McGraw Hill, New York, 1995
2. Modern Microeconomics : A. Koutsoyiannis, Macmillan,1975

Reference books:

1. Microeconomics: R. Pindyck and D.L. Rubinfield, Macmillan New York, 1989
2. Microeconomics: Gordon, 4th edition, Little Brown & Co., Boston, 1987
3. The Organization of Industry: William F. Shughart II, Richard D. Irwin, Illinois, 1990

Walchand Institute of Technology, Solapur
(An Autonomous Institute)
T. Y. B. Tech. (Mechanical and Automation Engineering)
Semester V
22ALU5SB9T Intellectual Property Rights for Technology Development and Management (Self-Learning - HSS)

Teaching Scheme:
Credits: 2 Credits

Examination Scheme
ESE-50 Marks

Course Objectives:

1. To introduce to student the legal and ethical importance of intellectual property associated with research and intellectual works.
2. To make student understand the overview of the process of acquiring the patent copyrights for the innovative works.
3. To make student aware of Indian IPR system and role of WTO in protecting Property Rights.
4. To make student aware about the plagiarism in the thesis, research papers etc.

Course Outcomes:

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

1. Explain importance of the intellectual property rights associated with research and intellectual works.
2. Explain the overview of process of acquiring the patents and copyrights for the innovative works.
3. Elaborate the role of Indian IPR system and role of WTO in protecting Intellectual Property Rights.
4. Explain how to avoid the plagiarism in the thesis, research papers etc.

Unit 1: Introduction to IPR

Dynamics of Knowledge evolution, creation of ownership domains in the knowledge space using various instruments of IPR

Unit 2: IPR for Engineers and Managers

Outlines concepts of confidentiality and information security, explores their role in technology development and transfer integrating Intellectual Property in project planning, execution & commercialization,

Unit 3: IPR and R&D

Discussion on the shifting paradigms of R&D and their linkage to IPR, Introduction to concepts of Valuation of IP & Value Realization

Unit 4: IPR for India

Comparison the Indian IPR system with international IPR frameworks especially in the context of WTO, followed by a few sessions on IPR litigations both for the enforcement of rights and business strategy

Unit 5: IPR and Contemporary Issues

Discussion on contentious issues of current interest such as Biotechnology and Intellectual Property, Protection of Traditional Knowledge, IPR and Electronic Commerce, TRIPS and Access to Medicines, Copyright issues in creative works, etc

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Text books:

1. Prabuddha Ganguli: Intellectual Property Rights Unleashing the Knowledge Economy. Tata McGraw Hill, New Delhi, 2001
2. Prabuddha Ganguli: Gearing Up for Patents The Indian Scenario. Universities Press India
   i. Ltd., Hyderabad, 1998
3. P. Narayan: Patent Law. Eastern Law Co., Calcutta

Reference Books:

1. Global Dimensions of Intellectual Property Rights in Science and Technology, Author:
2. National Research Council, National Academies Press, 1993.
3. Technology Transfer: Intellectual Property Rights, C Sri Krishna, ICFAI University press (2008)

Walchand Institute of Technology, Solapur
(An Autonomous Institute)

T. Y. B. Tech. (Mechanical and Automation Engineering)

Semester V

22ALU5SC9T Introduction to Sociology (Self-Learning - HSS)

Teaching Scheme:	**Examination Scheme**
Credits: 2 Credits	ESE- 50 Marks

Course Objectives:

1. To introduce to student various social phenomena.
2. To make student aware of effect of urbanization on society.
3. To instill social intuition for better society among student.
4. To make student conscious about impact of modernization on society.

Course Outcomes:

At the end of this course, Students will be able to,

1. Interpret the effect of various social phenomena on sociology.
2. Elaborate the role of urbanization on the society.
3. Evaluate the need of social intuition for better society.
4. Evaluate the role of modernization, industrialization, environmental/ecological changes in the development of society.

Unit 1: Introduction to Sociology

What is sociology, some sociological concepts: social structure, status, role, norms, values etc., Socialization, and culture and change , Social stratification - various approaches and concept of social mobility

Unit 2: Population and Sociology

Population and society - Trends of demographic change in India and the world, Human Ecology, Trends of Urbanization in the developing countries and the world.

Unit 3: Social Institutions

Major social institutions - Family and marriage, caste and tribe and organizations:

i. Formal organization (bureaucracy)

ii. Informal Organization

Unit 4: Social Changes

Processes of social change- Modernization (including Sanskritization), industrialization, Environmental/ecological changes and development

Unit 5: Social Movements

Social movements - protest movements, reformist movement and radical movements in India

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Text books:

1. Sociology, L. Broom, P. Selznick and D. Dorrock, 11th Edn. 1990 (Harper International).
2. Sociology: Themes and Perspectives, M. Haralambos, Oxford University Press, 1980.
3. General Introduction to Sociology, Guy Rocher, A, MacMillan, 1982.

Reference Books:

1. Social movements in India, vols. 1-2, 1984, M.S.A. Rao, Manohar Publications.
2. Society in India, David Mandelbaum, 1990, Popular Publications.
3. Social change in modern India, M.N. Srinivas, 1991, Orient Longman Publications.

Walchand Institute of Technology, Solapur
T. Y. B. Tech. (Mechanical and Automation Engineering) Semester V
22ALU5SD9T Stress & Coping (Self-Learning - HSS)

Teaching Scheme:
Credits: 2 Credits

Examination Scheme
ESE-50 Marks

Course Objectives:

1. To make student aware about nature of stress and its various sources.
2. To make student attentive to effect of various stress.
3. To introduce to student about various means to cope up with stress.
4. To introduce to students basic stress management techniques.

Course Outcomes:

At the end of this course, Students will be able to,

1. Explain nature of stress and identify various sources of stress.
2. Elaborate the effects of medical, psychological and behavioral stress.
3. Explain how social support can mitigate the stress.
4. Explain various stress management techniques.

Unit 1: Introduction to Stress

Concept of stress-current and historical status, the nature of the stress response

Unit 2: Sources of Stress

Common sources of stress biological, personality and environmental

Unit 3: Coping with Stress

Coping styles defensive behaviors and problem-solving. Consequences of stress - medical, psychological and behavioral

Unit 4: Social Support

The role of social support in mitigating stress

Unit 5: Introduction to Stress Management

Stress management techniques-relaxation, meditation, cognitive restructuring, self-control, bio-feedback and time management, Preparing stress profile of a student

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Text books:

1. Walt, S. "Stress Management for Wellness". Harcourt Brace & Jovanovich, N.York, 1994.
2. D. Girdano and G. Everly., "Controlling Stress and Tension", Prentice-Hall, 1986.
3. Monat and R. Lazarus, "Stress and Coping: An Anthology", Columbia Univ. Press, 1985.

Reference Books:

1. Weisman, "The Coping Capacity", Human Services Press, 1984.
2. Stress and Coping: The Indian Experience, D.M. Pestonjee, SAGE India; Second edition, 1998

Walchand Institute of Technology, Solapur
T. Y. B. Tech. (Mechanical and Automation Engineering)
Semester V
22ALU5SE9T Professional Ethics and Human Values
(Self-Learning - HSS)

Teaching Scheme: **Examination Scheme**

Credits: 2 Credits ESE-50 Marks

Course Objectives:

1. To emphasize importance of human values among student.
2. To introduce to student engineering ethics for professional practice.
3. To make student aware about safety, responsibility and professional rights in professional Practice.
4. To make student attentive to code of ethics of global professional organizations such as ASME, ASCE, and IEEE.

Course Outcomes:

At the end of this course, Students will be able to,

1. Explain importance of human values in modern society.
2. Explain how to integrate engineering ethics in their professional practice.
3. Explain about safety measures, responsibility and professional rights in professional Practice.
4. Explain the code of ethics of Global organizations such as ASME, ASCE, and IEEE.

Unit 1: Human Values

Morals, Values and Ethics, Integrity, Work Ethics, Service Learning, Civic Virtue, Respect for others, Living Peacefully, Caring, sharing, Honesty, Courage, Valuing Time, Cooperation, Commitment, Empathy, Self-Confidence, Character, spirituality

Unit 2: Engineering Ethics

Senses of engineering ethics, Variety of Moral Issues, Types of inquiry, Moral Dilemmas Moral Autonomy, Kohlberg's Theory, Gilligan's Theory, Consensus and Controversy, Models of Professional Roles, Theories about Right Action, Self Interest , Customs and Religion.

Unit 3: Safety, Responsibilities and Rights

Safety and Risk, Assessment of safety and Risk, Risk Benefit Analysis and Reducing Risk, The Three Mile Island and Chernobyl Case Studies. Collegiality and Loyalty, Respect for Authority, Collective Bargaining, Confidentiality, Conflicts of Interest, Occupational Crime, Whistle Blowing, Professional Rights – Employee Rights, Intellectual Property Rights (IPR) – Discrimination

Unit 4: Global Issues

Multinational Corporations, Environmental Ethics, Computer Ethics, Weapons Development, Engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisors, Sample Code of Ethics of ASME, ASCE, IEEE, Institution of Engineers (India), etc.

Text books:

1. Bayles, M.D.: Professional Ethics, California: Wadsworth Publishing Company, 1981.
2. Koehn, D.: The Ground of Professional Ethics, Routledge, 1995.
3. R.S. Naagarazan, A Text Book of Professional Ethics & Human Values, New Age International, 2006

Reference Books:

1. Camenisch, P.F.: Grounding Professional Ethics in a Pluralistic Society, N.Y.: Haven Publications, 1983.
2. Wuest, D.E.: Professional Ethics and Social Responsibility, Rowman & Littlefield, 1994

Walchand Institute of Technology, Solapur
T.Y. B. Tech (Mechanical & Automation Engineering)
Semester-VI
22MAU6CC1T DESIGN OF TRANSMISSION SYSTEMS

Teaching Scheme	**Examination Scheme**
Lectures– 3 Hours/week, 3 Credits	**ESE** - 60 Marks
Practical – 2 Hours/week, 1 Credit	**ISE** - 40 Marks
	ICA - 25 Marks
	OE - 25 Marks

The course on Design of Transmission Systems provides a comprehensive understanding of the principles and practices involved in the design of mechanical elements used in power transmission systems. It covers the selection and design of gears, bearings, shafts, and other components essential for efficient power transmission in various mechanical systems. The course also emphasizes the application of theoretical knowledge through practical examples and case studies, preparing students for real-world engineering challenges in the field of machine design.

Course Prerequisite:

Fundamental understanding of mechanical engineering principles, particularly in the areas of mechanics and materials. Prior knowledge of machine design and kinematics is beneficial. Familiarity with basic mathematics, including calculus and algebra, is essential. Experience with CAD software for designing mechanical components is advantageous.

Course Objectives:

1. To design spur and helical gears, considering strength and wear for specific applications.
2. To analyze and design bevel and worm gears, with an understanding of their unique geometries
3. To select and analyze rolling element and sliding contact bearings, applying load-life relationships and lubrication principles for optimal performance.
4. To design clutches and brakes, using energy equations and thermal considerations to meet specific torque requirements.

Course Outcomes:

Students will be able to

1. Design spur and helical gears, considering strength and wear for application-specific requirements.
2. Analyze and design bevel and worm gears, understanding their unique geometries and applications in power transmission systems.
3. Select and analyze rolling element and sliding contact bearings, applying load-life relationships and lubrication principles to optimize bearing performance.
4. Develop skills to design clutches and brakes, applying energy equations and thermal considerations to meet specific torque demands.

Unit 1-Spur Gears No. of Lectures- 05

Gear terminology and types, Types of gear failures, hunting of gear tooth, Tooth profiles and standards, minimum number of teeth, Design considerations of gears and Gear materials, Design of spur gears: strength and wear considerations.

Unit 2- Helical Gears No. of Lectures - 05

Helical gear geometry and nomenclature, Virtual number of teeth, Force analysis, Design of helical gears: strength and wear considerations, Advantages and applications of helical gears.

Unit 3-Bevel Gears No. of Lectures- 05

Types and geometry of bevel gears, Force analysis, Strength and wear considerations of bevel gears, bevel gear mountings, Applications of bevel gears in transmission systems.

Unit 4-Worm Gears No. of Lectures- 05

Characteristics and geometry of worm gears, Force analysis, Friction and Efficiency, Design of worm gears: strength and wear rating, Applications and limitations of worm gears.

Unit 5-Rolling Element Bearings No. of Lectures - 05

Types of rolling element bearings: Ball bearings, roller bearings, Stribeck's equation, Static and Dynamic load carrying capacity, Load-life relationship and bearing selection, equivalent bearing load, Bearing failures and their remedies.

Unit 6- Sliding Contact Bearings No. of Lectures- 05

Bearing types and their constructional details, Introduction to Hydrostatic bearing, Hydrodynamic lubrication: Performance analysis Hydrodynamic bearing by Raimondi Method and by Boyd Method.

Unit 7-Clutches No. of Lectures - 05

Clutches: Energy Equation, Design of plate clutches (single and multiplate clutch), Thermal consideration in clutches.

Unit 8-Brakes No. of Lectures - 05

Brakes: Energy Equation, Band and Block brakes, Internal Expanding shoe break, Disk brake, Thermal consideration in brakes.

- **Internal Continuous Assessment (ICA):**
  ICA consists of minimum 8 assignments based on curriculum.
  Recommended assignments:

1. Create a glossary of terms related to gears, including types of gears and their applications.
2. Research and document the common failure modes of gears, including tooth breakage, wear, and pitting.
3. Using the provided formulas and standards, design a spur gear for a given application, considering strength and wear.
4. Using the provided formulas and standards, design a helical gear for a given application, considering strength and wear.
5. Prepare a presentation on the different types of bevel gear mountings and their uses in transmission systems.
6. Calculate the efficiency of a worm gear set for different lead angles and discuss the results.
7. Implement a step-by-step procedure for selecting the appropriate rolling contact bearing for a given application.

8. Design a single or multiplate clutch that can handle a specified torque, considering the energy equation and thermal considerations.
9. Compare the working principles and applications of band and block brakes, internal expanding shoe brakes, and disk brakes.
10. Using CAD software, design a simple transmission system component (e.g., a spur gear or a bearing housing) and submit the digital model and a brief report on the design process.

Text Books

1. V. B. Bhandari, "Design of Machine Elements," Tata McGraw-Hill Education.
2. J. E. Shigley, C. R. Mischke, R. G. Budynas, "Mechanical Engineering Design," McGraw-Hill.

Reference Books

1. R. L. Norton, "Machine Design: An Integrated Approach," Prentice Hall.
2. M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayaram, C. V. Vaishak, "Design of Machine Elements," Pearson.

Walchand Institute of Technology, Solapur
T.Y. B. Tech (Mechanical and Automation Engineering)
Semester-VI
22MAU6CC2T METROLOGY AND QUALITY CONTROL

Teaching Scheme	**Examination Scheme**
Lectures– 3 Hours/week, 3 Credits	**ESE** - 60 Marks
Practical – 2 Hours/week, 1 Credit	**ISE** - 40 Marks
	ICA - 25 Marks
	OE - 25 Marks

This course explores into insights of Metrology and Quality Control, covering essential topics such as precision measurement techniques, advanced gear metrology, Total Quality Management (TQM), Statistical Quality Control, and Acceptance Sampling. It equips students with the knowledge and skills necessary for ensuring accurate measurements and enhancing product quality in industrial sector.

Course Prerequisite:

Prior understanding of fundamental engineering concepts and familiarity with basic measurement principles is recommended for students undertaking this course.

Course Objectives:

1. Equip students with essential knowledge in metrology, covering its definition, types, objectives, and the necessity of inspection in manufacturing.
2. Familiarize students with advanced gear metrology techniques and gauge design principles, including the use of Co-ordinate Measuring Machines, lasers, and 3D scanning technology.
3. Provide students with a holistic understanding of quality management principles, encompassing Total Quality Management (TQM) concepts, tools, and their integration with lean manufacturing, Industry 4.0, and Cyber-Physical Systems (CPS) for improved organizational performance and product quality.
4. Enable students to apply Statistical Quality Control methods, including Six Sigma, and understand Acceptance Sampling principles alongside ISO 9001:2015 Quality Management Systems for enhanced quality assurance.

Course Outcomes:

After completing this course, student shall be able to -

1. Attain competency in metrology fundamentals, including understanding standards and comparators, and mastering precision measurement techniques with basic instruments.
2. Analyze gear metrology, grasp metrology advancements, and apply gauge design principles, ensuring precise measurements according to standards like IS 919-1963.
3. Implement Total Quality Management (TQM) principles effectively, incorporating lean manufacturing, Industry 4.0, and Cyber-physical Systems (CPS), along with utilizing various TQM tools and the seven quality control tools, ensuring enhanced organizational performance and product quality.
4. Apply Statistical Quality Control techniques, including control charts, and Six Sigma methodology, and understand Acceptance Sampling principles and Quality Management Systems standards, facilitating effective quality management practices in various industrial settings.

Unit 1 – Introduction to Metrology, Standards and Comparators No of lectures – 04

Metrology – Definition, types and objectives of metrology, Need of inspection
Standards: Line, end and wavelength standards.
Comparators: Mechanical and Pneumatic Comparators.

Unit 2 – Linear, angular and other measurements No of lectures – 04

Accuracy, Precision, Calibration, Errors and sources of errors, Readability, Traceability, Reproducibility, etc. Basic linear and angular measuring instruments and their selection: Vernier Caliper, Micrometer, Slip gauges and Angle Gauges. Surface Finish measurement and instruments: Stylus probe type, Tomlinson's surface tester and Talysurf.

Unit 3 – Gear Metrology and Advancements in metrology No of lectures – 06

Errors in gears, Gear terminology of spur gear, Gear tooth vernier, Profile Projector,
Advancements in Metrology: Co-ordinate Measuring Machine, Laser in Metrology, Introduction to 3D scanning and imaging technology

Unit 4 – Limits, Fits, Tolerances and Gauge Design No of lectures – 06

Concepts related to Limits, Fits and Tolerances; Mechanical Gauges: Types and uses, Taylor's Principle for Design of Gauges and Indian Standard (IS 919-1963) for gauge design.

Unit 5 – Introduction to Quality Control and Tools No of lectures – 04

Quality Control basics: Cost of Quality and Value of Quality, Quality of Design, Quality of Conformance, Quality of Performance;
Seven Quality Control Tools: Check sheet, Flow chart, Pareto analysis, cause and effect diagram, scatter diagram, Brain storming, Quality circles.

Unit 6 - Total Quality Management No of lectures – 06

Total Quality Management (TQM): Definitions, Principles and Key elements of TQM
Introduction to lean manufacturing, industry 4.0 and Cyber-physical System (CPS) for TQM.
Introduction to tools of TQM: Quality Function Deployment (QFD), 5S, Kaizan, Kanban, Just-In-Time (JIT), Poka yoke, Total Productive Maintenance (TPM).

Unit 7 – Statistical Quality Control No of lectures – 06

Statistical Quality Control: statistical concept, Frequency diagram, Control charts for variable & attribute data and types of control charts, Process Capability, Six Sigma: Statistical meaning and methodology.

Unit 8 – Acceptance Sampling and Quality Management System No of lectures – 04

Acceptance Sampling, Sampling plans: single, double and multiple sampling plan, OC curve and its characteristics
Quality Management Systems: Introduction to ISO 9001:2015, Definition and aims of standardizations, Techniques of standardization, Codification system.

- **Internal Continuous Assessment (ICA):**
  ICA consists of minimum 8 practical based on curriculum.
  Recommended practical list is as follows:
  1. Comparison of measurements using vernier caliper and micrometer.
  2. Calibration of vernier caliper and micrometer using slip gauge.
  3. Measure Run Out of cylindrical component using dial gauge indicator.

4. Measurement of gear parameters using gear tooth vernier.
5. Measurement of taper angle using vernier bevel protractor and sine bar in combination with slip gauge.
6. Measurement of thread parameters by using floating carriage micrometer.
7. Design a gauge by using concept of limits, fits and tolerances.
8. Measurement of surface roughness using surface roughness tester.
9. Alignment Testing of Lathe Machine/CNC/VMC/Drilling/Milling Machine.
10. Draw the frequency histogram, polygon and normal distribution curve for the sample data. Also interpret the results from the central tendency and dispersion parameters.
11. Draw and interpret the control charts ($\bar{X}$ and R chart) for given data.
12. Draw and interpret the control charts (P- chart and C-chart) for given data.

- **Textbooks**

1. I. C. Gupta, "Engineering Metrology", Dhanpat and Rai Publications, New Delhi, India.
2. M. S. Mahajan, "Statistical Quality Control", Dhanpat and Rai Publications.

- **Reference Books**

1. R. K. Jain, "Engineering Metrology", Khanna Publications.
2. V. A. Kulkarni, A. K. Bewoor, "Quality Control", Wiley India Publication
3. K. J. Hume, "Engineering Metrology", McDonald Publications.
4. A. W. Judge, "Engineering Precision Measurements", Chapman and Hall, London
5. K. L. Narayana, "Engineering Metrology", Scitech Publications.
6. J. F. Galyer, C. R. Shotbolt, "Metrology for Engineers", Little-hampton Book Services Ltd.,
7. V. A. Kulkarni, A. K. Bewoor, "Metrology & Measurements", Tata McGraw Hill Co. Ltd.
8. Amitava Mitra, "Fundamental of Quality Control and Improvement", Wiley Publication.
9. Richard S. Figliola, D. E. Beasley, "Theory and Design for Mechanical Measurements", Wiley India Publication.
10. E. L. Grant, "Statistical Quality Control", Tata McGraw Hill Publications.
11. J. M. Juran, "Quality Planning and Analysis", Tata McGraw Hill Publications.

Walchand Institute of Technology, Solapur
T.Y. B. Tech (Mechanical and Automation Engineering)
Semester-VI
22MAU6CC3T HEAT TRANSFER

Teaching Scheme	**Examination Scheme**
Lectures– 3 Hours/week, 3 Credits	**ESE** - 60 Marks
Practical – 2 Hours/week, 1 Credit	**ISE** - 40 Marks
	ICA - 25 Marks
	POE - 25 Marks

This course deals with study of various modes of heat transfer such as conduction, convection and radiation. After completing the course, the students will be able to formulate and analyse a heat transfer problem involving any of the three modes of heat transfer. The students will be able to obtain exact solutions for the temperature variation using analytical methods, where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer. The students will be able to analyse the performance of devices such as heat exchangers and also estimate the insulation needed to reduce heat losses wherever necessary.

Course Prerequisite:

Engineering Mathematics. Applied Thermodynamics, Fluid Mechanics

Course Objectives:

1. To classify and study the important modes of heat transfer.
2. To formulate and apply the general three-dimensional heat conduction equations
3. To elaborate the mechanism of radiative heat transfer.
4. To elaborate the mechanism of convective heat transfer.
5. To demonstrate and explain the mechanism of boiling and condensation.
6. To describe the various two-phase heat transfer phenomena.

Course Outcomes:

After completing this course, student shall be able to:

1. Compare and distinguish the Modes of heat transfer & apply the laws of conduction to the analysis of heat transfer in steady & unsteady state as well as for extended surfaces.
2. Apply the different laws to the radiation phenomenon.
3. Analyse Heat transfer in case of natural & forced convection, Boiling & condensation.
4. Analyse the heat exchangers.

Unit 1- Conduction Modes of Heat Transfer No. of lectures-08

Modes of heat transfer. Basic laws of heat transfer, Thermal conductivity and its variation with temperature for various Engineering materials (Description Treatment).

Steady State Heat Conduction

Derivation of Generalized Heat Conduction equation in Cartesian coordinate & its reduction to Fourier, Laplace and Poisson‟s equations. Generalized Heat conduction equation in

cylindrical and spherical coordinates (no derivation) and its reduction to one dimension (1D) heat conduction through plane wall, cylinder, sphere; composites, critical radius of insulation for cylinder and sphere. One dimensional steady state heat conduction with uniform heat generation for wall & cylinder (Numerical Treatment)

Unit 2- Unsteady State Heat Conduction No. of lectures-02

Systems with negligible internal resistance, Biot and Fourier number and their significance, Lumped Heat capacity Analysis (Numerical Treatment).

Unit 3- Extended Surfaces No. of lectures-04

Types and applications of fins, Governing equation for constant cross section area fins, Solution for fins with convective tip, adequately long (with insulated end) and infinitely long. Fin effectiveness and efficiency (Numerical Treatment)

Unit 4- Radiation No. of lectures-07

Nature of thermal radiation, definitions of absorptivity, reflectivity, transmissivity, monochromatic emissive power. Total emissive power and emissivity, Concept of black body & gray body, Kirchhoff‟s law, Wein‟s law and Planck‟s law. Lambert cosine rule, Intensity of radiation. Energy exchange by radiation between two black surfaces with non absorbing medium in between and in absence of reradiating surfaces.

Concept of radiation shape factor and its properties, Energy exchange by radiation between two gray surfaces without absorbing medium and absence of reradiation and Radiosity. Radiation network method, network for two surfaces which see each other. (Numerical Treatment)

Unit 5- Convection No. of lectures-07

Forced Convection Mechanism of convection and its types, Concept of Hydrodynamic and thermal boundary layer, local and average convective coefficient. Dimensional analysis, dimensionless numbers and their physical significance, Empirical correlations for internal and external flow in forced convection problems. (Numerical Treatment)

Unit 6- Natural Convection

Introduction, Dimensional analysis, dimensionless numbers and their physical significance, Empirical correlations for natural convection problems. (Numerical Treatment)

Unit 7- Boiling and condensation No. of lectures-06

Boiling Heat Transfer, types of boiling, Pool boiling curves, Force boiling phenomenon, Condensation Heat transfer, Film wise and drop wise condensation. Introduction of Heat pipe (Construction, working, advantages and applications) (Descriptive Treatment)

Unit 8-Heat Exchangers No. of lectures-06

Classification & Types of Heat exchangers, Fouling factor, and Overall heat transfer coefficient, Analysis by LMTD and NTU method for parallel and counter flow, Design consideration for Heat exchangers.
(Numerical Treatment)

- **Internal Continuous Assessment (ICA)**
  ICA consists of minimum 8 practical based on curriculum.
  Recommended practical list is as follows:
    1. Determination of thermal conductivity of an insulating powder.

2. Determination of thermal conductivity of a composite wall.
3. Determination of Heat Transfer Coefficient for natural convection.
4. Determination of Heat Transfer Coefficient for forced convection.
5. Determination of Emissivity.
6. Determination of Stefan Boltzamann Constant.
7. Trail on Heat Exchangers.
8. Heat Pipe Demonstration/Trial.
9. CFD analysis on conduction of wall.
10. CFD analysis of fluid flow through pipe.

- **Text Books:**

1. Dr. S. P. Sukhatme, *A Textbook on Heat Transfer,* Orient Longman Publication, Hyderabad.
2. P. K. Nag, *Heat Transfer*, McGraw hill Publishing Company Ltd., New Delhi.
3. Mahesh M. Rathore, *Engineering Heat and Mass Transfer,* University Science Press, New Delhi.

- **Reference Books:**

1. J. P. Holman, *Heat Transfer*, McGraw Hill Book Company, New York.
2. Frank P. Incropera, David P., Fundamentals of Heat & Mass Transfer (Fifth Edition), John Wiley.
3. R. C. Sachdeva, *Fundamentals of Heat and Mass Transfer*, Wiley Eastern Ltd.
4. Yunus A. Cengel, *Heat Transfer – A Practical approach*, McGraw Hill.
5. S.C. Arora and S. Dokoundwar, *Heat and Mass Transfer*, Dhanpat Rai and Sons, Delhi.
6. Dr. D. S. Kumar, *Heat and Mass Transfer*, S. K. Kataria & Sons, Delhi.

Walchand Institute of Technology, Solapur
T.Y. B. Tech (Mechanical and Automation Engineering)
Semester-VI
Core Elective - II
22MAU6EB1T INDUSTRIAL PRODUCT DESIGN

Teaching Scheme	**Examination Scheme**	
Lectures – 3 Hours/week, 3 Credits	**ESE**	- 60 Marks
Practical – 2 Hours/week, 1 Credit	**ISE**	- 40 Marks
	ICA	- 25 Marks

The course offers an extensive exploration into Industrial Product Design, examining its core principles, practical applications, and emerging trends. Through a blend of theoretical discussions and practical exercises, students will gain insights into designing products across various industries, fostering essential skills and knowledge crucial for a career in industrial design.

Course Prerequisite:

Prospective students are expected to possess a foundational understanding of design principles and concepts, along with proficiency in using computer software applications. An inherent curiosity about industrial design and innovation is highly recommended for optimal engagement with the course material.

Course Objectives:

1. To introduce fundamentals of Industrial Product Design, covering importance, technical requirements, ergonomic principles, aesthetics, and economic factors.
2. To explore ergonomic principles and case studies in product design related to aesthetics and ergonomics.
3. To familiarize students with practical industrial design processes and methodologies.
4. To introduce Intellectual Property Rights and Computer-Aided Product Design.

Course Outcomes:

After completing this course, student shall be able to -

1. Gain understanding of Industrial Product Design's significance, technical and ergonomic considerations, aesthetic factors, and economic influences on design decisions.
2. Develop understanding and application of aesthetic and ergonomic design in products.
3. Execute design projects integrating quality deployment, market analysis, and Design Thinking for innovative product development.
4. Navigate patent systems, utilize suitable CAD tools and use rapid prototyping process for prototype development.

Unit 1 – Introduction to Industrial Product Design No of lectures – 06

Industrial Product Design: Overview, Importance, Role in industry, etc.

Technical requirements, Ergonomic principles, Aesthetic considerations, Economic factors, Understanding human factors in industrial design, Anthropometry and anthropometric data,

Unit 2 – Visual Elements in Industrial Design No of lectures – 04

Mechanics of vision and perception, Psychology of form and color perception, General inferences of line, form, color and light, Sustainable design practices on color choices.

Unit 3 – Ergonomic Design No of lectures – 04

Ergonomic design of products such as machine tools; testing machines; instruments; automobiles; process equipment's, Case studies on ergonomic design successes and failures.

Unit 4 – Aesthetic Design No of lectures – 06

Concept of unity and harmony in design, Concept of order with variety in product design, Design for purpose and style, Symmetry and balance in product aesthetics, Environmental considerations in design such as biomimicry and bio-inspired design.

Unit 5 – Industrial Design in Practice No of lectures – 06

Design process, design requirements and objectives, Quality Function Deployment (QFD) in product development, Introduction to Business Model Canvas and market analysis, Total Available Market (TAM), Serviceable Available Market (SAM), Serviceable Obtainable Market (SOM), Types of market surveys influencing design decisions.

Unit 6 - New product development No of lectures – 04

Design Thinking (DT) process, Steps in the DT process: Empathize, Define, Ideate, Prototype, Test, Case studies of products developed using Design Thinking (DT), Principles of Design for Manufacturing (DFM) and Design for Assembly (DFA).

Unit 7 – Intellectual Property Rights No of lectures – 04

Introduction to patents, patent search and patent databases: IP India patentability Search, patent scope, ESPACENET, Understanding patentability and intellectual property rights, Concept of prior art search.

Unit 8 – Computer-Aided Product Design and Rapid Prototyping No of lectures – 06

Introduction to Computer-Aided Product Design (CAPD) software, Technology Readiness Levels (TRL), Rapid prototyping, Additive Manufacturing.

- **Internal Continuous Assessment (ICA):**
  ICA consists of minimum 8 practical based on curriculum.
  Recommended practical list is as follows:
  1. Case study-based assignment on "Anthropometry".
  2. Case study-based assignment on "Visual Elements in Industrial Design".
  3. Case study-based assignment on "Ergonomic Design".
  4. Case study-based assignment on "Aesthetic Design".
  5. Case study-based assignment on "Design Thinking (DT)".
  6. Case study-based assignment on "Rapid Prototyping/ Computer aided product design/ Additive Manufacturing".
  7. Case study-based assignment on "Prior Art Search for Patent Idea Check".
  8. Case study-based assignment on "Patent Drafting".
  9. Prototype modelling based on concepts of industrial product design (Stage-I).
  10. Prototype modelling based on concepts of industrial product design (Stage-II).

- **Textbooks**
  1. Karl T Ulrich, Stevan Eppinger, Product Design & Development, McGraw-Hill Education
  2. W. H. Mayall, Industrial Designs for Engineers, Iliffe Publisher
  3. Otto, Product Design, Pearson Publication.
  4. Tom Kelley & David Kelley, Creative Confidence, William Collins Publisher

- **Reference Books**
  1. Anil Gupta, Grassroot Innovations, Penguin Portfolio Publisher

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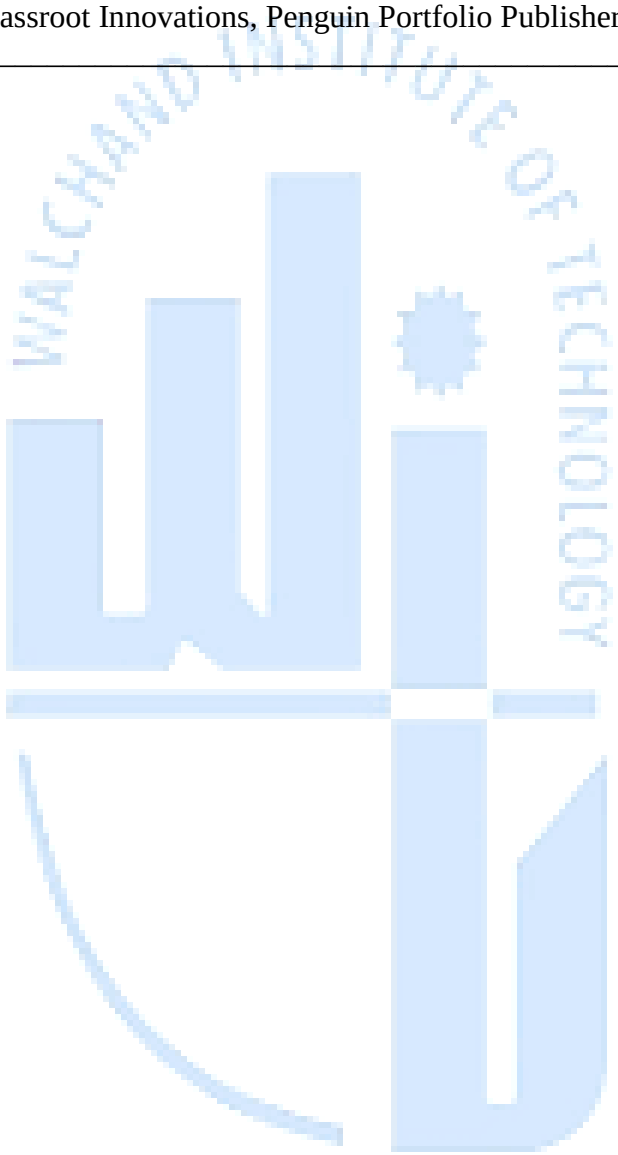

Walchand Institute of Technology, Solapur
T.Y. B. Tech (Mechanical and Automation Engineering)
Semester-VI
Core Elective II
22MAU6EB2T – MECHANICAL VIBRATIONS

Teaching Scheme	Examination Scheme	
Lectures– 3 Hours/week, 3 Credits	**ESE**	- 60 Marks
Practical – 2 Hours/week, 1 Credit	**ISE**	- 40 Marks
	ICA	- 25 Marks

Vibration is a common phenomenon existing in a mechanical system. Mechanical structures and systems are susceptible to vibrations, i.e. periodic changes in the physical state. Vibrations can both be a hindrance and a benefit to machines. In this course, we will learn how one can predict vibrations and interpret the measured vibrations using analytical and experimental means. The topic covered in the syllabus are damped and undamped free and forced vibration, Analysis of single-DOF, Two-DOF and multi-degree-of-freedom vibratory systems using energy conservation principles, vibration absorber and vibration measuring instruments.

Course Prerequisite: Engineering physics and mathematics, Basic Mechanical Engineering.

Course Objectives:

1. Study basic concepts of vibration
2. Develop competency in understanding vibration in systems
3. Develop analytical competency in solving vibration problems
4. Understand the various instrument used vibration measurement and techniques to control the vibrations.

Course Outcomes:-

At the end of the course, a student will be able to

1. Determine the natural frequency of transverse vibrations of the shaft and torsional vibrations of rotor systems.
2. Analyze the mathematical modeling of the two degrees of freedom systems and explain about the working principle of vibration absorber.
3. Compute the natural frequencies and mode shapes of a multi degree of freedom system and explain the modal analysis of a vibrating system.
4. Select the numerical methods to determine natural frequencies of the beam and rotor systems.

Unit 1- Introduction No of Lectures 03

Importance & scope, Concepts & terms used, SHM, Complex method of representing vibration, Fourier series & harmonic analysis.

Unit 2- Single degree of freedom systems No of Lectures 05

Free vibrations, types of damping, logarithmic decrement, coulomb damping, and damping materials.

Unit 3- Single degree of freedom systems: Forced Vibrations No of Lectures 07

Types of excitations, forced excitation, support excitation, excitation due to unbalance in

machines, response due to above types of excitations, transmissibility, force transmissibility &motion transmissibility, vibration isolators, commercial isolation materials & shock mounts. Study of non-harmonic excitations.

Unit 4- Vibration Measuring Instruments No of Lectures 05

Instruments for measurement of displacement, velocity, acceleration & frequency of vibration, spectral analyzers, FFT analyzer.

Unit 5- Two degrees of freedom systems No of Lectures – 06

Free un-damped vibrations – Principal modes and natural frequencies, co-ordinate coupling and principal co-ordinates.

Unit 6- Transient Vibration: No of Lectures – 06

Response of single DOF system to an impulsive step input, pulse input (rectangular & half sinusoidal), Laplace transfer method, phase plane method.

Unit 7- Introduction to Numerical Methods in Vibration No of Lectures – 06

Holzer method, Releigh's method, matrix iteration method, introduction to F. E. M, Analysis techniques used in vibration (Eigen value analysis).

- **Internal Continuous Assessment (ICA)**

  ICA consists of minimum 8 practical based on curriculum.

  Recommended practical list is as follows:

  1. To determine radius of gyration of a given pendulum
  2. To determine the natural frequency of longitudinal vibrations of a helical spring
  3. To study the effect of mass & initial displacement on frequency of free longitudinal vibration of a helical spring
  4. To study the free transverse vibrations
  5. To study the forced transverse vibrations
  6. To study the effect of viscous damping on the transverse vibrations
  7. To determine the natural frequency of free torsional vibrations
  8. Determination of Critical Speed in Whirling of Shafts.
  9. Demonstration of FFT analyser
  10. Study the machine fault diagnostic system based on vibration analysis

- **Text Books**
  1. G. K. Grover, Mechanical Vibration, Published by Nemchand & Brothers, Roorkee
  2. Austin Church, Mechanical Vibration, Wiely Eastern.
  3. S. Graham Kelly, Schaumm's Outline series in Mechanical Vibration, McGraw-Hill Education
  4. Dr. V. P. Singh, Mechanical Vibration, S. Chand & Sons New Delhi.
  5. Sadhu Singh, Mechanical Vibrations, Khanna Publishers
- **Reference Books**
  1. Thomson, Mechanical Vibrations, Pearson Education
  2. Rao S. S., Mechanical Vibrations, Pearson

Walchand Institute of Technology, Solapur
T.Y. B. Tech (Mechanical and Automation Engineering)
Semester-VI
Core Elective II
22MAU6EB3T – ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (AI/ML)

Teaching Scheme	**Examination Scheme**	
Lectures– 3 Hours/week, 3 Credits	**ESE**	- 60 Marks
Practical – 2 Hours/week, 1 Credit	**ISE**	- 40 Marks
	ICA	- 25 Marks

This course provides a foundational understanding of machine learning models as well as demonstrates, how these models can solve the real-time problems.

Course Prerequisite: Basics of programming languages.

Course Objectives:

1. To introduce various types of machine learning algorithms.
2. To enable the designing of a model selecting appropriate machine learning algorithms for a given problem.
3. To study methods to validate previously designed machine learning models.
4. To introduce methods to evaluate and tune machine learning models.

Course Outcomes:

At the end of this course students will be able to

1. Apply solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, social, environmental, and economic factors.
2. Identify problems where artificial intelligence techniques are applicable.
3. Apply selected basic AI-ML techniques to its judge applicability.
4. Train machine learning models and evaluate their performance using appropriate metrics

Unit 1- Introduction to AI & ML: No. of Lectures: - 04

Motivation behind AI approach and its history,Scope of AI and data science, Applications of AI-ML in mechanical engineering domain, Symbolic approach of AI, Sub-Symbolic approach of AI, Symbolic vs. Sub-Symbolic AI, Types of learnings- Supervised learning, Unsupervised learning, Supervised vs. unsupervised learning.

Unit 2- Feature Extraction and Feature Selection No. of Lectures: - 08

Introduction to features, Low level, high level, general, global and local features, Feature extraction, Feature vector, feature space, and feature construction, Over-fitting, under-fitting and optimum fitting, Over-fitting, under-fitting and optimum fitting in classification problem, Principal component analysis (PCA), Statistical features and mathematical expressions, Histogram features, Feature selection, Entropy reduction, information gain and Gini index in decision tree, Problems on PCA, Problems on calculating entropy and information gain for decision trees,

Unit 3- Feature Classification and Algorithms No. of Lectures: -08

Random forest trees, Random forest tree for classification, Random forest tree terminology, Decision tree vs. random forest tree, Bagging and Boosting, Which is the best, Bagging or Boosting?, Naive Bayes, Bayes' Theorem, Problems on application of Bayes theorem for classification, Support Vector Machine, Support Vector Machine terminology, Linear SVM, non-linear SVM, Hyper parameters of SVM, Kernel functions: linear, polynomial, rbf,

sigmoid, Multi class classification methods, K Nearest Neighbor algorithm, Difference between KNN and K means?, Is K nearest neighbor supervised or unsupervised?

Unit 4-Reinforcement Learning No. of Lectures- 06

Reinforcement learning, Key constituents of reinforcement learning, Key features of reinforcement learning, Approaches to implement reinforcement learning, Reinforcement Learning working, Types of reinforcement learning, Q-Learning, Difference between Reinforcement Learning and Supervised Learning.

Unit 5- Deep Learning No. of Lectures - 06

Introduction to deep learning, Artificial Neural Network (ANN), Activation Functions, Loss/ Cost Function, Convolutional Neural Network (CNN),Activation functions in CNN, how to choose the right Activation Function? Choosing Between Machine Learning and Deep Learning.

Unit 6- Development of ML model & Its Evaluation No. of Lectures-08

Typical problems to be solved using machine learning approach, Clustering is not classification!!, Classification vs. Clustering, Classification vs. Regression, Terminology of understanding ML based classification and regression model, Steps involved in development of classification model, Training data vs. test data vs. validation data, K-fold cross-validation mode,Hyper parameter tuning for simple decision tree, Hyper parameter tuning for SVM, Hyper parameter tuning for ANN, Confusion matrix and evaluation of ML models.

- **Internal Continuous Assessment (ICA)**
  ICA consists of minimum 8 practical based on curriculum.
  Recommended practical list is as follows:
  1. Identify and analyze a specific application of AI/ML in the mechanical engineering domain.
  2. Compare supervised and unsupervised learning techniques using a dataset of your choice.
  3. Use a decision tree algorithm to perform feature selection on a dataset.
  4. Choose a dataset and perform feature extraction. Identify low-level, high-level, global, and local features.
  5. Create models demonstrating over-fitting and under-fitting using a classification problem.
  6. Apply the Naive Bayes algorithm to a text classification problem3
  7. Develop a classification model for a dataset, following all steps from data preparation to model evaluation.
  8. Create confusion matrices for different classification models. Calculate evaluation metrics (accuracy, precision, recall, F1 score) and analyze the model performance.
  9. Develop a regression model for a dataset. Compare its performance with a classification model on the same dataset, discussing the differences and applications of each approach.
  10. Implement both clustering and classification techniques on the same dataset. Compare the results and discuss the differences in their approaches and outcomes.

- **Text Books**
  1. Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig
  2. Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy

- **Reference Books:**

    1. A classical approach to Artificial Intelligence, Munesh Chandra Trivedi, Khanna Publications
    2. Artificial Intelligence and Machine Learning, Chandra S.S. & H.S. Anand, PHI Publications
    3. Machine Learning, Rajiv Chopra, Khanna Publishing House
    4. V.K. Jain, Machine Learning, Khanna Publishing House
    5. Vinod Chandra S.S., Artificial Intelligence & Machine Learning, PHI
    2. Rajiv Chopra, Deep Learning, Khanna Book Publishing Co., New Delhi

Walchand Institute of Technology, Solapur

T.Y. B. Tech (Mechanical and Automation Engineering)

Semester-VI

Core Elective II

22MAU6EB4T – COMPUTER INTEGRATED MANUFACTURING

Teaching Scheme	Examination Scheme	
Lectures– 3 Hours/week, 3 Credits	**ESE**	- 60 Marks
Practical – 2 Hours/week, 1 Credit	**ISE**	- 40 Marks
	ICA	- 25 Marks

Computer Integrated Manufacturing (CIM), a comprehensive exploration of the integration of computer technology into manufacturing processes. This course is designed to provide students with a deep understanding of the principles and applications of CIM, preparing them to leverage technology for improved efficiency, quality, and innovation in manufacturing. Computer Integrated Manufacturing encompasses the use of computer systems to control the entire production process, from design and engineering to production and quality control

Course Prerequisite:

Students should have a basic understanding of manufacturing processes, including knowledge of traditional methods such as machining, casting, and assembly. Familiarity with engineering materials, including metals, polymers, ceramics, and composites, is essential. Proficiency in computer-aided design (CAD) software is required, as it forms the basis for learning computer-aided manufacturing (CAM) and other automated systems.

Course Objectives:

1. To develop a comprehensive understanding of Computer Integrated Manufacturing (CIM) systems, including their basic principles, components, and functions.
2. To acquire proficiency in utilizing computer-aided design (CAD), computer-aided manufacturing (CAM), and computer-aided engineering (CAE) tools for designing, analyzing, and optimizing manufacturing processes.
3. To explore the role of automation and robotics in the manufacturing industry, including programming and controlling industrial robots and understanding their integration within CIM systems.
4. To evaluate the benefits and challenges associated with implementing CIM systems, analyze their impact on manufacturing processes, and assess the potential for optimization and improvement.

Course Outcomes:

After completion of the course, the students will be able to: -

1. Understand the Basics and Components of CIM.
2. Apply CAD and CAM Techniques.
3. Explore Advanced Manufacturing Systems.
4. Assess Additive Manufacturing and Quality Control.

Unit 1-Introduction to Computer Integrated Manufacturing (CIM)

No of lectures – 05

Need for Computer Integrated Manufacturing (CIM): Introduction to CIM, Components of CIM, Product development cycle within CIM, Industry 4.0 and CIM.

Unit 2-CAD and Computer Graphics Software No of lectures – 05

Fundamentals of CAD, Product Design and CAD, Introduction to geometric modelling and its types, 2D Geometrical Transformations and its types, Software Configuration, Functions of Graphics Package, Features of 3D Modelling.

Unit 3-Cellular Manufacturing No of lectures – 05

Introduction to Cellular Manufacturing, Computer Aided Manufacturing (CAM): Basics and applications of CAM, Group Technology, Computer Aided Process Planning (CAPP): Types and benefits, Machine Cells.

Unit 4: Flexible Manufacturing System (FMS) and Automated Guided Vehicle

No of lectures – 05

Types of Flexibility in FMS, Components of FMS, Applications and Benefits of FMS, Automated Guided Vehicle Systems (AGVS), Vehicle Guidance Technology, Vehicle Management and Safety.

Unit 5-Automation and Robotics in Manufacturing No of lectures – 05

Introduction to Automation Systems, Types of Industrial Robots, Robot Programming and Control, Integration of Robots into CIM Systems.

Unit 6-Additive Manufacturing (AM) No of lectures – 05

Basic Principles of Additive Manufacturing, Steps in AM, Slicing CAD Models for AM, Classification of AM Processes, Base Materials Used in AM, Applications of AM: Various applications in different industries.

Unit 7-Quality Control and Testing in Manufacturing No of lectures – 05

Introduction to Quality Control, Testing Methods: Various testing methods used in manufacturing, Non-Destructive Testing (NDT), Destructive Testing, Statistical Process Control (SPC) , Quality Management Systems (QMS).

Unit 8-Future Trends and Innovations in Manufacturing No of lectures – 05

Smart Manufacturing, Internet of Things (IoT) in Manufacturing, Artificial Intelligence (AI) in Manufacturing, Sustainable Manufacturing.

- **Internal Continuous Assessment (ICA) :**

  ICA consists of minimum 8 practical based on curriculum.

  1. Introduction to Computer Integrated Manufacturing (CIM)
  2. Develop 3D CAD Assembly for any mechanical component using CAD Software.
  3. Simulate the manufacturing of a part using CAM software.
  4. Demonstration of FMS setup in FMS lab.
  5. Automation and Robotics in Manufacturing
  6. Development of 3D printed component for given 3D CAD assembly.
  7. Quality Control and Testing in Manufacturing
  8. Future Trends and Innovations in Manufacturing
  9. Study of IoT, AI in Smart manufacturing.
  10. Industry visit

- **Textbooks**

1. "Computer Integrated Manufacturing" by James A. Rehg and Henry W. Kraebber.
2. "CAD/CAM: Principles and Applications" by P. N. Rao.

- **Reference Books**

1. "Introduction to Autonomous Robots: Kinematics, Perception, Localization and Planning" by Nikolaus Correll and Bradley Hayes.
2. Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006.
3. Automation, Production Systems, and Computer-Integrated Manufacturing, 4e Paperback by Mikell P. Groover.

Walchand Institute of Technology, Solapur
Third Year. B. Tech (Mechanical & Automation Engineering)
Semester-VI
22MAU6CC5T INSTRUMENTATION & CONTROL ENGINEERING

Teaching Scheme	**Examination Scheme**
Lectures– 3 Hours/week, 3 Credits	**ESE** - 60 Marks
Practical – 2 Hours/week, 1 Credit	**ISE** - 40 Marks
	ICA - 25 Marks

Measurement activities are given prime importance in industry. The art of measurement plays an important role in all branches of engineering. This course aims at making mechanical engineering students familiar with the principle of instrumentation, transducer and measurement of non-electrical parameters like temperature, pressure, flow, speed, force, and torque for engineering applications. Also this course covers topics such as Fundamentals of automatic control, Root locus method and Bode plots.

Course Prerequisite:

Student understands Engineering physics and mathematics well. He also has basic knowledge of metrology

Course Objectives:

1. To make student understand measurement process of physical parameters such as temperature and pressure.
2. To make student understand measurement process of physical parameters such as displacement, speed, flow and force.
3. To make student study the types of control systems.
4. To make student study the root locus and bode plots in detail.

Course Outcomes:

After completing this course, student shall be able to -

1. Analyse the generalised measurement system, identify various static & dynamic characteristics of instruments, and make use of various measuring instruments for measurement of temperature, pressure and vacuum.
2. Use various measuring instruments for measurement of displacement, speed, flow and force.
3. Identify manual & automatic control systems, open and closed loop systems, and various modes of control, to apply block diagram algebra to determine the transfer function of a given control system.
4. Construct Root Locus & Bode Plots for a given control system and comment on system stability.

Unit 1 - Introduction to Instrumentation No of lectures – 04

Generalized measurement system & its functional elements, Static & Dynamic characteristics and terms, calibration, classification of errors.

Unit 2 – Temperature & Pressure Measurement No of lectures – 04

Measurement of Temperature: Concept of Temperature, scales, Thermometer, Thermocouples, RTDs, Thermistors.

Measurement of Pressure & vacuum: Terminology of pressure & vacuum, Bourdon tube, Deadweight pressure gauge, Diaphragm gauge, Vacuum gauges-McLeod's gauge.

Unit 3 –Measurement of Displacement & Speed No of lectures – 04

Measurement of Linear Position & displacement: Potentiometer, LVDT
Angular Speed Measurement-: Inductive pickup, Photoelectric pickup.

Unit 4 –Measurement of Flow and Force No of lectures – 04

Flow Measurement:-Rate meters and Quantity Meters, Turbine Meter, Rotameter, hot-wire anemometer
Force measurement: Hydraulic & Pneumatic Load Cells, Proving Ring

Unit 5 – Introduction to Control Systems No of lectures – 04

Introduction, Classification, open loop and closed loop control systems, modes of control- P, I, D, PI, PD and PID.

Unit 6 – Block Diagram Representation No of lectures – 06

General representation of a feedback control system, transfer function, block diagram algebra rules.(Numerical)

Unit 7 – Root Locus Method No of lectures – 07

Significance of Root locus, angle and magnitude conditions, pole, Significance of Root locus, angle and magnitude conditions, pole-zero plot, sections of R.L. on the real axis, Asymptotes & Centroid, breakaway points, intersection with imaginary axis, angles of departure and arrival, construction of root locus (on graph paper) using general rules and steps, comment on stability

Unit 8 – Bode Plots No of lectures – 07

Magnitude and Phase angle plots, standard form of open loop T.F. G(jω) H(jω), Bode plots for standard factors of G(jω) H(jω),steps to sketch Bode plots for following factors:System gain K, Poles & zeroes at the origin, simple poles & simple zeroes, frequency response specifications, Construction of Bode plots using a Semi-log paper, calculation of Gain Margin and Phase margin, comment on system stability

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- **Internal Continuous Assessment (ICA) :**

  ICA consists of minimum 8 practical based on curriculum.
  Recommended practicals:

  1. Experiment on Temperature measurement.
  2. Experiment on angular speed measurement.
  3. Force Measurement using proving ring, load cells.
  4. Displacement Measurement using LVDT.
  5. Flow measurement using rotameter.
  6. Assignment on fundamentals of control systems.
  7. Assignment to demonstrate modes of control.
  8. Assignment on determination of transfer function using block diagram algebra
  9. Assignment on construction of root locus
  10. Assignment on construction of Bode Plots

- **Textbooks**

1. Mechanical Measurement & Control: Dr. D. S. Kumar
2. Automatic control Engineering: F. H. Raven., McGraw Hill International editions, New Delhi, Fifth edition
3. Control Systems: U.A. Bakshi and V.U. Bakshi : Technical Publications, Pune, Fifth revised Edition –2007

- **Reference Books**

1. Mechanical Measurements : Dr Sirohi & Dr. Radhakrikshan.
2. Mechanical Measurements : Beckwith & Buck
3. Modern Control Engineering: K.Ogata, Prentice Hall of India Pvt. Ltd., New Delhi., 4th Edition.

Walchand Institute of Technology, Solapur
T.Y. B. Tech (Mechanical & Automation Engineering)
Semester-VI
22MAU6MP6L MINI PROJECT

Teaching Scheme	**Examination Scheme**
Practical – 2 Hours/week, 1 Credit	**ICA** - 25 Marks

This project is designed to provide you with hands-on experience in applying the concepts and techniques you have learned throughout. The mini project will enable you to tackle real-world problems, enhancing your understanding and practical skills.

Course Objectives:

1. To provide students with the opportunity to apply theoretical knowledge of AI and ML algorithms, concepts, and techniques to real-world problems.
2. To develop students' ability to identify, formulate, and solve complex problems
3. To introduce students to the process of managing a complete project lifecycle, including planning, execution, and documentation.
4. To foster teamwork and collaboration skills, enabling students to work effectively in groups

Course Outcomes:

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

1. Identify and analyze the potential technical problems.
2. Develop solution for a set of requirements for the problem identified.
3. Write a report with all the contents in logical order.

- **Internal Continuous Assessment (ICA)**

Guidelines for Project content & Mark Distribution

1. A group of maximum 04 students be formed for Mini-Project work.
2. Work diary and reporting to guide weekly
3. The contents of work diary shall reflect the efforts taken by project group for
    i. Searching suitable mini-project work
    ii. Brief report preferably on journals/ research or conference papers/ books or Literature surveyed to select and bring out the mini-project area.
    iii. Brief report of feasibility studies carried to implement the conclusion.
    iv. Rough Sketches/ Design Calculations, etc.
4. The mini-project may be based on software or experimental work.
5. It will be preferable if student will work on the area of mini project in line with their proposed final year project.
6. The group has to give a power point presentation in front of the faculty of department at the end of semester along with the spiral bound report.

Walchand Institute of Technology, Solapur
T.Y. B. Tech (Mechanical & Automation Engineering)
Semester-VI
22MAU6SK7L WORKSHOP PRACTICE-II

Teaching Scheme
Practical – 2 Hours/week, 1 Credit

Examination Scheme
ICA - 25 Marks

This course is important to make the students aware of various skills involved in manufacturing & assembly, develop skills to operate different machine tools and make students aware of operation sequence, speed, feed selection for different materials & operations along with their operational set up.

Course Prerequisite:
This course is important to make the students aware with various skills involved in manufacturing & assembly, develop skills to operate different machine tools and make students aware of operation sequence, speed, feed selection for different materials & operations along with their operational set up.

Course Objectives:
1. To set the manufacturing set up of different machining operations and study the corresponding set up parameters while working on actual machine tools.
2. To select appropriate and proper process parameter for obtaining desired requirement on work piece.
3. To identify the operational / processing problems and suggest remedial solution for adopted manufacturing processes.

Course Outcomes:
After completing this course, student shall be able to -
1. Select operational and process parameters during machining operations.
2. Manufacture a small assembly of components

- **Internal Continuous Assessment (ICA):**

Any one noncommercial assembly consisting of at least three components with tolerance involving use of lathe, drilling, milling, grinding and any additional machine tool or processes as per requirement. Use machining operations like boring, slotting, tapping, tapering, external taper turning, shaping, milling etc. (Any 5 Operations)

or

Development and Execution of one simple turning/milling job on CNC (Trainer) including geometric and dimensional tolerances. Preparation of process sheet for the above job.

- **Textbooks**

1. Workshop Technology (Volume VI) by Raghuvanshi.
2. Workshop Technology (Volume VI) by Hajra Chowdhary.
3. Workshop Technology (Volume VI) by W .A .J. Chapman.
4. Production Technology by P. C. Sharma.
5. Production Technology – HMT Handbook.
6. Production Technology (Volume VI) by Gupte - Patel..

7. Introduction to CAD/CAM, Rao P.N.
8. CAD/CAM/CAE, Chougule N.K.

- **Reference Books**

1. Manufacturing Processes & systems by Phillip F. Ostwald, Jairo Munoz-Wiley India.
2. Fundamentals of modern Manufacturing by Mikel P. Groover-Wiley India.
3. Theory and Practice, Ibrahim Zeid – CAD/CAM - Tata McGraw Hill Publishing Co.
4. CAD/CAM - Mastering, Ibrahim Zeid –-Tata McGraw Hill Publishing Co.
