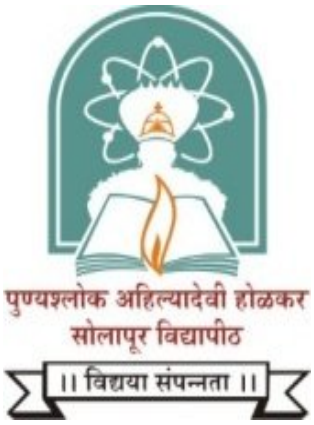
Punyashlok Ahilyadevi Holkar Solapur University, Solapur



NAAC Accredited-2015, 'B' Grade (CGPA 2.62)

Name of the Faculty: Science & Technology

CHOICE BASED CREDIT SYSTEM

Syllabus: MACHANICAL ENGINEERING

Name of the Course: S.Y. B. Tech. (Sem.- III & IV)

(Syllabus to be implemented from June, 2019)

PUNYASHLOK AHILYADEVI HOLKAR
SOLAPUR UNIVERSITY, SOLAPUR
FACULTY OF ENGINEERING & TECHNOLOGY
Mechanical Engineering

Programme Educational Objectives and Outcomes

A. Program Educational Objectives

1. Graduate will excel in professional career in Mechanical and allied interdisciplinary areas.

2. Graduate will exhibit strong fundamentals required to pursue higher education and continue professional development in Mechanical and other fields.

3. Graduate will adhere to professional ethics, develop team spirit and effective communication skills to be successful leaders with a holistic approach.

4. Graduate will be sensitive to ethical, societal and environmental issues while serving at their professional work.

B. Program Outcomes

Engineering Graduate will be able to –

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

engineering activities with an understanding of the limitations.

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

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

Faculty of Engineering & Technology

Credit System structure of S.Y. B. Tech. ***Mechanical Engineering*** *W.E.F. 2019-20*

Semester 3

Theory Courses

Course code	*Name of Theory Course*	*Hrs./week*				*Credits*	*Examination Scheme*			
		L	***T***	***P***	**D**		***ISE***	***ESE***	***ICA***	***Total***
ME211	Applied Thermodynamics	3	-	-	-	3	30	70	-	100
ME212	Mechanics of Materials	3	-	-	-	3	30	70	-	100
ME213	Manufacturing Processes	3	-	-	-	3	30	70	-	100
ME214	Machine Drawing & CAD	3	-	-	-	3	30	70	-	100
ME215	Professional Elective-I	3	-	-	-	3	30	70	-	100
	Sub Total	**15**	**-**	**-**	**-**	**15**	**150**	**350**	**-**	**500**
MEV21	Environmental Sciences	1	-	-	-	-	-	-	-	-

Semester 3: Laboratory / Tutorial Courses

Course code	*Name of Laboratory / Tutorial Course*	*Hrs./week*				*Credits*	*Examination Scheme*				
		L	***T***	***P***	**D**		***ISE***	***ESE***		***ICA***	***Total***
								POE	***OE***		
ME211	Applied Thermodynamics	-	-	-	-	-	-	-	-	-	-
ME212	Mechanics of Materials	-	1	-	-	1	-	-	-	25	25
ME213	Manufacturing Processes	-	-	2	-	1	-	-	25	25	50
ME214	Machine Drawing & CAD	-	-	-	4	2	-	50	-	50	100
ME215	Professional Elective-I	-	-	2	-	1	-	-	-	25	25
	Sub Total	**-**	**-**	**-**	**-**	**5**	**-**	**50**	**25**	**125**	**200**
	Grand Total	**15**	**01**	**04**	**04**	**20**	**150**	**425**		**125**	**700**

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

Professional Elective-I: A. Microprocessors in Automations **B.** Internal Combustion Engines **C**. Composite Materials

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

Faculty of Engineering & Technology

Credit System structure of S.Y. B. Tech. ***Mechanical Engineering*** *W.E.F. 2019-20*

Semester 4

Course code	***Name of Theory Course***	***Hrs./week***				***Credits***	***Examination Scheme***			
		L	T	P	**D**		ISE	ESE	ICA	Total
ME221	Engineering Mathematics –III	3	-	-	-	3	30	70	-	100
ME222	Manufacturing Technology	3	-	-	-	3	30	70	-	100
ME223	Fluid Mechanics & Fluid Machines	3	-	-	-	3	30	70	-	100
ME224	Kinematics & Theory of Machines	3	-	-	-	3	30	70	-	100
ME225	Professional Elective-II	3	-	-	-	3	30	70	-	100
	Sub Total	**15**	**-**	**-**	**-**	**15**	**150**	**350**	**-**	**500**
MEV22	Environmental Sciences	1	-	-		-	-	-	-	-

Semester 4: Laboratory / Tutorial Courses

Course code	***Name of Laboratory / Tutorial Course***	***Hrs./week***				***Credits***	***Examination Scheme***				
		L	***T***	***P***	**D**		***ISE***	***ESE***		***ICA***	***Total***
								POE	***OE***		
ME221	Engineering Mathematics –III	-	1	-	-	1	-	-	-	25	25
ME222	Manufacturing Technology	-	2	-	-	1	-	-	-	25	25
ME223	Fluid Mechanics & Fluid Machines	-	-	2	-	1	-	-	-	25	25
ME224	Kinematics & Theory of Machines	-	-	2	-	1	-	-	25	25	50
ME225	Professional Elective-II	-	-	2	-	1	-	-	-	25	25
ME 226	Mechanical Workshop-I	-	-	2	-	1	-	-	-	50	50
ME 227	Electrical Technology	-	-	2		1	-	-	25	25	50
	Sub Total	**-**	**01**	**12**	**-**	**07**	**-**	**50**		**200**	**250**
	Grand Total	**15**	**01**	**12**	**-**	**22**	**150**	**400**		**200**	**750**

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

Professional Elective-II: **A**. Mechatronic Systems **B.** Power Plant Engineering **C.** Solid Mechanics

- **Note** :

1. Batch size for the practical /tutorial shall be of 20 students. On forming the batches, if the strength of remaining student exceeds 9, then a new batch shall be formed.
2. Student is required to study and pass Environmental Science subject in Second Year to become eligible for award of degree.
3. Industrial Training (evaluated at B. Tech Sem.-7) of minimum 30 days shall be completed in any vacation after B. Tech. Sem.-3, but before B. Tech. Sem.-7 & the report shall be submitted and get evaluated in B. Tech. Sem.-7
4. Term work assessment shall be a continuous process based on student's performance in – class tests, assignments, homework, subject seminars, quizzes, and laboratory books and their interaction and attendance for theory and laboratory sessions as applicable.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
S.Y.B. Tech.(Mechanical Engineering) Semester-III
ME211 APPLIED THERMODYNAMICS

Teaching Scheme	**Examination Scheme**
Theory – 3 Hrs. /Week	**ESE** –70 Marks
	ISE – 30 Marks

- **Course Introduction:** Applied Thermodynamics is one of the core course in the Mechanical Engineering curriculum, as well as one of the traditional course, dating back from the last many centuries. In Applied Thermodynamics the significance moves from studying general concepts with illustrative examples to develop methods and performing analyses of real life problems. The objective of this subject is to apply knowledge of basic thermodynamic concepts to understand working and evaluate performance various cycles and devices used in thermal power plants and air compressors.
- **Course Prerequisite:** Engineering Physics, Engineering Chemistry, Basic Thermodynamics.
- **Course Objectives:**

1. To learn about of First law for reacting systems and heating value of fuels
2. To learn about vapor power cycles and their analysis.
3. To learn about flow of steam through nozzles.
4. To learn the about reciprocating compressors with and without intercooling.
5. To analyze the performance of steam boilers, steam turbines and steam condensers.

- **Course Outcomes:** By completion of the course the students will be able to:-

1. Apply knowledge of mathematics and science to solve real thermodynamics problems.
2. Evaluate performance of mechanical devices like boiler, compressor, steam turbine, etc.
3. Apply knowledge of basic thermodynamic concepts for analysis of vapour power cycles
4. Apply knowledge of thermodynamics concepts for analysis of flow of steam nozzles and steam condensers.

SECTION I

Unit 1: Basic Laws of Thermodynamics — No. of lectures-08

Unit content: Review of basic concepts, Application of First law of Thermodynamics to chemically reacting system: the standard enthalpy (heat) of reaction, the standard enthalpy of formation, standard enthalpy of combustion.**(Numerical Treatment)**

Second Law of Thermodynamics**:** Limitation of first law of thermodynamics, heat engine, refrigerator and heat pump, Kelvin- Plank and Clausius statements and their equivalence. Reversibility and Irreversibility, Carnot cycle. Principle of entropy increase Calculation of entropy change for: i) Phase change of pure substance ii) Change of state of an ideal gas. **(Numerical Treatment)**

Unit 2:– Properties of pure Substance & Steam **No. of lectures-02**

Unit content: Properties of pure substance-Property diagram for phase - change processes Steam Properties (wet, saturated, superheated, degree of superheat and dryness fraction); Temperature-entropy and temperature-enthalpy diagrams, Mollier diagram. **(Theoretical Treatment)**

Unit 3: Performance of Boilers **No. of lectures-05**

Unit content: Classification, salient features of high pressure boilers, Evaporation, equivalent evaporation, Boiler efficiency, heat losses in boiler plant & heat balance sheet **(Numerical treatment).**

Unit 4: Vapour Power Cycles **No. of lectures-04**

Unit content: Classification of cycles, vapour power cycles, Carnot vapour power cycle, simple Rankine cycle, actual Rankine cycle, Effect of operating conditions on Rankine cycle efficiency. **(Numerical Treatment)**

SECTION II

Unit 5: Steam Nozzles **No. of lectures-05**

Unit content: Types of Nozzles, flow of steam through nozzles, condition for maximum discharge, expansion of steam considering friction**,** Super saturated flow through nozzles, Mach. No., Types of flows. **(Numerical Treatment)**

Unit 6: Steam Condensers **No. of lectures-05**

Unit content: Elements of steam condensing plants, advantages of using condensers, types of condensers, Mass of circulating water, vacuum efficiency,Condenser efficiency.

Unit 7: Steam Turbines **No. of lectures-05**

Unit content: Steam Turbines:- Advantages and classification of steam turbines, simple impulse turbine, compounding of steam turbines, Parson's reaction turbine, Velocity diagrams, work done and efficiencies. . **(Theoretical Treatment)**

Unit 8: Reciprocating Air Compressors **No. of lectures-06**

Unit content: Uses of compressed air, classification of compressor, constructional detail of single & multistage compressor, computation of work, isothermal work done, isothermal efficiency, effect of clearance, volumetric efficiency, FAD, theoretical & actual indicator diagram, Need of multistage, work done, volumetric efficiency, condition for maximum efficiency, inter cooling. **(Numerical Treatment)**

In Semester Evaluation (ISE):

ISE shall be based upon student's performance in minimum two tests conducted and evaluated at institute level.

Text Books:

1. An introduction to Thermodynamics - Y.V.C. Rao – Universities Presss.
2. A Course in Thermal Engineering -S. Domukundwar, Kothandraman ,Dhanpat Rai & Co. Delhi.
3. Thermal Engineering -R. K. Rajput – Laxmi Publication – New Delhi (Sixth Edition)
4. Basic & Applied Thermodynamics -P.K. Nag Tata McGraw Hill Publication

Reference Books:

1. Thermodynamics by C.P. Arora TMH New Delhi 1998 edition.
2. Thermodynamics & Heat Engine – Vol 1 &Vol 2 – R. Yadav Central Book Depot.
3. Thermodynamics- Cengel Boles, Tata McGraw Hill New Delhi.
4. Steam & Gas Turbines- R. Yadav, CPH Allahabad

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

S.Y. B. Tech.–(MechanicalEngineering) Semester-III

ME212- MECHANICS OF MATERIALS

Teaching Scheme Examination Scheme

Theory/Lectures – 3 Hrs. /Week
Tutorial– 1Hr. /Week

ESE: 70 Marks
ISE: 30 Marks
ICA: 25 Marks

Course Introduction: This course consists of topics from the course Strength of Materials which are helpful for mechanical engineers. It consists of basic concepts of stresses &strains induced due to various types of loads which are vital in Design engineering. It includes the topics of simple stresses & strains, strain energy and impact load, Principal stresses & strains and torsion of circular shafts, in the first section. In second section, the topics covered are SFD & BMD for beams, bending stresses in beams, shear stresses in beams and slope & deflection of beams. This course emphasizes the fundamentals of various topics under strength of materials necessary for practicing mechanical engineers in design and inculcates problem solving skill amongst the students.

Course Objectives:

After successfully completion of this course, student will have an ability to:

1. Understand concepts of various types of stresses & strains, elastic constants & their relations.
2. Understand concept of strain energy and its significance.
3. Determine principal stresses, shear stresses on structural member under various loading combination analytically and graphically using Mohr's circle method.
4. Calculate the stresses and strains in circular torsion members, and members subject to flexural loadings.
5. Draw shear force and bending moment diagram for supported beam under various types of transverse loading.
6. Calculate bending and shear stresses in beam and determine distribution at any location along the section of beam.
7. Analyze simple bars, beams, and circular shafts for allowable stresses and loads.

Course Outcomes:

At the end of course students will be able to:

ME212.1	Determine the stresses, strains and deformation under various axial, torsional and flexural loading.
ME212.2	Determine strain energy in axially loaded members
ME212.3	Calculate principal stresses & position planes in a member subjected to various types of stress system by analytical & graphical method.
ME212.4	Determine torsional shear stress, angle of twist & design dimensions of shaft.
ME212.5	Draw S.F.D, B.M.D and determine shear & bending stresses, slope and deflection in various types of beams & sections.
ME212.6	Analyze simple bars, beams, and circular shafts for allowable stresses and load

SECTION – I

Unit No 01: Simple Stresses and Strains **No. of lectures-06**

• Unit content: Concept of stress and strain (tensile, compressive & shear), linear & lateral strains, Volumetric strain, Hooke's law, Elastic constants and their relationships, stresses and strains in three dimensions (only numerical treatment), Stress-Strain diagram for ductile and brittle materials, Stresses and deformation in homogeneous and composite bars under concentrated loads.

Unit No 02: Strain Energy and Impact Load **No. of lectures-04**

Unit content-Concept of strain energy or resilience, proof resilience and modulus of resilience, determination of strain energy in tension and compression for axially loaded members due to gradual, sudden and impact loads.

Unit No 03: Principal Stresses and Strains **No. of lectures-06**

.• Unit content: Normal and shear stresses on any oblique planes, concept of principal planes, principal stresses and maximum shear stress (2-D cases only), positions of principal planes and planes of maximum shear for various cases of loading (2-D only), maximum shear stress, Use of graphical method (Mohr's circle) for determination of principal stresses and maximum shear stresses.

Unit No 04: Torsion of Circular Shafts **No. of lectures-04**

• Unit content: Theory of torsion of circular shafts, assumptions, derivation of torsion equation, determination of torsional shear stress and angular twist for solid and hollow shafts in power transmission applications.

SECTION II

Unit No 05: Shear Force and Bending Moment Diagrams for Beams **No. of lectures-06**

• Unit content: Concept of shear force and bending moment in determinate beams due to concentrated loads, UDL, UVL and couples (analytical method only for cantilevers, simply supported and overhanging beams), determination of points of contra shear and contra flexure.

Unit No 06: Bending Stresses in Beams **No. of lectures-05**

• Unit content: Introduction, theory of pure bending of beams, assumptions and sign Conventions, bending stress distribution diagram, Flexure's formula derivation, moment of resistance and section modulus, determination of bending stresses for commonly used cross sections (rectangular, I-sections and T-sections).

Unit No 07: Shear Stresses in Beams **No. of lectures-04**

• Unit content: Shear Stresses in Beams: Concept of shear stress in beams, shear stress distribution diagram, Expression for shear stress in beams, maximum and average shear stress, and determination of shear stresses for commonly used sections like rectangular, I-section and T section.

Unit No 08: Slope and Deflection of Beams **No. of lectures-05**

• Unit content: Concept and definitions of slope and deflection, Determination of slope and deflection for cantilevers and simply supported beams subjected to point loads and UDL for standard cases only, Use of moment area method to determine slope and deflection for cantilever and simply supported beam carrying point loads and UDL only.

• **In Semester Evaluation (ISE):**
ISE shall be based upon student's performance in minimum two tests & mid-term written test conducted and evaluated at institute level.

• **In Semester Continuous Assessment (ICA):**

ICA shall be based on eight assignments on each topic to be taken during the tutorials.

1. Assignment and tutorial on Simple Stresses and Strains
2. Assignment and tutorial on Strain Energy and Impact Load
3. Assignment and tutorial on Principal Stresses and Strains
4. Assignment and tutorial on Torsion of Circular Shafts
5. Assignment and tutorial on SFD and BMD
6. Assignment and tutorial on Bending stresses in Beams
7. Assignment and tutorial on Shear stresses in beams
8. Assignment and tutorial on Slope and Deflection of Beams

• **Text Books:**
1. Rajput R. K., Strength of materials, S. Chand & Co. Ltd., New Delhi.
2. Bansal R.K., Strength of materials, Laxmi publications (P) Ltd., New Delhi.

• **Reference Books:**
1. Basu A. R., Strength of materials, Dhanpat Rai & Co. (P) Ltd., Delhi.
2. Khurmi R. S. & Gupta J. K., Strength of materials, S. Chand &Co.Ltd., New Delhi.
3. Ramamrutham S., Strength of materials, Dhanpat Rai & Co. (P) Ltd., Delhi.
4. Beer and Johnson, Strength of materials, Mc-Graw Hill International student series.
5. Timoshenko & Young, Strength of materials, CSB Publishers

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
S.Y.B. Tech.(Mechanical Engineering) Semester-III
ME213 MANUFACTURING PROCESSES

Teaching Scheme	**Examination Scheme**
Theory: 3Hrs/week	**ESE:** 70 Marks
Practical: 2Hrs/week	**ISE:** 30Marks
	ICA: 25Marks
	OE: 25 Marks

- **Course Introduction**:

This course covers all primary manufacturing processes like casting, forging, rolling, extrusion and Drawing along with Fabrication. These processes are basics of Mechanical Engineering Programme. The basics of this processes along with their applications and equipment and machinery required for the processes is covered in brief. This course also introduces Manufacturing Techniques for plastic products. Recent trends in various processes are also discussed in brief.

- **Course Perquisite:** Fundamentals of Mechanics, force, power and mechanical properties of materials, thermal properties of materials is required to be known to the candidate undergoing to the course.
- **Course Objective:**
  1. To introduce to the students the casting technique and its significance in manufacturing.
  2. To introduce to the students with various plastic deformation processes and their application.
  3. To introduce to the students the various fabrication techniques and their significance in Industry.
  4. To introduce to the students with various plastic manufacturing processes.
  5. To introduce to the students with recent trends in this processes.
- **Course Outcomes**: At the end of this course, the students will be able to
  1. Select appropriate manufacturing process for a given component.
  2. Understand performance of each process.
  3. Prepare manufacturing plan for the given component.

SECTION I

UNIT-1 Casting Processes **No. of lectures-06**

- Definition of casting, Basic steps in casting processes, Advantages, limitations and applications of casting process, General introduction to patterns, Types of patterns, materials used, Allowances, types of cores and core boxes, molding materials and its properties, Gating system, types of risers, Function of riser, , method to improve efficiency of risers. Riser design simple numerical problems.

UNIT-2 Molding processes **No. of lectures-09**

- Green sand molding (hand and machine molding), Shell molding, Investment casting, centrifugal casting, , gravity and pressure die casting processes.

- Induction furnace construction and working in brief of melting furnaces such as Cupola, Arc furnaces, induction furnaces, Crucible, oil and gas fired furnaces.

UNIT-3 Fettling, Cleaning and Inspection of Castings No. of lectures-05

- Need for fettling, stages in fettling, equipments used infettling and cleaning of castings, Common important defects in castings. Inspection procedure, Computer applications in foundry processes, foundry, Mechanization.

SECTION II

UNIT-4 Conventional Forming Processes: No. of lectures-07

- Introduction to forming process, Classification of forming processes, forging, types of forging, simple numerical problem on upset forging. Extrusion, Types – direct extrusion, indirect extrusion, impact extrusion, hydrostatic extrusion, Wire drawing process, Methods of tubedrawing, hot rolling, cold rolling of sheets, classification of Rolling mills, theory of rolling, simple numerical problems on rolling.

UNIT-5 Advanced Forming Processes: No. of lectures-05

- Introduction to advanced forming process, High energy rate forming process- explosive, electro-hydraulic, magnetic pulse forming. Forming with hydrostatic pressure- hydro-mechanical and hydro forming process.

UNIT–6 Introduction to Joining processes No. of lectures-08

- Welding processes, classification of welding process, arc welding, welding rod selection, TIG welding & MIG welding, submerged arc welding, gas welding, resistance welding, Brazing and soldering.

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

1. Design of pattern and core for a simple component.
2. Testing of silica sand for grain fineness and clay content.
3. Testing of green sand for green compression strength, permeability.
4. Study of mold for moisture content and core hardness tester.
5. Study of manufacturing sequence of upset forging with example.
6. Study of VI characteristic of welding process.
7. Visit to Foundry unit.
8. Visit to forging shop.

- **Text Books:**

1. Heine, Lopar, Rosenthal, Principles of Metal Casting.
2. N.D. Titov, Foundry Practice.
3. P.L. Jain, Principles of Foundry Technology.
4. P.N.Rao, Manufacturing Technology: Foundry, Forming and Welding.
5. Production Technology by P.C.Sharma

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
S.Y.B. Tech.(Mechanical Engineering) Semester-III
ME214 MACHINE DRAWING & CAD

Teaching Scheme
Lectures – 3 Hours/week
Practical – 4 Hour/week

Examination Scheme
ESE– 70 Marks
ISE – 30 Marks
ICA –50 Marks
OE – 50 Marks

Course Introduction: Drawing is called as language of engineers. This course emphasizes the fundamentals of various topics under machine drawing necessary for practicing mechanical engineers and inculcates problem solving skill amongst the students. Machine drawing on the other hand is the scientific representation of an object, according to certain national and international standards of practice. This course consists of selected topics from the subject Machine Drawing and Engineering Graphics which are helpful for mechanical engineers. It contains BIS convention, free hand sketching & Production drawing which are vital in Design engineering. It covers the topics of BIS conventions, free hand sketching, Production drawing, isometric projections along with assembly and details drawing. Also a very basic step in the process is to model the machine component accurately in the available CAD software packages. This course introduces the commands, procedures, for 2D as well 3D drawing used in such software. Use of software in the engineering design & manufacturing increases the productivity of the designer, improves the quality of design, improves communications through documentation, and creates a database for manufacturing. The course helps in skill development as per the need of the modern day industry & thus, enhances the employability.

Course Prerequisite: For this course, student is expected to have-

Knowledge of Engineering Drawing.
Knowledge of geometry.
Basic knowledge of computer operating

Course Objectives: During this course, student is expected to

1 To understand & use the principles and requirements of drawing practices as per BIS standards
2 To interpret and apply technique for making assembly from the detail/components
3 To interpret and apply, limits, fits and tolerances to the various machine elements
4 To operate the drafting software

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

At the end of this course, the student will be
1. Able to create drawings as per BIS standards
2. Able to apply technique for assembly drawing from the detail/components
3.Able to incorporate limits, fits and tolerances for components on the working/engineering drawings.
4. Familiar in using drafting software

***Note**: 1.The first angle method of projection should be followed.*

2. Practical to be completed using suitable drafting package.

3. The practical examination should be using suitable drafting software & oral examination will be based on the full syllabus.

Section I

Unit 1– Basics of Machine Drawing & B.I.S. Conventions No of lectures – 4

Basics of Machine Drawing

Types of drawing, Dimensioning **:-** Placing of dimensions, Functional and Non-functional dimensions, Dimensioning common features like: Circular Arcs, Diameters, Holes, Angles,

Chamfers, Tapers, Undercut, Repetitive features, Countersunk, Square, Sphere, Across

flat, Threads, etc.

Study of B.I.S. (Bureau of Indian Standards) Conventions-

Significance and importance of BIS Conventions, Drawings sheet sizes and layout recommended by BIS. Conventional representation of engineering *Materials*, spur helical and bevel gears, worm and worm wheel, rack and pinion, gear assemblies, type of helical, disc and leaf springs. Internal and external threads, square head, spline shaft, diamond knurling BIS conventions for sectioning, type of sections, exceptional cases. BIS methods of linear- and angular dimensioning. Symbolic representation of welds as per BIS. Surface finish symbol.

Unit 2– Free Hand Sketching of machine component No of lectures – 5

Importance of sketching and entering proportionate dimensions on sketches. Free hand sketches of various types of threads, nut, bolts (square and hexagonal flanged nuts, lock nuts, dome nut, capstan nut, wing nut, castle nut, split pin, square headed bolt, cup headed bolt, T-headed bolt, Rag foundation bolt, stud, washer. Various types of rivets and riveted joints, Various types of keys, Socket and spigot (Cotter joint) , Knuckle (pin) joint, Muff coupling, Protected and unprotected Flanged, coupling, universal coupling, solid and bush bearing. Plummer block (pedestal bearing), foot step bearing. Flat and V-belt pulleys, Fast and loose pulleys, speed cone pulleys, Pipe joint for C.I. Flanged, socket and spigot type pipe joint. Union pipe joint and standard pipe-fitting. The applications of above machine components.

Unit 3– Production Drawing: Limits, Fits, & Tolerances- No of lectures – 5

Dimensional Tolerances: Introduction to system of limits and fits. Basic concepts. Terminology**,** Tolerances, various types. Necessity of Limit system, Unilateral and Bilateral Tolerances, Relation between Tolerances and Manufacturing Processes, Methods of indicating tolerances on drawings, IT grades, Types of fits, Grades of tolerances, types of Holes & shafts based on fundamental deviations, designation of fit, Systems of fits, Selection of fits, Selection of tolerances based on fits

.**Geometrical Tolerances:-** Need of Geometrical Tolerances, Terminology, Tolerances for Single Features such as Straightness, Flatness, Circularity, Cylindricity. Tolerances for

Related Features such as Parallelism, Perpendicularity, Angularity, Concentricity, Tolerance Symbol and Value, Indicating Geometrical Tolerances on drawings.

Surface Finish:- Surface Texture, Surface Roughness Number, Roughness Symbols, Range of Roughness obtainable with different manufacturing processes.

*(**Note** : Numerals /calculations/problems/tasks/examples/theoretical questions on UNIT NO.3)*

Unit 4– Details and Assembly Drawing No of lectures – 6

To prepare detail drawings from given assembly drawing. To prepare assembly drawing from given drawing of details. Preparation of detailed drawing from the given details such as: Tools post of center lathe, Tail stock, Cross head Assembly, Jigs and fixtures, connecting rod and piston of I.C. Engines, Gland and stuffing box and many more suitable/considerations with moderate difficulty level, etc.

- Selection and showing of all the symbols & surface finish symbols, fits, tolerances for dimensions to details and assembly drawings.

Section II

Unit 5– Introduction to Computer Aided Drafting No of lectures – 7

(To be completed using suitable drafting package)

The treatment on 2D Drawing with-

1. Basic commands to draw 2-D objects like line, circle, arc, ellipse, polygon etc.
2. Edit & Modify commands: Erase, extension, break, fillet, chamfer, trim, scale, hatching etc.
3. Dimensioning & text commands
4. Viewing and other : Zoom , pan, block etc.

Unit 6– 2D drafting – Part Drawing & Isometric Drawing No of lectures – 4

Introduction to Computer aided drafting for Isometric Drawing. All necessary draw and edit and modify commands. Computer aided drafting (2D) of simple component part drawing & Isometric Drawing of machine components and plotting of drawings (printing process).

Unit 7– 2D drafting – Assembly & part Drawing No of lectures – 4

Commands required for Computer aided drafting (2D) and print out of –to draw details drawing from given assembly & assembly drawing from the given details drawing (With limits, fits, tolerances)

Unit 8– Computer aided drafting (3D) No of lectures – 5

Introduction to Computer aided drafting (3D). Introduction to modeling: Wireframe, Solid, Surface Modeling, Three dimensional drawing: UCS & three dimensional co-ordinates, Viewing in three dimensions, Solid modeling commands: primitive solids, extrude, revolve, sweep, loft, press pull, etc, Solid editing commands: 3D-rotate, 3D-Move. 3D-Scale, Boolean operations, Slice, Sections, etc.

- **Term Work:**

1. Sheet no. 1. Based on Basic of drawing & dimensioning along with BIS conventions mentioned in Unit No.1
2. Sheet no. 2: Based on Free hand sketches, drawing of various machine components mentioned in Unit No. 2
3. Sheet no. 3. Based on Production Drawing.(Dimensional and Geometrical Tolerances).
4. Sheet no. 4. Draw details drawing from given assembly & assembly drawing from the given details drawing (With limits, fits, tolerances)
5. Sheet no. 5 Computer aided drafting (2D) of two simple components and print out
6. Sheet no. 6 Computer aided drafting (2D) of isometric drawing and print out
7. Sheet no. 7 Computer aided drafting (2D) and print out of -Drawing details drawing from given assembly & assembly drawing from the given details drawing (With limits, fits, tolerances)
8. Sheet no. 8 Computer aided drafting (3D) of two simple components and print out

- **Text Books:**

1. P.S. Gill, Machine Drawing., S.K. Kataria and Sons , Delhi.
2. N. D. Bhatt,. Machine Drawing. Charotor Publication House, Bombay.
3. N. Sidheshwar . P. Kannaiah and V.V. S. Sastry. Machine Drawing, Tata McGraw Hill, New Delhi.
4. George Omura.,Mastering Auto CAD, BPB Publications.
5. K.L.Narayana, P.Kanniah, & K.V. Reddy,"Machine Drawing" SciTech Publications (India Pvt. Ltd.) Chennai

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- **Reference Books:**

1. IS: SP46- Engineering drawing practice for schools and colleges, B.I.S. Publications.
2. IS: 696- Code of practice for general engineering drawings B.I.S. Publications.
3. IS : 2709-Guide for selection of fits, B.I.S. Publications.
4. IS:919- Recommendation for limits and fits for Engineering, B.I.S. Publications
5. IS: 8000- Part I, II. III. TV, geometrical tolerencing of technical drawings -- B.I.S. Publications.
6. Ajeet Singh, "Working with AutoCAD 2000", Tata McGraw Hill.

- University Theory Paper Exam. Scheme :

Question paper will contain one compulsory question – objective question for 14 Marks.
Question paper will contain one compulsory question on Unit No. 4 for 22-24 Marks.
Question paper will NOT contain any question on Unit No. 5, 6, 7 & 8

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
S.Y. B. Tech (Mechanical Engineering) Semester - III
ME215 – A: Professional Elective -I
MICROPROCESSORS IN AUTOMATION

Teaching Scheme
Lectures– 3 Hours/week
Practical – 2 Hour/week

Examination Scheme
ESE–70 Marks
ISE – 30 Marks
ICA - 25 Marks

Course Introduction

The course is lab-centered and students will learn by working with real hardware such as 8085/8051 boards, Arduino and Raspberry Pi Boards and PLCs. Topics covered in the course include: assembly language programming, interfacing of software with hardware; digital logic, measurement and sensing, ladder programming. There are five specific labs on the topics of: sensor interfacing, DC motor control, stepper motor control, servo-motor control, and control using PLCs.

Course Prerequisites

Basic mechanical engineering, fundamental of electrical and electronics, basic programming skills.

Course Objectives: During this course, student is expected to

1. Understand microprocessor/microcontroller architecture and assembly programming.
2. Understand construction of Raspberry Pi and how to use it
3. Understand the construction, programming and applications of PLCs.
4. Understand applications of microprocessor in industry.

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

1. Program microprocessors in assembly and C/C++ or python.
2. Program and operate Raspberry Pi microprocessor boards.
3. Program PLCs using ladder logic (both on simulators and actual hardware).

Section I

Unit 1–Microprocessors **No. of lectures – 6 Hrs.**

Prerequisite: Basic electrical and electronics, basic programming

Objectives

1. Understand the architecture of microprocessors.
2. Understand how to program microprocessors/microcontroller using assembly and higher level programming languages.

Outcomes

After completing this unit, the student will be able to

1. Program 8085 microprocessor using assembly language.
2. Explain evolution of microprocessors from 8085 till date.

Unit Content

Introduction to 8085 microprocessor, 8085 architecture and pin layout, memory, 8085 programming and instruction set, addressing and interfacing,

Content Delivery Methods: Chalk and talk, PPTs. Demonstration using simulator and actual hardware.

Unit 2 –Microcontrollers **No. of lectures – 6 Hrs.**

Prerequisite: Basic electrical and electronics, basic programming

Objectives

1. Understand the architecture of microcontrollers.
2. Understand how to program microcontroller using assembly and higher level programming languages.

Outcomes

After completing this unit, the student will be able to

1. Program 8051 microcontrollers in assembly language.
2. Interface 8051 microcontroller to sensors and actuators.

Unit Content

Introduction to 8051microcontroller, architecture and pin layout, interfacing and programming, instruction set, addressing modes, special registers.

Content Delivery Methods: Chalk and talk, PPTs. Demonstration using simulator and actual hardware.

Unit 3 –Programming with Arduino **No. of lectures – 8Hrs.**

Objectives

1. Understand fundamentals Arduino controllers.
2. Understand how to use online Arduino resources for programming and tinkering.

Outcomes

After completing this unit, student will be able to

1. Program Arduino controllers using built in script.
2. Build small projects involving sensors and actuators using Arduino.

Unit Content

Arduino Environment: Board, shield, libraries and IDE.
Programming: Arduino programs, build, compiling, uploading
Debugging: Debug environments, UART, serial communication in Arduino

Content Delivery Methods: Chalk and talk, PPT, videos, expert lecture.

Section II

Unit 4–Programmable Logic Controllers **No. of lectures – 8 Hrs.**

Prerequisite: Fundamentals of electronics, microprocessors and microcontrollers, Boolean logic

Objectives

1. Understand how a PLC differs from an embedded controller.
2. Understand how to program a PLC using ladder logic.
3. Acquaint with the PLC and automation market scenario especially regards to applications.

Outcomes

After completing this unit, student will be able to

1. Use Open PLC (or equivalent free or proprietary software) for ladder programming.
2. Demonstrate simple control tasks on actual PLCs.
3. Compare PLC specifications and make conclusions about their capabilities and applications.

Unit Content

PLC architecture, PLC Input and output, I/O Processing, Boolean algebra, Ladder Diagrams and functional block programming, internal relays, jump and call.

Content Delivery Methods: Chalk and talk, PPTs, demonstration using software.

Unit 5 –Programming with Raspberry Pi **No. of lectures – 6 Hrs.**

Objectives

1. Understand fundamentals Raspberry Pi.
2. Understand how to use online Raspberry Pi resources for programming and tinkering.

Outcomes

After completing this unit, student will be able to

1. Program Raspberry Pi microprocess boards.
2. Build small IOT projects using Raspberry Pi.

Unit Content

Raspberry Pi Environment: how to set up and configure the board
Programming: Introduction to Linux and Python programming
Interfacing: Communicate devices using the I/O pins, programming using python

Content Delivery Methods: Chalk and talk, PPT, videos, expert lecture.

Unit 6 – Interfacing &Conditioning **No. of lectures – 6 Hrs.**

Prerequisite: Fundamentals of microprocessors, microcontrollers, basic electrical and electronic engineering

Objectives

1. Understand fundamentals of interfacing and signal conditioning.
2. Understand need for interfacing microprocessors and controllers.

Outcomes

After completing this unit, student will be able to

1. Interface sensors and actuators with microcontrollers.
2. Identify signal conditioning requirements for interfacing.

Unit Content

Interfacing, source and sink currents, pull up and pull down configuration, motor drivers, relays, optocouplers, ADC/DAC, OPAMPs, Signal Conditioning, Signal Processing, Computer Based Instrumentation, Data Recording and Logging, DAQs.

Content Delivery Methods: Chalk and talk, PPTs, demonstration using software and hardware.

Term Work:

1) Theory assignment on microprocessor and microcontrollers.
2) Theory assignment on interfacing.
3) One practical assignment on interfacing sensors with Arduino.
4) One practical assignment on dc motor control using Arduino.
5) One practical assignment of stepper motor control using Arduino.
6) One practical assignment on interfacing sensors and actuators with PLC.
7) One theory assignment on communication systems.
8) One practical assignment on interfacing sensors with Raspberry Pi.
9) One practical assignment on dc motor control using Raspberry Pi.
10) One practical assignment which includes building small Mechatronics systems which microprocessor/microcontroller receives input from sensors and controls actuators.

Text Books:

1. Gaonkar Ramesh, The 8085 microprocessor, Penram International Publishing
2. Kenneth J. Ayala, The 8051 Microcontroller, Delmar Learning
3. Banzi, Getting Started with Arduino, McGraw Hill.
4. W. Bolton, Programmable Logic Controllers, Pearson Publishing.
5. Gareth Halfacree, Eben Upton, Raspberry Pi User Guide, O'Riley
6. W. Bolton, Mechatronics, 4th edition (or later)Pearson Publishing

Recommended Reading

Unit	Text Book Sr. No
1	1
2	2
3	3
4	4
5	5
6	6

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
S.Y.B. Tech. (Mechanical Engineering) Semester-III
ME215 – B: Professional Elective -I
INTERNAL COMBUSTION ENGINE

Teaching Scheme	**Examination Scheme**
Theory: 3 Hrs/week	**ESE:** 70 Marks
Practical: 2 Hrs/week	**ISE:** 30 Marks
	ICA: 25 Marks

Course Objectives:
During this course, student is expected
1. Distinguish the different types of engine constructions and their thermodynamic principles.
2. Differentiate the constructional details of various fuel systems used in different types of I. C. Engines and calculate major dimensions of carburettor and fuel injection system.
3. Apply the basic knowledge to infer the different methods for enhancing the performance of I. C. engines
4. Correlate the difference in SI and CI engine combustion processes with the design of combustion chambers used in these engines
5. Evaluate the performance parameters of I. C. engines to justify their use in different applications.
6. Categorize different alternative fuels suitable for different engine applications and compare the pollutants formed in these engines and their control methods

Course Outcomes:
At the end of this course, student will be able to
1. Recognize and understand the reasons for differences in the construction of different types of internal combustion engines.
2. Understand the reasons for differences among operating characteristics of different engine types and designs
3. Select the appropriate engine for a given application.
4. Conduct performance tests on engines and Compare experimental results with Theoretical predictions.
5. Compare experimental results with theoretical predictions and make proper justifications.

Section I

Unit 1 - Introduction to I. C. Engine **No. of lectures – 05**
Introduction, Classification of I.C. Engines, Engine Cycles-Otto and Diesel Cycle, Valve timing diagram for high and low speed engines, Port timing diagram for two strokes S.I. Engines.

Unit 2–Fuel System for S. I. Engines **No. of lectures – 06**
Engine fuel requirements, Mixture requirements, Simple carburetor, and Additional systems in modern carburettor, compensating devices, Calculation of air fuel ratio (exact and approximate methods), Calculation of main dimensions of air and fuel supply (Numerical calculations of main dimensions of carburetor), Electronic Petrol injection system (MPFI).

Unit 3–Fuel System for C. I. Engines **No. of lectures – 05**

Requirements of fuel injection system for C.I. Engines, Types of injection systems-Individual pump, Common rail and Distributor systems, Unit injector, Types of fuel nozzles- single hole, multihole, pintle and pintaux, CRDI.

Unit 4–Supercharging **No. of lectures – 04**

Purpose of supercharging, Turbo charging, Thermodynamic cycle of supercharged and turbocharged Engines, Advantages and disadvantages, Limits of supercharging for S.I. and C.I. Engines.

Section II

Unit 5–Combustion in SI Engine **No. of lectures – 05**

Stages of combustion in S.I. Engines, Ignition lag, Flame propagation, Factors affecting flame speed, Abnormal combustion, Octane number, HUCR, Requirements of combustion chambers of S.I. Engines and its types.

Unit 6–combustion in C.I. Engines **No. of lectures – 05**

Stages of combustion in C.I. Engines, Delay period, Abnormal Combustion-Diesel knock, Requirements of combustion chambers for C.I. Engines and its types. Comparison of abnormal combustion in S I and C I Engines. Cetane number.

Unit 7 –Engine performance **No. of lectures – 05**

Performance parameters, Measurement of performance parameters like torque, power, and Volumetric Efficiency, Mechanical Efficiency, bsfc, Brake and Indicated Thermal efficiencies. Heat Balance Sheet. (Numerical on engine Performance and Heat Balance Sheet).

Unit 8–Alternative Fuels and Engine Emission **No. of lectures – 05**

Various alternative fuels and their suitability for I. C. Engines. S.I. Engine emissions (HC, CO, NOx),.C.I. Engines Emissions (CO, NOx, Smog, Particulate), Bharat Norms

TERM WORK

Term work (minimum 3 from group A and B, and all from Group C)

Group A (Study Group)

i. Constructional details of I.C. engines
ii. Study of Engine Cooling and Lubrication system
iii. Study of Ignition systems and Starting systems
iv. Study of fuel system for S.I. and C. I. engines

Group B (Trial Group)

i. Constant Speed Test (Influence of load on performance)
ii. Morse Test
iii. Heat balance sheet
iv. Test on computer controlled I.C. Engine/ Variable Compression Ratio Engine
v. Measurement of exhaust emissions of SI / CI engines

Group C

i. Assignment on recent trends in IC Engine.
ii. Visit to an engine manufacturing company / repairing unit.

Text books:

1 Internal Combustion Engines, Mathur and Sharma, DhanpatRai.
2 Engineering Fundamentals of the Internal Combustion Engine, Willard Pulkrabeck, Prentice Hall
3 Internal Combustion Engines, R. K. Rajput, DhanpatRai Publications.
4 Internal Combustion Engines, V.Ganesan, McGraw Hill.

Reference books:

1 Internal Combustion Engines Fundamentals, John Heywood, McGraw Hill
2 Internal Combustion Engines Emission and Control, Eran Sher, SAE
3 Engine Emissions Purandir, Narosa
4 Alternative Fuels, S.S Thipse, Jaico
5 Internal Combustion Engines Fundamentals, Maleev, McGraw Hill
6 Internal Combustion Engines Vol. 1 and Vol. 2, C.F Taylor, MIT Press
7 Internal Combustion Engines, *Obert*, McGraw Hill
8 Internal Combustion Engines: AppliedThermo sciences, Fergusson & Kirkpatrick, Wiley.
9 SAE Handbook, SAE, SAE.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

S.Y.B. Tech. (Mechanical Engineering) Semester - III

ME215 – C: Professional Elective -I

COMPOSITE MATERIALS

Teaching Scheme
Theory: 3 Hrs/week
Practical: 2 Hrs/week

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

Course Introduction:

This course aims at introducing basics of composite materials. Rapid technological advances in engineering brought the scientists and engineers to appoint, where they became limited by the capabilities of traditional materials. With the limits of the technology pushed, the materials failed to answer the requirements of the designers or manufacturers. Researchers in materials technology are constantly looking for solutions to provide stronger, durable materials which will answer the needs of their fellow engineers. Composite materials are one of the most favored solutions to this problem in the field. By combining the stronger properties of traditional materials and eliminating the disadvantages they bear, composite materials technology is providing compromising solutions and alternatives to many engineering fields. Problems born from material limitations like heavy weight, structural strength, and thermal resistance are being solved by the composite material alternatives, and many more alternatives are being introduced to readily use engineering applications.

Course Prerequisite:

Student shall have knowledge of materials sciences, Engineering Materials, fundamentals of design and Manufacturing Process.

Course Objectives: During this course, student is expected

1. To know which are various types of composite materials and their applications.
2. To know the properties of composite materials.
3. To know various manufacturing processes of composites.

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

1. Studentswillunderstandadvantagesandlimitationsofcompositematerialsas competing material to conventional materials.
2. Students will be able to evaluate strength and mechanical properties of composite material.
3. Students will understand different manufacturing methods of composite material and effect of various manufacturing parameters on mechanical properties of composite materials.
4. Students will be able to design simple machine components or structures made of composite materials.

Section I

Unit 1-Introductionto Composite Materials
Unit Content: Definition, Classification, Types of matrix materials and reinforcements, Significance and objectives of composite materials, Characteristics & selection, Fiber composites, types fibrous laminated composites, Metal matrix composite, Particulate composites and Pre-pegs, Application of Composite Materials.

Unit 2: Mechanical Behavior of Lamina
Unit Content: Anisotropy, orthotropy, stiffness, engineering constants, uniaxial and biaxial strength of lamina, failure theories maximum stress, maximum strain, Tsai Hill, Hoffman, Tsai Wu, computational procedure, applicability, mechanics approach to stiffness and strength

Unit 3: Polymer composites
Unit Content: Types, properties and applications of Plastics, Unsaturated polyester resins, Epoxy resins and Polyurethanes,

Section II

Unit 4:Manufacturing: Lay-up and curing
Unit Content: Open and closed mold processing, Hand lay-up techniques, Bag molding and filament winding. Pultrusion, Pulforming, Thermo forming, Injection molding, Types of defects.

Unit 5: Analysis of Composite Structures
Unit Content: Basic Principles of fracture mechanics and effect of discontinuity in laminates, applications.

Unit 6: Introduction to Design of Composite Structures
Unit Content: Introduction to Design of Composite Structures

Term Work: **Six assignments based on above syllabus**

Reference Books:

1. Mechanics of Composite Materials, R M. Jones, Taylor & Francis.
2. Mechanics of composite materials, Autar K. Kaw, C R C Press New York.
3. Composite Materials handbook, Mein Schwartz, Mc Graw Hill Book Company, 1984.
4. Stress analysis of fiber Reinforced Composite Materials, Michael W, Hyer, Mc-Graw Hill International.
5. Composite Material Science and Engineering, Krishan K. Chawla, Springer .Fiber Reinforced Composites, P. C. Mallik, Marcel Decker

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
S.Y.B. Tech.(Mechanical Engineering) Semester-IV
ME221 ENGINEERING MATHEMATICS-III

Teaching Scheme	**Examination Scheme**
Lectures – 3 Hours/week	**ESE** – 70 Marks
Tutorials – 1 Hour/week	**ISE** –30 Marks
	ICA- 25 Marks

Course Objectives:

1. To introduce partial differential equations of first order.
2. To introduce to students Fourier series of periodic functions
3. To introduce numerical methods for evaluating definite integrals.
4. To introduce numerical methods for solving linear and non-linear equations.
5. To introduce concepts of Probability distribution.

Course Outcomes:

1. Student can solve partial differential equation of first order
2. Student can express a function in terms of sine and cosine components so as to model simple periodic functions.
3. Student can use numerical methods for evaluating definite integrals.
4. Student can use numerical methods for solving linear and non-linear equations.
5. Student can sketch and explain various probability distribution functions.

SECTION – I

Unit 1: First Order Partial Differential equations **No. of lectures- 07 Hrs**

Non-linear partial differential Equations of *Type I f(p, q)=0, Type II f(p, q, z) = 0, Type III* $f_1(p, x) = f_2(q, y)$, Linear partial differential equations – Lagranges method, Solution of partial differential equation by method of separation of variables.

Unit 2: Fourier series: **No. of lectures- 06** Hrs

Introduction, Definition, Euler's formula, Fourier series of periodic functions with period 2Π and 2L, Dirichlet's theorem (only statement), even and odd functions, half range sine and cosine series.

Unit 3: Numerical Integration: **No. of lectures- 07 Hrs**

Newton Cotes Integration Formula: Trapezoidal rule, Simpson's Rule (1/3rd and 3/8th), Double integration, Integration of Equation: Gauss Quadrature 2 point and 3 point method.

Section II

Unit 4: Solution of Algebraic and Transcendental Equations: **No. of lectures- 08 Hrs**

Introduction, Basic properties of equations. Bisection Method, False position Method, Newton-Raphson Method, Multiple Roots, Newton's iterative formula for obtaining square root, Muller's Method. System of non linear equations by Newton Raphson Method.

Unit 5: Statistics – I (Probability): **No. of lectures- 08** Hrs

Random variable, discrete and continuous random variable, Probability density function, Binomial, Poisson and Normal distributions.

Unit 6: Statistics – II **No. of lectures- 04** Hrs

Coefficient of correlation and lines of Regression of bivariate data

In Semester Evaluation (ISE):

ISE shall be based upon student's performance in minimum two tests and mid-term Written test conducted & evaluated at institute level.

Internal Continuous Assessment (ICA):

ICA shall be based on student's performance during tutorial sessions and it consists of minimum Six Assignments based on above all units.

Text Books:

1. "A Text of Applied Mathematics Vol. I and Vol. II", J. N. and P. N. Wartikar, Vidyarthi Grah Prakashan, Pune.
2. "Higher Engineering Mathematics", B. S. Grewal, Khanna Publication, Delhi.
3. "Advanced Engineering Mathematics", Jaggi and Mathur, Dhanpatrai and Sons, Bhopal.
4. "A Text of Applied Mathematics", N. P. Bali, Ashok Saxenaand N. Ch. S. N. Iyengar, Laxmi Publication, Delhi.

Reference Books:

1. "Advanced Engineering Mathematics", Kreyzig, John Wiley & Sons, New York.
2. "Engineering Mathematics", Peter O Neil, CRC Press.
3. "Fundamental of statistics", S. G. Gupta, Himalaya Publishing House.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
S.Y.B. Tech.(Mechanical Engineering) Semester-IV
ME222 MANUFACTURING TECHNOLOGY

Teaching Scheme	**Examination Scheme**
Theory: 3Hrs/week	**ESE:** 70 Marks
Practical: 2Hrs/week	**ISE –** 30Marks
	ICA: 25Marks

 Course Introduction:

Machining is accomplished with the use of machines known asmachine tools. For production of variety of machined surfaces, different types of machinetools have been developed. The kind of surface produced depends upon the shape ofcutting, the path of the tool as it passes through the material or both depending on metalcutting processes are called either turning or planning or boring or other operationsperformed by machine tools like lathe shaper, planer drilling milling grinding gear cutting,CNC or VMC and other Non-conventional machine.

Course Perquisite:

In general manufacturing process is economic term for making goods and services available to satisfy human wants. It involves a series of related activities and operation is called production System. It is depicted as an input –output system, here the inputs elements undergo technological transformation (machine tools) to yield a set of output elements called as product.

Course Objective:

1. To study the conventional machining processes such as drilling, milling, shaping, planning carried out on typical machine tools for different applications.
2. To study unconventional machining processes such as EDM, ECM, AWJM and USM carried out on special purpose machine tools for typical applications.
3. To compare and select a suitable manufacturing process.

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

1. Exhibit knowledge of conventional, unconventional & modern machining processes and machine tools.
2. Select proper manufacturing process for the typical application.

SECTION I

UNIT-1 Conventional Lathe Machine **No. of lectures-06**

Introduction to Centre Lathe, parts and functions, specifications, accessories and attachments. Lathe operations, Taper turning methods, simple Numerical on Thread cutting. Introduction to CNC machine tools, Classification of CNC, advantages, limitations and application.

UNIT-2 Hole making machine tools **No. of lectures-08**

Classification, construction and working of Pillar type and radial drilling machines, Job & Tool holding devices and accessories, various operations. Horizontal and vertical boring machines, construction and working, Boring tools and bars, Jig boring machines. Broaching, principal, classification, pull and push type broach, advantages, limitations and application.

UNIT-3 Reciprocating motion machine tools **No. of lectures-06**

Principle, types, specifications, operations on shaper, Types of shapers, Types of planers, standard double housing plainer, construction, and operations. Introduction to construction and working of slotting machine.

SECTION II

UNIT-4 Milling & gear manufacturing **No. of lectures-09**

Classification of Milling Machines, construction and working of column and knee type milling Machines, Milling methods – Up milling and down milling, milling operations, Gear cutting on milling machines, Gear Hobbing, gear shaving, gear burnishing, indexing methods, Numerical on Indexing Methods.

UNIT-5 Finishing Processes **No. of lectures-05**

Classifications – Cylindrical, Center less, Surface grinder etc. Selection mounting, glazing, loading, truing, balancing, Surface finishing process, Honing, Lapping, super finishing.

UNIT–6 Unconventional Machining **No. of lectures-06**

Introduction, classification, significance of Unconventional machining, Electrical discharge machining (EDM), Electrochemical Machining (ECM), Ultrasonic machining (USM), Abrasive Water Jet Machining (AWJM), Principle, working, applications, advantages, limitations

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

1. Setting the lathe machine for taper turning by swiveling compound rest.
2. Setting the lathe machine for taper turning by set over of tail stock and taper turning attachment.
3. Setting the lathe machine for thread cutting operation.
4. Study and demonstration of attachments on milling machine.
5. Study and demonstration of various types of milling cutters.
6. Setting the milling machine for gear cutting operation.
7. Study and demonstration of various types of grinding wheels and their specifications.
8. Visit to at least one machine shop and one CNC shop.

- **Text Books:**

1. Workshop Technology (Volume II) by Hajra Chowdhary.
2. Workshop Technology (Volume II) by Raghuvanshi
3. Production Technology (Volume II) by Gupte-Patel.
4. Workshop Technology (Volume II) by W. A. J. Chapman.
5. Manufacturing Technology-P. N. Rao Vol. II.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
S. Y. B. Tech. (Mechanical Engg.) Semester-IV
ME223 FLUID MECHANICS & FLUID MACHINES

Teaching Scheme
Theory – 3 Hrs. /Week
Laboratory– 2 Hrs. /Week

Examination Scheme
Theory – ESE -70 Marks
ISE – 30 Mark
ICA – 25 Marks

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

- Solve issues related to fluid statics & kinematics
- Apply Bernouilli's theorem in real world situations
- Perform dimensional analysis for research problems in fluid mechanics
- Solve problems related to drag, lift , drag & lift
- Select / design Pelton, Francis & Kaplan turbines
- Select/design centrifugal pump

Section - I

Unit No. 01: Fluid statics **No. of lectures-05**

•Center of pressure, Total pressure on immersed surfaces – horizontal, vertical & inclined The principle of buoyancy, Archimedes' principle, conditions of equilibrium for submerged & floating bodies, discussions on stability, Meta-center & metacentric height. (No numerical treatment to Metacentric height)

Unit No. 02: Fluid kinematics **No. of lectures-05**

• Langrangian & Eulerian method of description of fluid flow, Types of flow with examples, Streamlines, path lines & streak lines, velocity components, local & convective acceleration, velocity potential function, equi-potential lines, Laplace equation governing potential flow, stream function, continuity equation in Cartesian co-ordinates

Unit No. 03: Fluid dynamics **No. of lectures-05**

• Euler's equation along a stream line & Bernoulli's equation, applications of Bernoulli's Theorem: Venturi meter, Orifice meter & Pitot tube, Flow through sharp edged small circular orifices, Determination of hydraulic coefficients of an orifice. (No numerical treatment to Orificemeter & Pitot tube)

Unit No. 04: Flow through pipes **No. of lectures-05**

Major & minor Energy losses, Darcy-Weisbach equation, loss of head in pipe connections & fittings, equivalent pipe, Hydraulic Gradient Line (HGL) & Total Energy Line (TEL), Siphon (No numerical treatment to HGL, TEL & Siphon), flow through pipes in series &parallel, efficiency of power transmission, maximum transmission of fluid power through a given pipe

Section - II

Unit No. 05: Dimensional Analysis, Similitude and Forces on Immersed Bodies.

No. of lectures-05

Dimensions of Commonly Encountered Fluid Properties , Dimensional Analysis, Rayleigh Theorem , Buckingham's Π theorem, similitude, modeling, Drag & Lift on immersed bodies, Drag & Lift forces on stationary body.

Unit No.6: 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 No.07: 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 (Theoretical treatment only for draft tube), Types and function, governing of reaction turbines.

Unit No. 8: Centrifugal Pumps **No of lectures – 05**

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.

Internal Continuous Assessment (ICA)

Compulsory:

1. Numerical & theoretical assignments on basics of fluid mechanics (Properties of fluids & related laws)
2. Numericals on Piezometer, Simple & inverted U tube manometer

Any seven out of the following.

1. Determination of meta centric height for a ship
2. Determination of Coefficient of friction for Pipes
3. Verification of Bernoulli's theorem.
4. Calibration of Venturimeter / Orifice meter.
5. Determination of Hydraulic Coefficient of an Orifice.
6. Trial on a Pelton wheel.
7. Trial on a Francis/ Kaplan turbine.
8. Trial on a centrifugal pump.
9. Two problems using CFD software

• Text Books

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. Streeter, Wylie, Bedford - Fluid Mechanics, McGraw Hill Publication.

• Reference Books

1. White - Fluid Mechanics, McGraw Hill Publication
2. Irving Shames - Mechanics of Fluid, McGraw Hill Publication.
3. Murlidhar - Advanced Fluid Engineering, Narosa Publication.
4. S. K. Som, G. Biswas- Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill publications

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
S. Y. B. Tech. (Mechanical Engg.) Semester-IV
ME224 KINEMATICS &THEORY OF MACHINES

Teaching Scheme
Theory – 3 Hrs. /Week
Laboratory– 2 Hrs. /Week

Examination Scheme
Theory – ESE -70 Marks
ISE – 30 Marks
ICA – 25 Marks
OE – 25 marks

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

- Select proper type of mechanism for different applications
- Determine velocity & acceleration of different components in mechanism
- Select proper type of cam & follower for any application & draw cam profile
- Select proper type of brakes for various applications
- Select gear & design gear trains for any application
- Analyze the effect of gyroscopic couple of any vehicle
- Design governor for different use
- Do balancing of rotary & reciprocating masses

Section - I

Unit No 01: Simple Mechanisms **No. of lectures-03**
Kinematic links, kinematic pairs, classification, kinematic chain, degrees of freedom, Types of constrained motion, Kutzbach's and Grubler's criteria for plane mechanisms, structure, mechanism & machine, Grashoff's law for four bar mechanism, Inversion, Inversions of Four bar chain, Single slider crank chain and double slider crank chain.

Unit No 02: Velocity & Acceleration in Mechanisms **No. of lectures-07**
Velocity and acceleration in mechanisms, Velocity analysis in mechanisms by following graphical methods. 1) Relative velocity & acceleration , Corioli's Component of Acceleration 2) Klein's Construction.

Unit No 03: Cams **No. of lectures-05**
Types of cams and followers, cam nomenclature, Follower motions, displacement, velocity and acceleration diagrams for following motions of the follower 1) Uniform velocity 2) Simple harmonic motion 3) Uniform acceleration & retardation. 4) Cycloidal motion 5) Oscillatory follower, Construction of cam profile for radial cams with different types of followers.

Unit No 04: Brakes **No. of lectures-05**
Classification of brakes. Band brake, band & block brake. Internal & external shoe brakes, design considerations of brakes.

Section -II

Unit No 05: Gear & Gear trains **No of lectures – 05**

Gear:- Geometry of motion, Gear geometry, Types of gear profile- involutes & cycloidal, Theory of Spur, Helical, Interference in involute tooth gears and methods for its prevention, Contact ratio, Path of contact (No numerical treatment)

Gear Trains:- Types of Gear trains- Simple, Compound, Epicyclic, Reverted gear train, Tabular method for finding the speeds of elements in simple and compound epicyclic gear train, Differential gear train

Unit No 06: Gyroscope. **No of lectures – 05**

Gyroscopic couple, Spinning and Precessional motion, Gyroscopic couple and its effect on i) Aero plane ii) Ship iii) Four-Wheeler iv) Two –Wheeler

Unit No 07: Governor **No of lectures –06**

Governors :-Types of governors Watt, Porter & Hartnell governors, sensitivity, stability & isochronisms, Hunting of governor, governor effort, power and controlling force diagram of governors.

Unit No 08: Balancing **No of lectures – 04**

Static and Dynamic balancing of rotary masses. Balancing of Single cylinder Engines.

In Semester Evaluation (ISE):

ISE shall be based upon student's performance in minimum two tests & mid-term written test conducted and evaluated at institute level.

Internal Continuous Assessment (ICA) (1 to 4 Compulsory & Any 4 out of remaining):

1. Demonstration of Grash off's law for four bar mechanism.
2. Velocity & acceleration problems by relative velocity & acceleration method on drawing sheet.
3. Problems on Klein's construction on drawing sheet.
4. Drawing the cam profile by plotting displacement, velocity & acceleration diagrams on drawing sheet.
5. Experiment on Gyroscope
6. Experiment to generate involute gear tooth profile.
7. Two Problems on each type of Epicyclic gear train using tabular method.
8. Experiment on Watt, Porter & Hartnell governors to study governor characteristics.
9. Balancing of rotary masses (Static and Dynamic).

Text Books:

1. Ballaney P. L., Theory of Machines, Khanna Publications, New Delhi.
2. Khurmi R. S. & Gupta J. K., Theory of Machines, S. Chand publications, New Delhi.
3. Bansal R. K., Theory of Machines, Laxmi publications, New Delhi.
4. V.P. Singh, Theory of Machines, Dhanpat Rai & Sons Co. Pvt. Ltd., Delhi.

Reference Books:

1. Rattan S. S., Theory of Machines, Tata McGraw Hill publication, New Delhi.
2. Shigley J., Theory of Machines & Mechanisms, McGraw Hill International students' edition.
3. Thomas Bevan, Theory of Machines, CBS publication, New Delhi
4. Grover, Mechanical Vibrations.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
S.Y. B. Tech (Mechanical Engineering) Semester IV
ME225 – A: Professional Elective -II
MECHATRONIC SYSTEMS

Teaching Scheme
Lectures– 3 Hours/week
Practical – 2 Hour/week

Examination Scheme
ESE–70 Marks
ISE – 30 Marks
ICA - 25 Marks

Course Introduction

The course is an introductory course aimed to designing mechatronic systems, which require integration of the mechanical, electrical, electronic and computing engineering disciplines within a unified framework. Contents covered in this course include mechatronic systems, sensors and actuators, mechatronics in the industry, system modelling and control. The second part of the course deals with Programmable Logic Controllers and Communication systems. Practical of the course include programming, interfacing of software with hardware; digital logic, measurement and sensing, ladder programming. There are five specific labs on the topics of: sensor interfacing, DC motor control, stepper motor control, servo-motor control, and control using PLCs.

Course Prerequisites

Basic mechanical engineering, matrix algebra, fundamental of electrical and electronics, basic engineering mathematics.

Course Objectives: During this course, student is expected to

1. Understand what makes up a mechatronic system.
2. Understand how model mechatronic systems.
3. Understand how to build system models in Open Modelica and/or Matlab (or similar software such as Scilab).
4. Understand networks and communication systems and its associated epistemology.

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

1. Explain mechatronic terminology
2. Explain types and applications of sensors and actuators in mechatronic systems.
3. Explain latest trends in industrial mechatronics such as IOT, industry 4.0
4. Program PLCs using ladder logic (both on simulators and actual hardware).
5. 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)

Section I

Unit 1–Introduction to Mechatronics **No. of lectures – 4Hrs.**

Objectives

1. Understand fundamental concepts of mechatronic systems.
2. Understand how mechatronic system have evolved over the years.

Outcomes

After completing this unit, student will be able to

1. Recall definition, scope and elements of mechatronic systems.
2. Explain the working of mechatronic systems such as CNCs, ABS etc.
3. Draw a conceptual block diagram of mechatronic systems.

Unit Content

Basic Definition, Key elements of Mechatronics, Historical Perspective, Examples of Mechatronics Systems: Car Engine Management, Automatic Camera, White goods and domestic appliances, various systems in a modern automobile (ABS, TCS, DAS), Modern HVACs, CNC machines and factory automation

Content Delivery Methods: Chalk and talk, videos, PPTs,expert lecture/field visits.

Unit 2–Sensors and Actuators **No. of lectures – 10Hrs.**

Prerequisite: Basic electrical and electronics, fundamentals of measurement systems,

Objectives

1. Understand classification, basic operation and applications of sensors and actuators.
2. Understand modern trends in sensor and actuator design.

Outcomes

After completing this unit, student will be able to

1. Select appropriate sensor and actuator for a given application.
2. Explain the basic principle of operation of sensors and actuators.

Unit Content

Sensors: Classification, Principle of Operation & Characteristics, Linear and rotational sensors, acceleration sensors, Force sensors, Torque Sensors, Flow Sensors, Temperature Sensors, Distance Sensors, Optical Sensors, Ultrasonic Sensors , Selection criteria. Applications: Sensors for Condition Monitoring, Micro sensors.

Actuators: Classification of Actuators, DC Motors, AC Motors, Stepper Motors, Switches, Solenoids, Piezoelectric Actuators, Micro motors.

Content Delivery Methods: Chalk and talk,demonstration using Matlab/Scilab/Octave.

Unit 3 –Mechatronics Applications in Industry **No. of lectures – 4 Hrs.**

Prerequisites: Previous units

Objectives

1. Understand mechatronics applications in industry
2. Acquaint with terminology related to automation and high technology.

Outcomes

After completing this unit, student will be able to

1. Explain terms such as automation, Industry 4.0, IOT.
2. Explain the application of mechatronics in industry and high technology.

Unit Content

MEMS based applications, Industrial Automation, machine diagnostics, IOT and mechatronic systems, Industry 4.0.

Content Delivery Methods: Chalk and talk, PPTs, videos, field visits, expert lecture.

Section II

Unit 4–Modelling and Simulation of Mechatronic Systems **No. of lectures – 8 Hrs.**

Prerequisite: Basic mathematics, previous units

Objectives

1. Understand how a mechatronic system modeled.
2. Understand how to develop block diagram and transition diagrams for mechatronic systems.
3. Understand mathematical modelling in OpenModelica and/or Matlab/Scilab/Octave.

Outcomes

After completing this unit, student will be able to

1. Develop mathematical models of mechatronic systems.
2. Build and solve dynamic models in Open Modelica or Matlab/Scilab/Octave.
3. Solve state space equations.

Unit Content

Open and Closed loop systems, review of differential equations, Laplace transform, transfer functions, block diagrams and their solutions, electric systems, fluid systems, thermal systems, modelling physical components using analogies, state space methods.

Content Delivery Methods: Chalk and talk, PPTs,demonstration using software.

Unit 5–Control using PLCs **No. of lectures – 8 Hrs.**

Prerequisite: Fundamentals of electronics, microprocessors and microcontrollers, Boolean logic

Objectives

1. Understand how a PLC differs from an embedded controller.
2. Understand how to program a PLC using ladder logic.
3. Acquaint with the PLC and automation market scenario especially regards to applications.

Outcomes

After completing this unit, student will be able to

1. Use OpenPLC (or equivalent free or proprietary software) for ladder programming.
2. Demonstrate simple control tasks on actual PLCs.
3. Compare PLC specifications and make conclusions about their capabilities and applications.

Unit Content

PLC architecture, I/O Processing, Ladder Diagrams, Internal Relays, Jump and Call, Timers, Counters, Shift Registers and Data Handling, Programs for temperature control, sequencing etc., PLC Vs. PC based systems, top manufacturers.

Content Delivery Methods: Chalk and talk, PPTs, demonstration using software.

Unit 6 –Networking and Communications **No. of lectures – 4 Hrs.**

Objectives

1. Understand fundamentals of networking and data communication.
2. Acquaint with terminology related to transmission standards and communication protocols.

Outcomes

After completing this unit, student will be able to

1. Define transmission and communication protocols and standards.
2. Explain scope and application of networking models and protocols and systems.

Unit Content

Terminology: Serial and Parallel communications, bit and baud rate, protocols, data flow, handshaking, signal transmission

TIA/EIA Serial Standards (RS 232, RS422, RS485), IEEE 488 General Purpose Interface bus. Computer Networks, OSI model, LAN, WAN, MAN, CAN bus, PROFI bus and SCADA.

Content Delivery Methods: Chalk and talk, PPT, videos, expert lecture.

Term Work

1) Survey assignment on mechatronic products.
2) Theory assignment on sensors, actuators.
3) Interfacing sensors with Arduino/Raspberry Pi.
4) One practical assignment on dc motor control using Arduino/Raspberry Pi.
5) One practical assignment of stepper motor control Arduino/Raspberry Pi.
6) One practical assignment on basic control using PLC.
7) One practical assignment on timers in PLCs
8) Once practical assignment on counters and shift registers with PLC.
9) One theory assignment on communication systems.
10) One theory assignment latest trends and applications.
11) One practical assignment which includes building small Mechatronics systems which microprocessor/microcontroller receives input from sensors and controls actuators

Textbooks

1) W. Bolton, Mechatronics,4th Edition, Pearson Publishing
2) Shetty & Kolk, Mechatronics System Design,2nd Edition Cengage Learning.
3) Mahalik, Mechatronics: Principles, Concepts and Applications, Tata McGraw Hill

Reference Books

1) Bishop et.al, Handbook of Mechatronics, CRC Press.
2) Macia & Thaler,Modelling and Control of Dynamic Systems, Cengage Learning.
3) W. Bolton, Programmable Logic Controllers, Pearson Publishing.
4) Petruzella Frank, Programmable Logic Controllers, McGraw Hill.

Recommended Reading

Unit	Textbook Sr. No	Reference Book Sr. No.
1	1,2,3	1
2	1,2,3	1,2
3	1,2,3	1
4	1,2,3	1,2
5	1,2,3	3,4
6	1,2,3	1

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
S. Y.-B. Tech. (Mechanical Engg.) Semester-IV
ME225 – B: Professional Elective -II
POWER PLANT AND ENERGY ENGINEERING

Teaching Scheme	**Examination Scheme**
Lectures – 3 Hours/week	**ESE–** 70 Marks
Practical – 2 Hour/week	**ISE –**30Marks
	ICA- 25Marks

Course Introduction:

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

Course Prerequisite:
Basic Mechanical Engineering, Engineering Physics, Thermal Power Engineering- Boilers, thermal cycle, Thermodynamic devices

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Course Objectives: During this course, student is expected to-
1. Study of Power Station performance evaluation & economic analysis.
2. Study of various non-conventional energy sources & principles of energy
3. Explain various loads on power plant.
4. Illustrate Significance of different load curves and load factors on power plant.
5. Explain variable load on power plant.
6. Study & explain economics of power plant.
7. Study various Other Non- Conventional Energy Sources.
8. Study Process of Energy Audit.

Course Outcomes: At the end of this course, student will be able to-
1. Get basic knowledge for effective use of available energy sources by suitable planning of power generation in thermal, hydro, gas & atomic power plant. .
2. Describe energy conversion in power plants.
3. Describe role of various organizations of power sector
4. Explain load curves and load factors.
5. Explain calculation of fixed & operating cost
6. Study the Classification of WEC systems.
7. Explain duties & responsibilities of energy auditors.

Section I

Unit 1– Introduction of Energy Sources **No. of lectures – 04**

Forms & characteristics of renewable energy sources, Organization of Power Sector in India, Impact of energy sources (coal, oil, natural gas, solar, wind, biomass, hydro, geothermal, tidal, wave, ocean thermal and nuclear) on environment, Role of private sector in energy management.

Unit 2– Loads on Power Plant **No. of lectures – 05**

Introduction, Different load curves and load factors, Effect of variable load on power plant, design & operation, comparison of the various power plants. (Numerical treatment)

Unit 3– Peak Load & Base Load Power Plants **No. of lectures – 05**

Introduction & classification, Requirement of peak load plant, Types, Pumped storage plants, Compressed air storage plants, Load sharing between base load & peak load power stations. (Numerical treatment)

Unit 4– Economic Analysis of Power Plants **No. of lectures – 06**

Introduction, Cost of electric energy, Fixed and operating cost, Methods of determining depreciation, Selection of site for Power station(thermal, hydro, nuclear), Selection of generation equipment, Tariff methods. (Numerical treatment)

Section II

Unit 5– Solar Energy **No. of lectures – 05**

a) Solar radiation outside the earth's atmosphere & at the earth's surface, Solar radiation measurement – Pyranometer & Pyrheliometer, solar radiation geometry. LAT & SCT, Solar concentrators-Method and classification, Types of concentrators.
b) Liquid flat plate collector – General, Performance analysis, Effects of various parameters. (Numerical treatment)

Unit 6– Wind Energy **No. of lectures – 05**

Introduction, Power of wind, Basic components of 'WECS', Classification of WEC systems., Horizontal axis machines, Vertical axis machines, Advantages & Disadvantages of WECS, Application of wind energy. (Numerical treatment)

Unit 7.Non- Conventional Energy Sources **No. of lectures – 05**

Geothermal energy – Introduction, Types of geothermal resources, Methods of Harnessing. Tidal energy components of tidal power plant, single basin system, Double basin system, Advantages &Disadvantages of tidal energy. Ocean thermal energy – Introduction, open & closed systems. Wave Energy – wave energy, energy conversion devices- High pressure accumulator wave machines, Dolphin type wave machine, Dam Atoll wave machine.

Unit 8– Energy Audit & Energy Conservation **No. of lectures – 05**

Energy Audit - Definition & objective of Energy audit, Energy flow diagram, Energy Audit Instruments; Duties and responsibilities of energy auditors, Duties and responsibilities of energy managers.

Energy Conservation- Introduction, energy conservation act 2001 & its feature, energy conservation in industries – Chemical industry, Cement industry & Sugar industry. Energy conservation in house hold & commercial sectors.

- **Term Work:**

Group - I: Any two Experiment from Expt. No. 1 to 5

1. Solar radiation & its measurement
2. Test on solar water heater
3. Efficiency measurement of standalone solar P-V system
4. Study of components of windmill
5. Identifying & measuring the parameters of a solar PV module in the field

Group - II: Minimum Six Assignments based on following topics –

1. Study of solar collectors
2. Study of solar thermal applications- solar water heating, space heating, power
3. Study of solar pond / solar photovoltaic
4. Study of Biogas plants
5. Study of instruments of a power plant water purity, PH meter, Gas analysis, Measurement of smoke & dust.
6. Study of various pollution control devices
7. Study of various Energy storage devices.

Group - III

1. The report based on any Industrial Visit to renewable energy appliances or power generation transmission station.

- **Text Books:**

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

- **Reference Books:**

1. Power Plant Technology – M. M. El Wakil.
2. Berau of Energy efficiency Manual
3. Non-conventional Energy Sources- G.D.Rai, Khanna Publisher.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
S. Y. B.Tech.–(Mechanical Engineering) Semester-IV
ME225 – C: Professional Elective -II
SOLID MECHANICS

Teaching Scheme
Theory/Lectures – 3 Hrs. /Week
Tutorial– 1Hr. /Week

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

Course Introduction: This course covers plane stress and plane strain. Additionally students will study material properties for isotropic materials and their relations.Applications to polynomials in rectangular co-ordinates will be studied by solving 2D problems. The theory of failure which is important to assess reliability of any component will be studied. The shear stress distribution will be studied by finding shear center of thin walled sections. Torsion in various cross sections will be studied. The introduction about viscoelastic materials and response will be discussed. At the end determination of crippling load for various cross sections of columns will be discussed.

- **Course Objectives:**

After successfully completion of this course, student will have ability to:

1. To prepare the students to succeed as designer in industry/technical profession.
2. To provide students with a sound foundation in solid mechanics required to apply in solving industrial problems
3. To train the students with good design engineering concepts required for safe and efficient design, construction, installation, inspection and testing of structural parts of the mechanical system.

- **Course Outcomes:**

After the completion of course students will be able to

1. Solve the problems related to theory of elasticity, plane stress and plane strain.
2. To study various isotropic materials and their relations.
3. Analyze two dimensional problems in rectangular co- ordinates and polar co-ordinates
4. Find shear centre for thin walled open sections, beam, etc
5. To study theories of failure.
6. To understand the torsion theory of elliptical, square & rectangular crosses section.
7. To understand theory of viscoelastic material.
8. Apply Euler's & Rankine's formula, to determine crippling load for various cross sections of columns.

SECTION-I

Unit No 01: Stress and strain **(No. of lectures 5)**

Unit Content: Stress at a point, Hooke's law, Cauchy stress tensor, analysis of deformation and definition of strain components, principal stresses and strains, stress and strain invariants, Mohr's circle representation.

Unit No 02: Isotropic Materials **(No. of lectures 5)**

Unit Content: Material properties for isotropic materials and their relations. Theories of failures for isotropic materials.

Unit No 03: Applications to polynomials **(No. of lectures 5)**

Unit Content: Two dimensional problems in Rectangular co-ordinates. Applications to polynomials in rectangular co-ordinates, Saint Venant's Principle.

Unit No 04: Theory of Failures **(No. of lectures 5)**

Unit Content: Maximum normal stress theory, Von-Mises yield criteria, Tresca yield criteria.

SECTION-II

Unit No 05: Shear Center **(No. of lectures 5)**

Unit Content: Shear stress distribution and Shear center for thin walled open sections.

Unit No 06: Torsion **(No. of lectures 5)**

Unit Content: Torsion of bars with elliptical, square & rectangular cross section. Membrane analogy, Hydro dynamical analogy, Torsion of hollow & thin tubes.

Unit No 07: Introduction to Visco-elasticity **(No. of lectures 5)**

Unit Content: Viscoelastic Materials, Response of Viscoelastic Materials, Linear Viscoelasticity, Introduction to Testing of Viscoelastic Materials, Examples and Applications of Viscoelastic Materials, Models of Viscoelasticity.

Unit No 08: Axially Loaded Columns **(No. of lectures 5)**

Unit Content: Concept of critical load and buckling, crippling and crushing stress, Euler and Rankine theory, Assumption made & sign conventions. concept of various end connections and equivalent length, Slenderness ratio, safe load on a column, Rankine's formula for critical load of any column, determination of crippling load using Euler's and Rankine's formulae.

Term Work:

8 Study assignments based on above topics.

Books recommended:

1. S. Timoshenko & J.W. Goodeer, "Theory of Elasticity", MGH books co Ltd.
2. L. S. Srinath, "Advanced Mechanics of Solids", McGraw Hill Education.
3. J.P.Den Hartog, "Advanced Strength of Materials." MGH books co Ltd.
4. F.B. Seely&Smlth, "Advanced mechanics of materials", John Wiley & Sons.
5. Kelly, "Solid Mechanics", John Wiley & Sons.
6. Aleksey D. Drozdov, "Mechanics of Viscoelastic Solids", John Wiley & Sons.
7. P. H. Jain, "Strength of Material", Soham Publications.
8. R. S. Khurmi, "Strength of Material", S Chand Publications.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
S. Y.-B. Tech. (Mechanical Engg.) Semester-IV
ME 226 MECHANICAL WORKSHOP-I

Teaching Scheme
Practical– 2 Hrs. /Week

Examination Scheme
ICA – 50 Marks

Course Prerequisite:- fundamental machine shop instruction involving safety use and care of hand and measuring tools basic operation of all conventional machines and grinding of single point tools, screw threads and taper turning and their application classes of fits and tolerances are stressed students will be provided the opportunity to learn and practice bench work skills.

Course Objectives:
1. To get hands on experience of machining techniques such as grinding, drilling, shaping, turning etc. studied in theory subjects.
2. To develop skills to operate different machine tools.
3. To get hands on experience in pattern making, joining processes and forming processes.
4. To develop skills in pattern making and sheet metal work.

Course Outcomes: At the end of this course, the student will be able
1. To operate different machine tools such as grinders, lathes, drilling machines etc.
2. To machine the component as per specified dimensions.
3. To develop the skills necessary for engineering practices like joining and forming processes.
4. To Choose and apply the appropriate methods for pattern making & sheet metal working

Preparation of Wooden pattern (single piece) for a simple component:
Part A –
1. This shall cover – Study of component drawing, preparing casting drawing, Allowance table, Pattern drawing, Deciding parting line & Deciding pattern making process. (2 Turns)

Part B – Actual manufacturing of pattern. (2 Turns)
2. Study of gas welding & gas cutting equipments, Study of arc welding equipment, Study & demonstration of resistance welding, Study of various types of welding joints & demonstration of gas & arc welding, Manufacturing of one job on arc welding. (2 turns)
3. Demonstration Study of sheet metal operations like bending, shearing, lancing, perforating, punching etc...
4. One sheet metal job consisting of at least 3 operations. (2 Turns)
(Either performed manually or on press) Demonstration:

OR

4. Study of various hand forging operations like upsetting, drawing dawn, piercing, swaging etc…One job involving 3 operations. (Either performed manually or on press) (2 Turns)

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 members may evaluate the term work.

• **Books:**

1. Workshop Technology (Volume II) by Raghuvanshi.
2. Workshop Technology (Volume II) by Hajra Chowdhary.
3. Workshop Technology (Volume II) by W.A.J.Chapman.
4. Production Technology by P.C. Sharma.
5. Production Technology – HMT Handbook. 6. Production Technology (Volume II) by Gupte-Patel.
6. P.L. Jain, Principles of Foundry Technology.
7. P.N. Rao, Manufacturing Technology: Foundry, Forming and Welding.
8. Workshop Technology (Volume II) by W.A.J. Chapman. 6. Production Technology – HMT Handbook.

• **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

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
S. Y. B. Tech. (Mechanical Engg.) Semester-IV

ME227 - ELECTRICAL TECHNOLOGY

Teaching Scheme
Practical: 2Hrs./week

Examination Scheme
ICA: 25 Marks
OE: 25 Marks

- **Course Introduction**

  This course focuses on the fundamental concepts and applications of electrical machines and concept of digital electronics in the field of Mechanical engineering. The course introduces basic working principles, construction details and characteristics of DC motors, AC motors, & its selection criteria for industrial applications. Due to wide applications of digital electronics the course also covers the basic knowledge of digital circuits, signal conditioning and microcontrollers.

- **Course Prerequisite**

  Student shall possess basic knowledge of electromagnetism, fundamentals of electricity and electric circuits including basic electronics

- **Course Objectives**

  1. To understand essential concepts and applications of electrical motors in mechanical Engineering.
  2. To understand embedded system terminologies.
  3. To understand the need for signal conditioning and interfacing
  4. To understand programming and interfacing microcontrollers.

- **Course Outcomes**

  On completion of this course the student will be able to

  1. Identify and select suitable DC motor / induction motor / special purpose motor and its speed control method for given industrial application.
  2. Program Arduino IDE using conditional statements
  3. Interfacing sensors with Arduino IDE

- **In Semester Continuous Assessment (ICA)**

  Minimum six experiments from each section will be conducted and assessment should be based on the same.

Section-1

1. Speed control of DC shunt motors by flux control and armature control.
2. Speed control of DC shunt motors by armature voltage controlmethod.
3. Study of starters used for DC shuntmotors.
4. Load test on DC Motor
5. Load test on three phase inductionmotor.
6. Load test on single phase induction motor.
7. Study of starters used for three phase inductionmotor.
8. Study characteristics and applications of different types of AC and DC motors.

Section-II

1. Build and test combinational logic & sequential logic circuits in simulator and on bread board.
2. Basic programming on 8085 trainer/simulator as an introduction to microprocessor and assembly programming.
3. Basic programming on 8051 trainer/simulator as a basic introduction to microcontroller.
4. Interface IR sensor, sound sensor, range sensor with Arduino Uno microcontroller board.
5. Interface and control stepper motor with Arduino Uno board.
6. Interface and control DC motor using PWM with Arduino Uno board.
7. Interface and control DC servo Motor using Arduino Uno board.
8. Build a small circuit which will demonstrate interfacing both sensors and actuators with the Arduino UNO board

- **Text books:**
  1) Electric Drives, Vedam Subramaniam 3rd Edition, McGraw Hill
  2) Make: Getting Started With Arduino, Massimo Banzi& Michael Shiloh, Shroff Maker Media.

- **Reference Books:**
  1) Electric Machinery, A Fitzgerald, Charles Kingsley, Stephan Umans, McGraw Hill
  2) Electric Machines and Drives: A First Course, Ned Mohan, Wiley India.
  3) Digital Logic & Computer Design, Morris Mano, Pearson India.
  4) 8051 and embedded systems, M Mazidi, Pearson India.
  5) Mechatronics, W Bolton, 4th Edition, Pearson India.