SOLAPUR UNIVERSITY, SOLAPUR

Faculty of Engineering & Technology

CBCS Curriculum for Second Year (Mechanical Engineering) WEF 2017-18

Semester I: Theory Courses

Course code	Name of Theory Course	Hrs./week				Credits	Examination Scheme			
		L	T	P	D		ISE	ESE	ICA	Total
ME211	Analysis of Mechanical Elements	3	-	-	-	3	30	70	-	100
ME212	Applied Thermodynamics	3	-	-	-	3	30	70	-	100
ME213	Engineering Mathematics -III	3	-	-	-	3	30	70	-	100
ME214	Manufacturing Processes	3	-	-	-	3	30	70	-	100
ME215	Machine Drawing	3	-	-	-	3	30	70	-	100
	Sub Total	**16**	**-**	**-**	-	**16**	**150**	**350**	**-**	**500**
MEV21	Environmental Sciences	1	-	-	-	-	-	-	-	-

Semester I: Laboratory / Tutorial Courses

Course code	Name of Laboratory / Tutorial Course	Hrs./week				Credits	Examination Scheme				
		L	T	P	D		ISE	POE	OE	ICA	Total
ME211	Analysis of Mechanical Elements	-	1	-	-	1	-	-	-	25	25
ME212	Applied Thermodynamics	-	-	2	-	1	-	-	25	25	50
ME213	Engineering Mathematics -III	-	1	-	-	1	-	-	-	25	25
ME214	Manufacturing Processes	-	-	2	-	1	-	-	-	25	25
ME215	Machine Drawing	-	-	-	4	2	-	-	25	50	75
ME216	Professional Elective-I	1	-	2	-	2	-	25	-	25	50
ME217	Workshop Practices -II	-	-	2	-	1	-	-	-	50	50
	Sub Total	-	-	-	-	8	-	25	50	225	300
	Grand Total	**16**	**02**	**08**	**04**	**24**	**150**	**425**		**225**	**800**

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

Professional Elective-I: Computer Programming in C ++, Dot Net, General Proficiency.

SOLAPUR UNIVERSITY, SOLAPUR

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Semester II: Theory Courses

Course code	*Name of Theory Course*	*Hrs./week*				*Credits*	*Examination Scheme*			
		L	T	P	D		ISE	ESE	ICA	Total
ME221	Theory of Machine-I	3	-	-	-	3	30	70	-	100
ME222	Machine Tools & Processes	3	-	-	-	3	30	70	-	100
ME223	Fluid Mechanics	3	-	-	-	3	30	70	-	100
ME224	Electrical and Electronic Technology	3	-	-	-	3	30	70	-	100
ME225	Professional Elective-II	3	-	-	-	3	30	70	-	100
	Sub Total	**16**	**-**	**-**	**-**	**16**	**150**	**350**	**-**	**500**
MEV22	Environmental Sciences	1	-	-		-	-	-	-	-

Semester II: 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	Theory of Machine-I	-	-	2	-	1	-	-	-	25	25
ME222	Machine Tools & Processes	-	-	2	-	1	-	-	-	25	25
ME223	Fluid Mechanics	-	-	2	-	1	-	-	25	25	50
ME224	Electrical Technology and Electronics	-	-	2	-	1	-	-	-	25	25
ME225	Professional Elective-II	-	-	2	-	1	-	-	-	25	25
ME226	Computer Aided Machine Drawing	1	-	2	-	2	-	50	-	50	100
ME 227	Workshop Practices -III	-	-	2	-	1	-	-	-	50	50
	Sub Total	**-**	**-**	**14**	**-**	**07**	**-**	**75**		**225**	**300**
	Grand Total	**16**	**-**	**14**	**-**	**23**	**150**	**425**		**225**	**800**

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

Professional Elective-II: Computational Techniques & Numerical Methods, Simulation Techniques

- **Note** :

1. Batch size for the practical /tutorial shall be of 20 students. On forming the batches, if the strength of remaining student exceeds 09, then a new batch shall be formed.
2. Industrial Training (evaluated at B.E. Sem.-I) of minimum 30 days shall be completed in any vacation after S.E. Sem.-II, may be Maximum in two slots but before B.E. Sem.-I & the report shall be submitted and evaluated in B.E. Sem.-I
3. Appropriate subjects under Elective I & II may be added as per the requirement.
4. Term work assessment shall be a continuous process based on student's performance in – class tests, assignments, homework, subject seminars, quizzes, laboratory books and their interaction and attendance for theory and laboratory sessions as applicable

Solapur University, Solapur

S.E. (Mechanical Engineering) Semester-I

ME212 APPLIED THERMODYNAMICS

Teaching Scheme		**Examination Scheme**
Theory – 3 Hrs. /Week		**ESE -70 Marks**
Laboratory– 2 Hrs. /Week	**ISE – 30 Marks**	
	ICA - 25 Marks	
		Oral Exam – 25 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 such as temperature, pressure, work & heat, internal energy, enthalpy and entropy to systems. The teaching of this course has followed the well-established topics required for industrial applications, which in brief, where some general properties & graphical representation of various thermodynamics systems.

- **Course Prerequisite:** Engineering Physics, Engineering Chemistry, Basic Mechanical Engineering.

- **Course Objectives:**

1. To study fundamental laws of Thermodynamics and its real life applications.
2. To study and analyze power producing devices used in practice such as boilers and turbines.
3. To study Power consuming devices used in practice such as compressor and their analysis.

- **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. Calculate the efficiency of mechanical devices like boiler, compressor, steam turbine, etc.
3. Apply knowledge of basic thermodynamic concepts such as temperature, pressure, work & heat, internal energy, enthalpy and entropy to systems.
4. Design and analyze power producing devices used in practice such as boilers and turbines.

SECTION I

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

- **Prerequisite:** Fundamentals of basic concepts of Physics and Chemistry behind thermodynamics.
- **Objectives:**
    1. To define laws of thermodynamics & describe their applications.
    2. To determine standard enthalpy change for formation & combustion reactions.
    3. To study thermal systems like heat engine, heat pump & refrigerator.
    4. To calculate entropy change for different thermodynamic processes.

- **Outcomes:** After completing this unit, students will be able to-
  1. Explain different laws of thermodynamics.
  2. Determine standard enthalpy change for formation & combustion reactions.
  3. Describe thermal systems like heat engine, heat pump & refrigerator.
  4. Calculate entropy change for different thermodynamic processes.
- **Unit content:** Review of basic concepts, Application of First law of Thermodynamics to chemically reacting system: Fuels & combustion, the standard enthalpy (heat) of reaction, the standard enthalpy of formation, standard enthalpy of combustion.
  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) Absorption of energy by a constant temperature bath ii) Heating OR cooling of matter.
  iii) Phase change iv) Adiabatic mixing v) Change of state of an ideal gas.
- **Content Delivering Methods:** Board, Chalk & talk and Power Point Presentation.
- **Assessment Methods:** Questions based on applications of laws of thermodynamics, explanations of standard enthalpy (heat) of reaction, standard enthalpy of formation, standard enthalpy of combustion, analysis of heat engine, heat pump & refrigerator, calculation of entropy change for different thermodynamic processes.

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

- **Prerequisite:** Fundamentals of laws of thermodynamics, basics of thermodynamic properties and basic chemistry.
- **Objectives:**
  1. To understand phase change process of pure substances.
  2. To describe properties of different types of steam.
  3. To study steam tables & Mollier diagram.
- **Outcomes:** After completing this unit, students will be able to-
  1. Understand phase change process of pure substances.
  2. Describe properties of steam.
  3. Apply Steam tables & Mollier diagram for thermodynamic problems.
- **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
- **Content Delivering Methods:** Board, Chalk & talk and Charts.
- **Assessment Methods:** Questions based on definition, explanation & thermodynamics plots

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

- **Prerequisite:** Fundamentals of laws of thermodynamics & basics of steam power plant.
- **Objectives:**
  1. To explain boiler, its classification and constructional details.
  2. To study performance parameters of boilers.
  3. To calculate efficiency of boiler & draw heat balance sheet.
- **Outcomes:** After completing this unit, students will be able to-
  1. Explain boiler & its classification.
  2. Describe performance parameters of boiler.
  3. To calculate efficiency of boiler & draw heat balance sheet for boiler.

- **Unit content:** Classification, salient features of high pressure boilers, Evaporation, equivalent evaporation, Boiler efficiency, heat losses in boiler plant & heat balance sheet (Numerical treatment).
- **Content Delivering Methods:** Board, Chalk & talk, Animated videos and Models.
- **Assessment Methods:** Questions based on definition, explanation, Problems on performance parameters of boiler, efficiency, heat losses in boiler plant & heat balance sheet.

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

- **Prerequisite:** Properties of pure substance and steam & basics of steam power plant.
- **Objectives:**
  1. To describe classification of thermodynamics cycles.
  2. To understand Carnot and Rankine Vapour Power Cycle.
  3. To analyze Rankine Cycle.
  4. To study effect of operating condition on Rankine Cycle.
- **Outcomes:** After completing this unit, students will be able to -
  1. Describe classification of thermodynamics cycles.
  2. Differentiate Carnot and Rankine cycle.
  3. To solve numerical on Rankine cycle.
  4. Discuss effect of operating condition on Rankine cycle.
- **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, Ideal reheat cycle, open feed water heater (direct contact heating) regenerative cycle.
- **Content Delivering Methods:** Board, Chalk and talk.
- **Assessment Methods:** Questions based on explanation, derivations, problems on Carnot and Rankine vapour power cycles.

SECTION II

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

- **Prerequisite:** Knowledge of basic properties of steam & compressibility of fluid.
- **Objectives:**
  1. To describe types of nozzles.
  2. To apply thermodynamic properties for flow through nozzle.
  3. To use Mollier diagram for problems on nozzles.
- **Outcomes:** After completing this unit, students will be able to-
  1. Describe types of nozzles.
  2. Derive discharge through nozzles.
  3. Solve problems by using Steam tables & Mollier diagram.
- **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.
- **Content Delivering Methods:** Board, Chalk & talk and Power Point Presentation.
- **Assessment Methods:** Questions based on definition, explanation, derivation. Problems on discharge through nozzles using Mollier diagram.

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

- **Prerequisite:** Knowledge about laws of thermodynamics & Steam power plant.
- **Objectives:**
  1. To describe elements of steam condensing plants.
  2. To study classification & construction of condensers and cooling towers.
  3. To study thermodynamic analysis of condenser.
- **Outcomes:** After completing this unit, students will be able to-
  1. Describe elements of steam condensing plants.
  2. Differentiate between surface and jet condensers
  3. Explain thermodynamic analysis of condenser.
- **Unit content:** Elements of steam condensing plants, advantages of using condensers, types of condensers, Thermodynamic analysis of condensers, efficiencies, cooling towers.
- **Content Delivering Methods:** Board, Chalk & talk, Animated videos and Power Point Presentation.
- **Assessment Methods:** Questions based on definition, classification and explanation.

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

- **Prerequisite:** Knowledge about laws of thermodynamics, Steam power plant & Steam nozzles.
- **Objectives:**
  1. To summarize classification and applications of steam turbines.
  2. To study principle & construction of steam turbines.
  3. To study losses in steam turbines.
  4. To calculate efficiency of steam turbine.
- **Outcomes:** After completing this unit, students will be able to-
  1. Differentiate between Impulse and reaction turbines and various applications of steam turbine.
  2. Describe construction of steam turbine.
  3. Explain losses in steam turbines.
  4. Calculate efficiency of steam turbine.
- **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, losses in turbines.
- **Content Delivering Methods:** Board, Chalk & talk, Animated videos and Power Point Presentation.
- **Assessment Methods:** Questions based on classification, explanation, derivation, problems on work done and efficiencies of impulse turbine.

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

- **Prerequisite:** Laws of thermodynamics & thermodynamic processes.
- **Objectives:**
  1. To describe classification and applications of air compressors.
  2. To understand construction & working of single stage & multistage air compressor.
  3. To calculate work input required for different compression processes.
  4. To determine efficiencies of a reciprocating air compressor.

- **Outcomes:** After completing this unit, students will be able to -
  1. Describe classification and applications of air compressors.
  2. Explain constructional details of single stage and multistage reciprocating compressor.
  3. Compute work input required for different compression processes.
  4. Calculate efficiencies of a reciprocating air compressor.
- **Unit content:** Uses of compressed air, classification of compressor, constructional detail of single & multistage compressor, types of compressor valves, computation of work, isothermal work done, isothermal efficiency, effect of clearance, volumetric efficiency FAD, theoretical & actual indicator diagram, method of improving volumetric efficiency, Need of multistage, work done, volumetric efficiency, condition for maximum efficiency, inter cooling.
- **Content Delivering Methods:** Board, Chalk & talk, animated videos, Power Point Presentation.
- **Assessment Methods:** Questions based on classification, explanation, derivation, problems on computation of work, various efficiencies, FAD, maximum efficiency.

- **In Semester Evaluation (ISE):**
  ISE shall be based upon student's performance in minimum two tests conducted and evaluated at institute level.
- **In Semester Continuous Assessment (ICA):**

ICA shall be based on below experiments and assignments

Group – I

Any Three Assignments on following topics

1. Study of process boilers (Cochran, Babcock & Wilcox, Lancashire)
2. Boiler mountings & accessories
3. Study of various types of steam calorimeter
4. Lubrication – Necessity, types of lubricants, properties ofLubricants (oil & Greases), Selection of lubricants

Group – II

Any Six Experiments of following:

1. Cloud & Pour point of a lubricant
2. Flash & Fire point
3. Test on carbon residue
4. Trial on Redwood viscometer
5. Trial / Study of Bomb calorimeter
6. Test on grease penetrometer
7. Trial on reciprocating air compressor.
8. Trial on steam calorimeter
9. Industrial visit to any process / power industry

- **Text Books:**
  1. An introduction to Thermodynamics – Y.V.C. Rao – Universities Presss.
  2. A Course in Thermal Engineering – Domukundwar Kothandraman Dhanpat Rai & Co. Delhi.
  3. Thermal Engineering R. K. Rajput – Laxmi Publication – New Delhi (Sixth Edition)
  4. Basic & Applied Thermodynamics by 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.

Solapur University, Solapur

S.E. (Mechanical Engineering) Semester-I

ME214 MANUFACTURING PROCESSES

Teaching Scheme	**Examination Scheme**
	ESE: 70 Marks (3 Hrs.)
Theory: 3 Hrs/week/Class	**ISE – 30 Marks**
Practical: 2 Hrs/week /batch	**ICA:** 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

- **Prerequisite:**

Various mechanical, thermal properties of material

- **Objectives:**
  1. To introduce to the students with basic foundry process.
  2. To introduce to the students with various steps like casting processes.
  3. To introduce to the students with advantages, limitations and uniqueness of the foundry process.
  4. To introduce to the students with techniques of filling the mold cavity and feeding the casting
- **Outcomes:** After completing the unit
  1. Students will be able to understand basic concepts in foundry process.
  2. Students will be able to understand importance of allowances to be provided on pattern materials and factors in selection of pattern.
  3. Students will be coversant with gating system and its parts with their functions will be able to understand functions and significance of Riser.

- **Unit Content:** Basic steps in casting processes, Importance and uniqueness of casting as a manufacturing process, Advantages and limitations of casting process, General introduction to patterns, Core boxes and Gating systems. Types of patterns, Cores, Core boxes, materials used, Allowances, selection criteria, Components of gating system, functions of each part, Function of riser, types of risers, method to improve efficiency of risers.
- **Content Delivering Methods:** Board, Chalk and Talk.

UNIT-2 Moulding and core making processes **No. of lectures-07**

- **Prerequisite:** Students should have understood basic steps in foundry process, what is mold, what is core.
- **Objectives:**
  1. To make students to understand basics of green sand, its ingredients, additives and its requisite properties.
  2. To introduce to the students oil sand core making, and other core making techniques and their comparison.
  3. To make the students aware of green sand molding techniques with its scope and limitations along with other molding techniques and their comparison.
  4. To introduce to the students with their advantages, limitations and applications.
- **Outcome :** After completing the unit
  1. Student will be able to understand the variation in properties of green sand with variation in ingredients and additives.
  2. Students will be able to able to understand significance and simplicity of green sand molding technique.
  3. Students will be able to able to select proper casting technique forecasting a particular component.
- **Unit Content:** Green Moulding sand, its ingredients and properties, facing sand, backing sand, shell sand,CO2 sand, Oil sand cores, and core making, CO2 core making, shell core making, cold box process of core making, Green sand moulding (hand and machine moulding), shell moulding, CO2 process, Introduction to special casting techniques, such as Investment casting, centrifugal casting, Continuous casting, gravity and pressure die casting processes.
- **Content Delivering Methods:** Board, Chalk and Talk.

UNIT-3 Melting and pouring **No. of lectures-04**

- **Prerequisite:** Understanding of melting process and basics of electric Engg.
- **Objectives:**
  1. To introduce the students with construction and working of various melting furnaces used in CI foundry with their charge materials and their thermal efficiency.
  2. To introduce to the students with working of Arc furnace and its application.
  3. To make the students aware regarding various metal pouring techniques.
- **Outcomes:** After completing the unit,
  1. Students will be able to understand and compare melting of CI induction Furnace and cupola and will be able to judge the advantages and limitations of various units and will be able to apply proper melting unit for manufacturing particular component/components.
  2. Students will be able to understand importance of Arc furnace is a melting unit in heavy steel foundries.
  3. Students will be able to select to select prospering method for a particular cast metal/ alloys.

- **Unit Content:** Melting furnaces used in C.I. Foundries, i.e. Cupola, Induction furnace construction and working in brief, Arc furnaces used in steel foundries, Crucible, oil and gas fired furnaces, Pouring equipments
- **Content Delivering Methods:** Board, Chalk and Talk.

UNIT-4 Fettling, Cleaning and Inspection of Castings **No. of lectures-03**

- **Perquisite:** Understanding of Unit I, II, III
- **Objectives:**
  1. To introduce to the students with need for fettling operation and equipment.
  2. To introduce to the students with various casting defects with their causes and remedies.
  3. To introduce to the students with concept of mechanization and computer application.
- **Outcome:** At the end of unit students will be able to
  1. Understand need for fettling and cleaning will be able to understand how to fettling work by taking proper core in molding process.
  2. Understand the basic defects and will be able to how these defects can be minimize by adapting proper process control at each stage of process.
  3. Understand effects of mechanization and application of computers.
- **Unit Content:** 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.
- **Content Delivering Methods:** Board, Chalk and Talk.

SECTION II

UNIT-5 Forming Processes: Rolling & forging **No. of lectures-06**

- **Perquisite:** Knowledge of Ductility, Malleability and Plastic deformation.
- **Objective:**
  1. To introduce to the students with various plastic deformation processes like forging, rolling.
  2. To introduce to the students with their advantages and limitations of various Plastic deformation process.
  3. To introduce to the students the various forging techniques and their application.
  4. To introduce to the students the various rolling techniques and their application.
- **Outcome:** On completion unit students will be able to
  1. Understand application and scope of various plastic deformation processes.
  2. Select proper plastic deformation process for a manufacture of particular component.
- **Unit Content:** Introduction to forming process, Classification of forming processes, Introduction to Rolling mills, Classification, hot rolling, rolling of billets, rods, sections, sheet, Tube rolling, cold rolling of sheets, Advantages of forging processes over other processes, Basic forging equipments, Open die forging, closed die forging, drop forging, cold heading etc.
- **Content Delivering Methods:** Board, Chalk and Talk.

UNIT–6 Extrusion, Wire, rod and tube drawing **No. of lectures-03**

- **Prerequisite:** Plastic deformation technique
- **Objectives:**
  1. To introduce to the students with extrusion of bar and tube and its significance in industry.
  2. To introduce to the students with various technique of bar, wire and tube drawing and its significance in industry.
- **Outcome:** At the end of unit, students will be able to
  1. Understand significance of extrusion and drawing process and shall be able to select proper process for manufacturing of tube/bar, wire.
- **Unit Content:** Types – direct extrusion, indirect extrusion, impact extrusion, hydrostatic extrusion, Wire drawing process, single pass and multi pass wire, drawing, wire drawing bench, Methods of rod and tube drawing
- **Content Delivering Methods:** Board, Chalk and Talk.

UNIT–7 Introduction to Joining processes **No. of lectures-08**

- **Prerequisite:** Introduction to joining methods
- **Objectives:**
  1. To introduce to the students with various joining methods.
  2. To introduce to the students with various equipments of gas welding, methods and its application.
  3. To introduce to the students with principle of are welding, methods of are welding, their scope and limitation.
  4. To introduce to the students with brazing and soldering techniques and their significance
- **Outcome:** At the end of unit student will be able to
  1. Select proper gas mix, for proper pressure, proper torch during gas welding, cutting.
  2. Select proper current and voltage, proper equipment dur are welding.
  3. Select proper welding process with proper weld joints for joining of components.
  4. Understand and compare between welding, soldering and brazing.
- **Unit Content:** Welding processes, such as gas welding, arc welding, submerged arc welding, TIG welding & MIG welding, resistance welding, Gas cutting, Plasma arc cutting etc, Brazing and soldering.
- **Content Delivering Methods:** Board, Chalk and Talk.

UNIT-8 Processes for Plastics **No. of lectures-03**

- **Prerequisite:** Introduction to Polymer
- **Objectives:** To introduce to the students with various processes for manufacturing of components with plastics (both thermoplastic and thermosetting plastics) brief introduction to the process is desired.
- **Outcome:** At the end of unit student will be able to understand
  1. Significance and scope of various plastic manufacturing processes.
  2. Will be able to select proper process for thermoplastic and thermosets.
  3. Importance of application of plastics in various fields
- **Unit Content:** Injection moulding, Extrusion, Blow moulding, Compression moulding.
- **Content Delivering Methods:** Board, Chalk and Talk.

- **Note: - For all processes introductory treatment only, in depth coverage not expected.**

- **Internal Continuous Assessment (ICA):**
  1. Exercise on pattern and core box design, & drawing, for a simple component (Drawing on sheet expected).
  2. Testing of silica sand for grain fineness and clay content.
  3. Testing of green sand for green compression strength, permeability, moisture content.
  4. Study of mould and core hardness tester.
  5. Study of manufacturing sequence of any one forged product.
  6. Study of manufacturing sequence of any one rolled product.
  7. Visit to Foundry unit.
  8. Visit to forging shop

(Journal based on above term work)

- **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

Solapur University, Solapur

S. E. (Mechanical Engg.) Semester-I

ME217 WORKSHOP PRACTICE – II

Teaching Scheme: **Examination Scheme:**

Practical: 2 Hours / week **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

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

Solapur University, Solapur

S. E. (Mechanical Engg.) Semester-II

ME222 MACHINE TOOLS & PROCESSES

Teaching Scheme	**Examination Scheme**
Theory – 3 Hrs. /Week	**Theory –70 Marks**
Laboratory– 2 Hrs. /Week	**ISE – 30 Marks**
	ICA – 25 Marks

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

- **Course Prerequisite**: 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 Objectives:**
  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 student will:
  1. Exhibit knowledge of conventional, unconventional & modern machining processes and machine tools.
  2. be able to select proper manufacturing process for the typical application

- **Course Curriculum**

SECTION I

Unit No 01: Lathe Machine **No. of lectures-08**

- **Prerequisite**: The lathe is a machine tool on which metal machining is done by combining the rotation of the job with a perpendicular feed of the tool it is primarily designed to produce cylindrical surfaces with a designed to produce cylindrical surfaces with a single point tool.
- **Objectives**:
  1. To study about construction and working principle of lathe machine.
  2. To study about various accessories and attachment of lathe machine.
  3. To study about various operations to be performed on lathe machine.
- **Outcomes**:
  1. To know and exhibit various parts of lathe machine.
  2. Students should be able to select proper speed, feed, and depth of cut as per operation.
  3. Student should know about how to process a simple component on lathe machine.

- **Unit content:** Introduction to Centre Lathe, parts and functions, specifications, accessories and attachments. Lathe operations, Taper turning methods, simple Numerical on Thread cutting, processing of simple component on lathe
- **Content Delivering Methods:** Board, Chalk and Talk.

Unit No 2: Drilling Machine **No. of lectures-03**

- **Prerequisite**: It is process of making hole or enlarging a hole in an object by forcing a rotation tool called as drill.
- **Objectives**:
  1. To study about construction and working of grilling machine.
  2. To study about tool and job holding devices on drilling machine.
- **Course Outcomes**:
  1. Be able to select speed, feed while drilling.
  2. Student should know about various operations to be performed on drilling machine.
- **Unit content:** Classification, construction and working of Pillar type and radial drilling machines, Job & Tool holding devices and accessories, various operations.
- **Content Delivering Methods:** Board, Chalk and Talk.

Unit No 3: Shaper, Plainer and slotting Machine **No. of lectures-04**

- **Prerequisite**: There are reciprocating types of machine tools inclined flat surface horizontal, vertical in clined flat surfaces as well as keyway.
- **Objectives**:
  1. To study about various parts of shaper planner and slotting machine
  2. To study about construction and working principle about all above machine.
- **Outcomes**:
  1. To know and exhibit knowledge about various job performed an above machine.
  2. Able to know about specification types and selection of above on machine for particular job.
- **Unit content:** Principle, types, specifications, operations on shaper, Types of planers, standard double housing plainer, construction, and operations. Introduction to construction and working of slotting machine
- **Content Delivering Methods:** Board, Chalk and Talk.

Unit No 04 Unconventional Machining **No. of lectures-05**

- **Prerequisite**: Machining of hard and complex surface with high accuracies and surface finish by using chemical mechanical thermal energy sources.
- **Objectives**:
  1. To study about working principle of unconventional machine
  2. To study about important and application unconventional machine.
- **Outcomes**:
  1. To know about machining of hard surface and how to achieve good surface finish.
  2. Able to know about selection of particular unconventional machine for given job.
- **Unit content:** 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.
- **Content Delivering Methods:** Board, Chalk and Talk.

SECTION II

Unit No 5: Milling Machines **No. of lectures-07**

- **Prerequisite**: it is a machine tool in which metal is removed by means of a revolving cutter with many teeth each tooth having a cutting edge which removes metal from a work piece.
- **Objectives**:
  1. To study about horizontal and vertical milling machine and their various parts.
  2. To study about various attachment used on milling machine for various operation.
- **Outcomes**:
  1. To know about how to manufactured gear and sprocket on milling machine.
  2. Able to select various type of cutter and its use.
- **Unit content:** 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, indexing methods, Numerical on Indexing Methods
- **Content Delivering Methods:** Board, Chalk and Talk.

Unit No 6: Grinding Machines **No. of lectures-06**

- **Prerequisite**: it is a machine tool in which metal is removed by means of a revolving cutter with many teeth each tooth having a cutting edge which removes metal from a work piece.
- **Objectives**:
  1. To study about horizontal and vertical milling machine and their various parts.
  2. To study about various attachment used on milling machine for various operation.
- **Outcomes**:
  1. To know about how to manufactured gear and sprocket on milling machine.
  2. Able to select various type of cutter and its use.
- **Unit content:** Classifications – Cylindrical, Center less, Surface grinder etc, Selection mounting, glazing, loading, truing, balancing, Surface finishing process, Honing, Lapping, super finishing.
- **Content Delivering Methods:** Board, Chalk and Talk.

Unit No 7: Boring Machine **No. of lectures-02**

- **Prerequisite**: it is a machine tool in which metal is removed by means of a revolving cutter with many teeth each tooth having a cutting edge which removes metal from a work piece.
- **Objectives**:
  1. To study about horizontal and vertical milling machine and their various parts.
  2. To study about various attachment used on milling machine for various operation.
- **Outcomes**:
  1. To know about how to manufactured gear and sprocket on milling machine.
  2. Able to select various types of cutter and its use.
- **Unit content:** Horizontal and vertical boring machines, construction and working, Boring tools and bars, Jig boring machines
- **Content Delivering Methods:** Board, Chalk and Talk.

Unit No 8: Gear manufacturing processes **No. of lectures-03**

- **Prerequisite**: it is a machine tool in which metal is removed by means of a revolving cutter with many teeth each tooth having a cutting edge which removes metal from a work piece.

- **Objectives**:
  1. To study about horizontal and vertical milling machine and their various parts.
  2. To study about various attachment used on milling machine for various operation.
- **Outcomes**:
  1. To know about how to manufactured gear and sprocket on milling machine.
  2. Able to select various types of cutter and its use.
- **Unit content:** Gear Hobbing, gear broaching, Gear finishing processes, gear shaving, gear burnishing
- **Content Delivering Methods:** Board, Chalk and Talk.

Unit No 9: Introductions to CNC & VMC Machine **No. of lectures-02**

- **Prerequisite**: it is a machine tool in which metal is removed by means of a revolving cutter with many teeth each tooth having a cutting edge which removes metal from a work piece.
- **Objectives**:
  1. To study about horizontal and vertical milling machine and their various parts.
  2. To study about various attachment used on milling machine for various operation.
- **Outcomes**:
  1. To know about how to manufactured gear and sprocket on milling machine.
  2. Able to select various types of cutter and its use.
- **Unit content:** Construction and working of CNC & VMC machine tools, Classification of CNC.
- **Content Delivering Methods:** Board, Chalk and Talk.

- **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. Setting the Hobbing machine for gear cutting operation.
  8. Study and demonstration of various types of grinding wheels and their specifications.
  9. Visit to at least one machine shop and one CNC shop.
  10. Study and demonstration of broaching operations

  Note: Any Eight of the above exercises are expected. Journal based on above exercises shall be prepared by the Students.
- **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.

Solapur University, Solapur

S. E. (Mechanical Engg.) Semester-I

ME227 WORKSHOP PRACTICE – III

Teaching Scheme: **Examination Scheme: Practical: 2**

Hours / week **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

1. Tool Grinding – Demonstration and actual grinding to understand the tool geometry (01 turns)
2. One composite job in M.S. consisting of one components and inclusive of following operation shall be performed by students: Turning, Step turning, , Chamfering, Grooving, , Knurling, . At least one dimension of the job shall carry close tolerance (04turns)
3. Preparation of process sheet for the above job (01 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 HajraChowdhary.
  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.

SOLAPURUNIVERSITY, SOLAPUR

FACULTY OF ENGINEERING & TECHNOLOGY

MECHANICAL ENGINEERING

Syllabus Structure for

T.E. (Mechanical Engineering)
w. e. f. Academic Year 2018-19

Choice Based Credit System

SOLAPUR UNIVERSITY, SOLAPUR

Faculty of Engineering & Technology

Structure of CBCS Curriculum for Third Year (Mechanical Engineering) w .e. f .2018-19

Semester I : Theory Courses

Course code	*Name of Theory Course*	Hrs./week				Credits	Examination Scheme			
		L	T	P	D		ISE	ESE	ICA	Total
ME311	Theory of Machine -II	3	-	-	-	3	30	70	-	100
ME312	Metrology and Mechanical Measurement	3	-	-	-	3	30	70	-	100
ME313	Metallurgy	3	-	-	-	3	30	70	-	100
ME314	Machine Design -I	3	-	-	-	3	30	70	-	100
ME315	Professional Elective -III	3	-	-	-	3	30	70	-	100
SLH31	Self Learning Course I -HSS	-	-	-	-	2	-	50		50
	Sub Total	**15**	**-**	**-**	-	**17**	**150**	**400**		**550**

Semester I: 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*		
ME311	Theory of Machine -II	-	-	2	-	1	-	-	25	25	50
ME312	Metrology and Mechanical Measurement	-	-	2	-	1	-	-	-	25	25
ME313	Metallurgy	-	-	2	-	1	-	-	25	25	50
ME314	Machine Design -I	-	-	2	-	1	-	-	-	25	25
ME315	Professional Elective -III	-	-	2	-	1	-	-	-	25	25
ME316	Advanced Computer Programming -I	1	-	2	-	2	-	-	-	50	50
ME317	Workshop Practices -IV	-	-	2	-	1	-	-	-	50	50
	Sub Total	-	-	14	-	8	-	-	50	225	275
	Grand Total	**16**	**-**	**14**	-	**25**	**150**	**450**		**225**	**825**

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 –III: Machine Tool Design, Material Handling System, Fluid Machinery & Fluid Power

SOLAPUR UNIVERSITY, SOLAPUR

Faculty of Engineering & Technology

Structure of CBCS Curriculum for Third Year (Mechanical Engineering) w. e. f 2018-19

Semester II : Theory Courses

Course code	*Name of Theory Course*	Hrs./week				Credits	Examination Scheme			
		L	T	P	D		ISE	ESE	ICA	Total
ME321	Heat and Mass Transfer	3	-	-	-	3	30	70	-	100
ME322	Internal Combustion Engine	3	-	-	-	3	30	70	-	100
ME323	CAD-CAM & CAE	3	-	-	-	3	30	70	-	100
ME324	Machine Design -II	3	-	-	-	3	30	70	-	100
ME325	Professional Elective -IV	3	-	-	-	3	30	70	-	100
ME326	Self Learning Course II-Technical	-	-	-	-	2	-	50	-	50
	Sub Total	**15**	**-**	**-**	**-**	**17**	**150**	**400**	**-**	**550**

Semester II: 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*		
ME321	Heat and Mass Transfer	-	-	2	-	1	-	25	-	25	50
ME322	Internal Combustion Engine	-	-	2	-	1	-	-	-	25	25
ME323	CAD-CAM & CAE	-	-	2	-	1	-	-	-	25	25
ME324	Machine Design -II	-	-	2	-	1	-	-	25	25	50
ME325	Professional Elective - IV	-	-	2	-	1	-	-	-	25	25
ME327	Advanced Computing Techniques'-II	1	-	2	-	2	-	-	-	50	50
ME328	Workshop Practice –V	-	-	2	-	1	-	25#	-	25	50
	Sub Total	-	**-**	14	-	08	-	75		200	275
	Grand Total	**16**	-	**14**	-	**25**	**150**	**475**		**200**	**825**

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 – IV: Experimental Stress Analysis, Mechanical Vibration, Tool engineering # Indicates practical Examination only.

- **Note –**

1. Batch size for the practical /tutorial shall be of 15 students. On forming the batches, if the strength of remaining students exceeds 07, then a new batch shall be formed.
2. Industrial Training (evaluated at B.E. Sem.-I) of minimum 15 days shall be completed in any vacation after S.E. Sem.-II, may be Maximum in two slots but before B.E. Sem.-I & the report shall be submitted and evaluated in B.E. Sem.-I.
3. Students shall select one Self Learning Module at T.E. Sem. I and T.E. Sem. II each from Humanities and Social Sciences and Technical Groups Respectively.
4. Curriculum for Humanities and Social Sciences Self Learning Modules is common for all under graduate programmes of faculty of Engineering and Technology.
5. Minimum four assignments for Self Learning Modules at T.E. Sem.-I be submitted by the students which shall be evaluated by a Module Coordinator assigned by institute / department.
6. **for TE Part I -**

A. Student can select a Self Learning Course from Solapur University, Solapur HSS Course List and appear for its examination as and when conducted by Solapur University, Solapur

OR

B. Student can enroll for National Programme on Technology Enhanced Learning (NPTEL) course, complete its assignments and appear for certificate examination as and when conducted by NPTEL.

For more details about Self Learning Course (HSS) please refer to separate rule document available from Solapur University, Solapur

More details about NPTEL are available at http://nptel.ac.in

7. ICA assessment shall be a continuous process based on student's performance in class tests, assignments, homework, subject Seminars, quizzes, laboratory books and their interaction and attendance for theory and laboratory sessions as applicable

Solapur University, Solapur

T.E. (Mechanical Engineering) Semester-I

ME312 Metrology and Mechanical Measurement

Teaching Scheme	Examination Scheme
Lectures– 3 Hours/week, 3 Credits	ESE– 70 Marks
Practical – 2 Hour/week, 1 Credit	ISE –30 Marks
	ICA- 25 Marks

Course Introduction:

This course seeks to provide an introduction to measurements and to concepts and terms related to it. The subject covers working of generalized measuring systems and elements in it. The course provides information about the principle and working of various measuring instruments used for the measurement of dimensions and geometrical properties. The course covers the design and working of the measuring instruments which are used for measurements of other physical properties such as temperature, pressure etc. and quantities such as force, strain, speed etc. The course also covers the study of various standards, limit gauges as well as comparators.

Course Prerequisite:

Student shall have knowledge of function of machine elements such as gears, levers etc. and of simple mechanisms. A sound background of fundamental laws and principles related to different properties such as pressure, temperature etc. and quantities such as force, stress, strain etc. is essential.

Course Objectives: During this course, student is expected

1. To study the principles, construction and working of various measuring instruments used for measurement of various mechanical properties such as geometrical, dimensional, pressure, temperature etc and of parameters such as force, strain etc.
2. To study the concepts related to interchangeability, limits, fits, guidelines by BIS and design of limit gauges.
3. To learn the use of various measuring instruments with different setups for accurate measurements.
4. To get acquainted with various standards of measurements & the calibration process of instruments.

Course Outcomes: At the end of this course,

1. Students will understand the design & construction of measuring instruments.
2. Students will setup the Instruments & accessories for measurement of properties by avoiding errors.
3. Students will calibrate the simple instruments using more accurate standards.
4. Students will use the instruments for various industrial applications such as quality control, process control etc

Section I

Unit 1. Introduction: Principles and Standards of measurement No of lectures – 05

- **Prerequisite:** Knowledge of basic principles from the subjects of Physics, Theory of Machines and machine drawing.
- **Objectives:**
    1. To get acquainted with various standards of measurements.
    2. To Study the principles of simple length measuring instruments.
- **Outcomes:** After completing this unit, student will
    1. Use the length measuring instruments.
    2. Calibrate the simple instruments using more accurate standards.
- **Unit Content:**

Concept and need of measurement. Precision and accuracy. Classification of standards, International standards of length. Line, End & Wave length standards, Slip gauges, Slip-gauge sets (M-45, M-87). Selection of slip gauges including numerical problems. Measuring principles of Vernier caliper & micrometer.

- **Content Delivery Methods:** Board, Chalk and talk

Unit 2. Systems of Limits and Fits and Limit Gauging: No of lectures – 05

Prerequisite: Knowledge of manufacturing processes, machine drawing.

- **Objectives:**
    1. To study the concepts related to interchangeability, limits, fits, guidelines by BIS and design of limit gauges.
- **Outcomes:** After completing this unit, student will
    1. Use IS 919 for identifying the tolerances and limit deviations as well as for selection of fits.
    2. Design limit gauges for simple hole and shaft components.
- **Unit Content:**

Terminology, Interchangeability, Types of tolerances, Types of fits, Grades of tolerances and types of fundamental deviations. Hole and shaft basis systems. Use of BIS charts (IS 919) specifying fundamental deviations and tolerances. Taylor's Principles of gauge design, types of gauges, Design of limit gauges, gauge tolerance & wear allowance, (numerical problems).

- **Content Delivery Methods:** Board, Chalk and talk

Unit 3. Comparators & angular measurements: No of lectures – 05

- **Prerequisite:** Knowledge of function of basic machine elements and mechanisms, Basic principles from Geometry and Physics.
- **Objectives:**
    1. To Study the principles, construction and use of comparators and angle measuring instruments.
- **Outcomes:** After completing this unit, student will
    1. Describe the design & construction of comparators and angle measuring instruments.

2. Setup the Instruments & accessories for measurement of properties by avoiding errors.

- **Unit Content:**

Introduction to comparators, Characteristics, Classification of comparators. Mechanical comparators – Johanson Mikrokator, Sigma comparator, dial indicators. Pneumatic comparators, Principle of optical comparators. Angular Measurements - Spirit level, Clinometers, Bevel Protractor, Principle & use of Sine Bars, Sine Centre, Use of angle gauges (Numerical on Building of angles) Autocollimator.

- **Content Delivery Methods:** Board, Chalk and talk

Unit 4. Screw-Threads, Gear Metrology & Recent trends in measurement: No of lectures – 05

- **Prerequisite:** Knowledge of machine elements such as screw threads and gears and of principles from Theory of Machines, Geometry.
- **Objectives:**
  1. To Study the principles, construction and use of Instruments used for measurement of Screw thread diameters and gear tooth thickness.
  2. To get acquainted to latest trends in the mechanical measurements.
- **Outcomes:** After completing this unit, student will
  1. Describe the design &construction measuring instruments used for screw thread and gear tooth measurement.
  2. Setup the above instruments & accessories for measurement of properties by avoiding errors.
- **Unit Content:**

Basic elements of screw-thread, Methods of measurement of effective diameter, floating carriage Micrometer. Basic elements of spur-gear, Methods of measurement of gear tooth thickness. Introduction to modern measurement techniques- Co-ordinate Measuring Machine, laser Measurement, Multi Gauging Systems.

- **Content Delivery Methods:** Board, Chalk and talk

Section - II

Unit 5. Introduction to Mechanical Measurements: No of lectures – 05

- **Prerequisite:** Knowledge of basic principles in Physics, Analysis of mechanical elements and basic electrical engineering.
- **Objectives:**
  1. To learn the working of generalized measurement system and of the functional elements in it.
  2. To know the static and dynamic terms and characteristics of general measuring instruments.
- **Outcomes:** After completing this unit, student will
  1. Describe the working of the general measuring system and role of functional units.
  2. Explain the effect of different characteristics on the performance of the instrument.

• **Unit Content:**

Need of Mechanical Measurement, Instruments, Measurement methods, generalized measurement system & its functional elements. Instrument characteristics - Static & Dynamic characteristics and terms, calibration. Classification of transducers.

• **Content Delivery Methods:** Board, Chalk and talk

Unit 6. Measurement of Temperature and Pressure: No of lectures – 05

• **Prerequisite:** Knowledge of basic principles of thermodynamics, fluid mechanics, machine elements and theory of machines.

• **Objectives:**

1. To acquire the knowledge of principle, construction and use of various instruments used for measurement of temperature and pressure.

• **Outcomes:** After completing this unit, student will

1. Explain the working of various temperature and pressure measuring instruments.
2. Setup the instruments and accessories thereof for accurate measurement.

• **Unit Content:**

Importance of temperature measurement, Thermometer, Thermocouple - Principle, Types. Resistance Thermometers - RTD, Thermistor. Importance of pressure & vacuum measurement, Range of high pressure & vacuum Bourdon tubes, Deadweight pressure-gauge tester, Diaphragm gauge, Piezo-electrical pressure gauge, Vacuum gauges - McLeod gauge, Pirani gauge.

• **Content Delivery Methods:** Board, Chalk and talk

Unit 7. Measurement of angular speed & flow: No of lectures – 05

• **Prerequisite:** Knowledge of basic principles of fluid mechanics, machine elements, theory of machines and basic electrical engineering.

• **Objectives:**

1. To acquire knowledge of principle, construction and use of various instruments used for measurement of angular speed and flow rate.

• **Outcomes:** After completing this unit, student will

1. Explain the working of various speed and flow rate measuring instruments.
2. Setup the instruments and accessories thereof for accurate measurement.

• **Unit Content:**

Importance of angular speed measurement, Mechanical tachometers, Electrical tachometers-Drag cup, Inductive, Photoelectric pickup, Stroboscope. Importance of Flow measurement, Turbine meter, Rota meter, Gas flow meter, Hot wire anemometer.

• **Content Delivery Methods:** Board, Chalk and talk

Unit 8. Measurement of Force, Torque & Strain: No of lectures – 05

• **Prerequisite:** Knowledge of machine elements, mechanics, basic electrical engineering, fluid mechanics.

- **Objectives:**
    1. To acquire knowledge of principle, construction and use of various instruments used for measurement of force, torque and strain.
- **Outcomes:** After completing this unit, student will
    1. Explain the working of various force, torque and strain measuring instruments.
    2. Setup the instruments and accessories thereof for accurate measurement.
- **Unit Content:**

Force measurement- Balance, Proving Ring, Hydraulic, Pneumatic Load Cells, Torque measurement - Hydraulic, Eddy Current. Classification of strain gauges, Principle of electrical strain gauge, Gauge factor, Introduction to half bridge and full bridge network circuits.

- **Content Delivery Methods:** Board, Chalk and talk
- **TERMWORK**

A) Metrology Laboratory:

Any five of the following experiments (Experiment No. 1 is compulsory).

1. Uses of various length measuring instruments .Vernier instruments, Micrometer instruments, Dial instruments and Auxiliary instruments for carrying out measurements.
2. Calibration of Vernier caliper / Micrometer using slip gauges.
3. Use of at least one type of each class of comparator such as mechanical, optical, pneumatic, etc.
4. Measurement of angle using Bevel protractor and sine bar / sine centre. Use of Clinometer and Angle gauges.
5. Measurement of Gear tooth thickness using gear tooth vernier caliper/ plate type micrometer
6. Measurement of diameters of screw threads using screw thread micrometer and floating carriage micrometer.
7. Demonstration of advanced measuring equipment such as Co-ordinate Measuring Machine Multigauging Machines, Automatic inspection systems. (May be done through Industrial Visits / Virtual Laboratories).

B) Mechanical Measurements Laboratory

Any five out of the following experiments:

1. Temperature Measurement using thermo couples, RTD, Thermistor.
2. Testing of mechanical pressure gauge using Dead Weight pressure tester.
3. Vacuum measurement using U tube manometer & Mechanical Vacuum Gauge.
4. Angular speed measurement using mechanical tachometer, stroboscope, photo electric pickup, inductive pickup.
5. Flow measurement using Rotameter.
6. Measurement of bending strain or load using strain gauges.
7. Use of proving ring, load cells.
8. Measurement of torque.

* Industrial Visit (Recommended for introduction to modern measuring instruments / Calibration Lab)

Solapur University, Solapur
T.E. (Mechanical Engineering) Semester-I
Professional Elective-III Course -III
ME315 Fluid Machinery & Fluid Power

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

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

- **Course Introduction:**

This course seeks to provide an introduction to Fluid Machinery like water turbine, gas turbine, centrifugal pump and Fluid Power like hydraulic, pneumatic etc and discusses various procedures, requirements, design methods. A turbine design procedure against various head is also covered in content of the course. A further content explains in detail the various efficiency improving methods of open cycle gas turbine. It introduces various hydraulic and pneumatic elements for building various circuits according to the application. The features and varieties of hydraulic and pneumatic accessories is also covered in the course.

- **Course Prerequisite:**

Students shall have introductory knowledge of Water Turbines, Pumps, Gas Turbines and Various thermodynamic processes, laws of motion, material science etc is essential for successful completion of this course. A sound knowledge of vector algebra, fluid mechanics is essential for the study of this subject.

- **Course objectives:**
  1. To study different types of Water turbines, Gas turbines and Pumps, in details.
  2. To construct velocity triangles for turbines and pumps.
  3. To learn the fundamentals and applications of fluid power technology, besides construction & working of different components.
  4. To design various types of hydraulic & pneumatic circuits & their applications.
- **Course outcomes:** At the end of this course, the student will be able to
  1. Classify turbines and pumps. Select/design water turbines, gas turbines & centrifugal pumps to meet the specific requirements.
  2. Draw velocity triangles for turbines and pumps.
  3. Analyze different components of hydraulic and pneumatic systems.
  4. Construct different hydraulic & pneumatic circuits needed for different applications.

Section –I

Unit 1: Impulse Water Turbines **No of lectures – 05**

- **Prerequisite:** Introductory knowledge of roto dynamic machines, material science, fluid mechanics and vector calculations is essential.
- **Objectives:**
  1. Explain working principle of impulse turbines.
  2. To introduce conceptual Euler's Equation of rotod ynamic machines.
  3. To study the performance of a Pelton Wheel turbine
  4. To determine the characteristic curves of a Pelton turbine operating at a different fluid flow rates with high head.
- **Outcomes:**
  1. Student can calculate work done and various efficiencies of impulse turbines.
  2. Student will be able to understand different characteristics curves of impulse turbine due to the head available.
  3. Student will be able to calculate the performance of turbine based on Euler's equation for roto dynamic machines.
- **Unit Content:** Euler's equation for roto dynamic 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, Performance characteristics of Pelton turbine. (Numerical Treatment)

i. **Content Delivery Methods:** Board, Chalk and talk, Animation Video

Unit 2: Reaction Water Turbines: **No of lectures – 05**

ii. **Prerequisite:** Introductory knowledge of roto dynamic machines, material science, fluid mechanics and vector calculations is essential.

iii. Objectives:

1. To introduce working principle of Francis & Kaplan Turbines.
2. To introduce Governing of Reaction Turbine
3. To introduce unit quantities & model testing
4. To introduce the concept of draft tube.

iv. Outcomes:

1. Understand the concept of unit quantities & model testing
2. Calculate the Work done & efficiency of reaction turbine
3. Understand the concept of Governing of reaction turbine

v. Unit Content:

Construction and Working of Francis, Kaplan turbine. Work done and efficiencies of Francis & Kaplan turbine, Working Proportions of Francis & Kaplan turbine, Specific speed of turbine (Pelton, Francis & Kaplan turbine), Model testing, unit quantities, Prediction of performance at other operating conditions, Draft tube (Theoretical treatment only), Types and function, governing of reaction turbines, Performance characteristics of Francis & Kaplan turbine. (Numerical Treatment).

vi. **Content Delivery Methods:** Board, Chalk and talk, Animation Video

Unit 3: Centrifugal Pumps **No of lectures – 05**

- **Prerequisite:** Knowledge of Centrifugal force, fluid mechanics, vector calculations, material science, etc. is essential.

vii. Objectives:

1. To make students to understand basics of working principle of centrifugal pump
2. To introduce constructional details of centrifugal pump
3. To make the students aware of Maximum Suction Height & Net Positive Suction Head
4. To introduce specific speed of pumps, Performance characteristics of pump

viii. Outcomes:

1. Understand working of centrifugal and multistage pumps.
2. Understand the concept of cavitations in pumps.
3. Calculate manometric head, work done and various efficiencies related to the Pump

ix. **Unit Content:** Working principle, construction, types, various Heads, multistage pumps, Velocity triangles, Minimum starting speed, Cavitations, 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.
(Numerical Treatment)

x. Content Delivery Methods: Board, Chalk and talk

Unit 4: Gas Turbines **No of lectures – 05**

xi. **Prerequisite:** Knowledge of various thermodynamic processes, concept of thermal efficiency is essential.

xii. **Objectives:**

i. To introduce classification of gas turbine.
ii. To introduce various methods for improvements of thermal efficiency of open cycle gas turbine.
iii. To introduce the various gas turbine fuels.

- **Outcomes:**

i. Understand the classification of gas turbines.
ii. Understand the various methods for improvement of thermal efficiency of open cycle gas turbine.
iii. Student understands fuels used for gas turbine.

- **Unit Content:**

General aspects, Classification of gas turbines, merits of gas turbines, constant Pressure combustion gas turbines-open cycle gas turbine, methods for improvement of thermal efficiency of open cycle gas turbine plant-inter cooling, reheating, regeneration, effect of operating variables on thermal efficiency, closed cycle gas turbine, uses of gas turbine, gas turbine fuels.
(Numerical Treatment on basic Joule Cycle)

- **Content Delivery Methods:** Board, Chalk and talk

Section – II

Unit 5: Introduction to Fluid Power and Hydraulic System elements No of lectures – 05

- **Prerequisite:** Knowledge of Pumps and its types, material science, machine drawing, etc is necessary.

xiii. **Objectives:**

1. To Identify the various components used in Hydraulic System.
2. To Introduce the construction and working principle of various components used in Hydraulic System.
3. To Introduce the various symbols used in hydraulic and pneumatic system.
4. To calculate the force and velocity of piston.

- **Outcomes:**

1. Understand working principle of various components used in hydraulic system.
2. Understand the Accessories of hydraulic system.
3. Understand the various symbols and its meaning used in hydraulic and pneumatic system.
4. Calculate force and velocity of piston.

- **Unit Content:**

Types, advantages, applications of fluid power, Pumps- Types, working, Characteristics, Applications. Seals & Packing- Types, materials, Applications. Hydraulic Actuators- Linear &Rotary, Types, Working, Cushioning effects, Calculation of force & velocity of piston. System components: Accumulators, Intensifiers, their types, working, applications. Symbols used in hydraulic and pneumatic circuits.

- **Content Delivery Methods:** Board, Chalk and talk

Unit 6: Pneumatic System Elements: No of lectures – 05

- **Prerequisite:** Knowledge of air compressor, fluid mechanics, force calculations, etc is necessary.
- **Objectives:**
  i. To introduce the construction and working principle of various components used in Pneumatic System.
  ii. To Introduce the various Accessories used in Pneumatic system.
- **Outcomes:**
  i. Understand working principle of various components used in Pneumatic system.
  ii. Understand the Accessories of pneumatic system
  iii. Student Get the importance of the Piping layout while building the circuit diagram.
- **Unit Content:**

Piping, materials and pressure ratings, piping layout, air compressors, types,working, selection criteria, FRL unit- construction and working, pneumatic cylinders and air motors, construction and working, types.

- **Content Delivery Methods:** Board, Chalk and talk

Unit7: Hydraulic and Pneumatic Control Elements **No of lectures – 05**

- **Prerequisite:** Knowledge of engineering drawing, properties of fluid used in Hydraulic & Pneumatic System.
- **Objectives:**
  i. To introduce the construction and working of various direction control valve used in hydraulic and pneumatic system.
  ii. To introduce the construction and working of various flow control valves and pressure control valves used in hydraulic and pneumatic system.
  iii. The selection of proper control valves for building the various circuit diagram.
- **Outcomes:**
  i. Understand working principle of various direction control valves used in hydraulic and pneumatic system.
  ii. Understand working principle of various flow control valves, pressure control valves used in hydraulic and Pneumatic system.
  iii. To differentiate the various control valves used in hydraulic and pneumatic system.
  iv. To choose proper control valves according to the applications/ circuits.
- **Unit Content:**

  Hydraulic - Pressure control valves- Direct acting type, pilot operated, sequence, Counter balancing, unloading, pressure reducing, Construction & Working. Direction control valves- Types, Construction & working, Spool actuation methods, spool centre positions, Flow control valves-Compensated& Non-Compensated, Construction & Working. Pneumatic-Direction control valves, Flow control valves and pressure control valves–types and working.
- **Content Delivery Methods:** Board, Chalk and talk

Unit 8: Hydraulic and Pneumatic Circuits & their applications: **No of lectures – 05**

- **Prerequisite:** Knowledge of various hydraulic and pneumatic systems, theory of machines is essential.
- **Objectives:**
  1. To introduce Speed control circuits
  2. To introduce Regenerative circuits
  3. To introduce Sequencing circuits
  4. To introduce Counter balancing, Synchronizing, circuits
- **Outcomes:**
  1. Understand the operation of hydraulic circuits and components typically used in industry
  2. Correctly maintain power units (fixed / variable pumps, reservoirs, filters, strainers and gauges)
  3. Use hydraulic test equipment to determine the nature and position of faults
  4. Construct a range of functional hydraulic circuits
- **Unit Content:**

  Speed control circuits, Regenerative, Sequencing, Counter balancing, synchronizing, Traverse & Feed circuit, Hydraulic and pneumatic clamping & braking systems, Pneumatic power tools, time delay circuits

- **Content Delivery Methods:** Board, Chalk and talk

Term-Work

Compulsory:

1. A drawing sheet on standard symbols of hydraulic & pneumatic components.

List of Experiments

A) Fluid Machinery-

Minimum 3 experiments from the following

1. Trial on a Pelton wheel.
2. Trial on a Francis/ Kaplan turbine.
3. Trial on a centrifugal pump.
4. Trial on gear pump

B) Fluid Power

Minimum 3 assignments from the following

5. Study of Pressure Control Valves & circuits using pressure control valves
6. Study of flow control valves & circuits using flow control valves
7. Study of direction control valves & check valves circuits.
8. Study of hydraulic power unit &accessories.
9. Demonstration of Minimum of Three hydraulic circuits such as :Basic hydraulic, Regenerative, Speed control (Meter in, meter out & bleed off), Sequencing, Synchronization, traverse & feed, Circuit for riveting machine, automatic reciprocating, fail safe circuit, counter balance circuit, actuator locking, circuit for hydraulic press, unloading circuit, motor breaking circuit.
11. Demonstration on Pneumatic Trainer of Minimum of Three Pneumatic circuits (based on syllabus of UNIT 10above).

***C)* Industrial visit to one of the following**

- Hydro-electric power station
- Pumping station
- Service station of Earth Moving equipment's.

Note: Students should write visit report based on the observations made during the visit.

- **Text Books**

1. "A text book of Fluid Mechanics & Hydraulic Machines", Dr.R.K. Bansal, Laxmi Publications Ltd.
2. Thermal Engineering R. K. Rajput
3. "Oil Hydraulics- Principle & Maintenance", Majumadar, Tata McGrawHill
4. "Pneumatics- Principle & Maintenance", Majumadar, Tata McGrawHill

- **Reference Books**

1. Theory of Hydraulic Machinery", V.P. Vasandani, Khanna Publishers, Delhi.
2. "Hydraulic Machines", Dr. J. Lal, Metropolitan Book Co. Pvt. Ltd., Delhi.
3. Vickers Manual on Industrial Hydraulics
4. Festo's Manual on Pneumatic Principle, applications
5. "ABC's of Hydraulic Circuits", H L Stewart, (Taraporwala Press)
6. "ABC's of Pneumatic Circuits", H L Stewart, (Taraporwala Press)
7. Hydraulics and Pneumatics'H.L.Stewart –, Industrial Press

Solapur University, Solapur
T.E. (Mechanical Engineering) Semester-I
ME317Workshop Practice – IV (T.E. Part - I)

Teaching Scheme
Practical: 2 hours a week

Examination Scheme
ICA: 50 Marks

- **Course Objective:**

i. To make the students aware with various skills involved in manufacturing &Assembly.
ii. To develop skills to operate different machine tools.
iii. To make the students aware of limits, fits & tolerance while manufacturing assembly.
iv. To make students aware of operation sequence, speed feed selection for different materials & operations

- **Course Outcomes:**

i. To create confidence amongst the students in Production / manufacturing activities.
ii. Students should get experience about manual skills required to perform machining operations.
iii. To create confidence in students while designing limits, fits & tolerances during manufacturing.
iv. To create awareness in students regarding time management, work study, method study & tool engineering.

1. A composite job consisting of three components machined from Φ32 mm MS bar.

(Excluding commercial components) requiring minimum five operations listed below:

1. Turning
2. Drilling
3. Boring
4. Hand tapping
5. Milling
6. Internal & External V-threading
7. Grinding

2. The components of the composite job shall carry at least two specified close tolerance operations.In addition to the above, following operations are to be demonstrated during the term. (These are not to be included in the job operations for term work & exams.)

1. Shaping
2. Slotting
3. Grinding
4. Form Turning
5. Knurling
6. Grooving

4. Journal should contain detailed process sheet of above job.

5. Assessment of Workshop Practice-IV-Term work shall be done for 50 % Work or one major Component & Workshop Practice-V-Term work shall be done for remaining work at the end of T.E. (Mech.) Part II.

6. Practical examination of 6 Hrs. duration having component of 2 to 3 parts.

Note: Material specification for practical work & examination is raw material **Φ32mm MS bar.**

Books:

1. Workshop Technology (Volume II) by Raghuvanshi.

2. Workshop Technology (Volume II) by HajraChowdhary.

3. Workshop Technology (Volume II) by W.A.J.Chapman.

Reference Books:

1. Production Technology by P.C.Sharma.

2. Production Technology – HMT Handbook.

3. Production Technology (Volume II) by Gupte-Patel.

4. HGerling, All about Machine Tools, New Age International, 1995.

Solapur University, Solapur
T.E. (Mechanical Engineering) Semester-II
ME322 Internal Combustion Engine

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

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

Course Introduction:

This course provides an introduction to Internal Combustion Engine. It introduces four stroke and two stroke engine working, also highlights the difference between these two. It briefs introduction about fuel system for SI and CI engine. It focuses on normal and abnormal combustion in SI and CI engine. This course also includes performance parameter and its testing. In this subject student will learn the various engine systems like cooling, lubrication, starting systems etc. It touches to some of the recent advance in the Engine field like Electronic Engine management system, Carbon Credit system, Hybrid vehicles, Alternative fuels etc.

Course Prerequisite:

Student should have knowledge of Basic thermal Principal, Thermodynamics, and Heat Transfer. They should know basic processes and cycles. A sound background of analysis of thermal systems is essential for successful completion of this course.

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 carburetor 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.
7. Compare experimental results with theoretical predictions and make proper justifications.

Section I

Unit 1 - Introduction to I. C. Engine **No of lectures – 05**

- **Prerequisite:** Knowledge of Basic Thermal concepts like Temperature, Pressure, Process, Cycle etc.
- **Objectives:**
  1. To Introduce I. C Engine, its cycle.
  2. To study theoretical and actual cycle of Engine.
  3. To know valve timing and port timing diagram
- **Outcomes:** After completing this unit, student will be able to
  1. Explain working of I C Engine.
  2. Differentiate between 4 stroke and 2 stroke Engine.
  3. Differentiate between Actual and theoretical cycle
- **Unit Content:**
  Introduction, Classification of I.C. Engines, Engine Cycles-Otto and Diesel Cycle, Deviation of actual cycles from air standard cycles, Valve timing diagram for high and low speed engines, Port timing diagram for two strokes S.I. Engines.
- **Content Delivery Methods:** Board, Chalk and talk, PPT.

Unit 2–Fuel System for S. I. Engines **No of lectures – 06**

- **Prerequisite:** Basic Knowledge of engine fuels, its properties like Ignition Point, Boiling Point, Volatility, etc.
- **Objectives:**
  1. To introduce procedure of mixing air and Fuel.
  2. To know mixture requirement at different load condition
  3. To impart knowledge of design of Carburetor.
- **Outcomes:** After completing this unit, student will be able to
  1. Understand need of mixture preparation.
  2. Explain working of Carburetor.
  3. Determine dimensions of Carburetor.
- **Unit Content:**
  Engine fuel requirements, Mixture requirements, Simple carburetor, and Additional systems in modern carburetor, 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).
- **Content Delivery Methods:** Board, Chalk and talk**,** PPT.

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

- **Prerequisite:** Diesel fuel properties, working of some basic components like pump, strainer, hoses, nozzles etc.

- **Objectives:**
  1. To understand working of Fuel System for C. I. Engines.
  2. To know process of spray formation, injection.
- **Outcomes:** After completing of this unit, student will be able to-
  1. Explain the fuel injection system.
  2. Calculate the dimensions of fuel injector nozzle.
- **Unit Content:**

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, multi hole, pintle and pintaux, Governing of C.I. Engines, (Numerical on calculations of main dimensions of fuel injection system).

- **Content Delivery Methods:** Board, Chalk and talk, PPT.

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

- **Prerequisite:** Working of some basic compressor and its types, basic engine cycle.
- **Objectives:**
  1. To understand working of supercharger and turbocharger.
  2. To understand effect of supercharging on thermodynamic cycle.
- **Outcomes:** After completing this unit, student will be able to-
  1. Explain the type and working of supercharger and turbocharger.
  2. Explain limitation of supercharger and turbocharger for SI and CI engine.
- **Unit Content:**

  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.
- **Content Delivery Methods:**

  Board, Chalk and talk**,** PPT, Video

Section II

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

- **Prerequisite:** Combustion phenomenon, Heat release process.
- **Objectives:**
  1. To learn stages of combustion in SI engine.
  2. To understand the normal and abnormal combustion in SI Engine.
  3. To learn knocking in SI engine.
- **Outcomes:** After completing this unit, student will be able to-
  1. Explain the combustion in SI engine.
  2. Parameter affecting on normal and abnormal combustion.
- **Unit Content:**

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

- **Content Delivery Methods:**
  Board, Chalk and talk, PPT, Video

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

- **Prerequisite:** Combustion in phenomenon, Heat release process, Properties of diesel fuel.
- **Objectives:**
  1. To learn Stages of combustion CI engine.
  2. To know abnormal combustion in CI engine.
  3. To understand difference between SI engines knocking and CI engine knocking.
- **Outcomes:** After completing this unit, student will be able to
  1. Explain Stages of combustion CI engine.
  2. Explain the knocking in CI engine.
- **Unit Content:**

Stages of combustion in C.I. Engines, Delay period, Factors affecting delay period, Abnormal Combustion-Diesel knock, Influence of engine design and operating variables on 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, Antiknock Agent.

- **Content Delivery Methods:** Board, Chalk and talk**,** PPT.

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

- **Prerequisite:** Basic concepts like Energy, Power, Engine working, Principle of orifice etc.
- **Objectives:**
  1. To understand performance parameter of Engine
  2. To learn heat balance sheet of Engine.
  3. To know Morse test of Multi cylinder engine
- **Outcomes:** After completing this unit, student will be able to-
  1. Calculate the performance parameters of the engine.
  2. Draw heat balance sheet.
- **Unit Content:**

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)

- **Content Delivery Methods:**
  Board, Chalk and talk

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

- **Prerequisite:** Regular fuels of Engine, Basic reactions of fuel.
- **Objectives:**
  1. To find alternative fuel for I C Engine.
  2. To understand pollution control devices.
  3. To know Pollution norms.

- **Outcomes:** After completing this unit, student will be able to
  1. Explain alternative fuels for I C Engine.
  2. Explain the basic pollutants from the engine.
  3. Explain the pollution control devices.
- **Unit Content:**

Various alternative fuels and their suitability for I. C. Engines.S.I. Engine emissions (HC, CO, NOx) Control methods, Catalytic converters.C.I. Engines Emissions (CO, NOx, Smog, Particulate), Control methods, EGR, Bharat Norms III and IV

- **Content Delivery Methods:** Board, Chalk and talk
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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, Dhanpat Rai 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, EranSher, 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.

Solapur University, Solapur
T.E. (Mechanical Engineering) Semester-II
ME323 (CAD, CAM & CAE)

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

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

Course Introduction:

Now a day's industries cannot survive worldwide competition unless they introduce new products with better quality, at lower cost, and with shorter lead time. Accordingly, they have tried to use the computer's huge memory capacity, fast processing speed, and user-friendly interactive graphics capabilities to automate and bind together thus reducing the time and cost of product development and production. Computer-aided design (CAD), computer-aided manufacturing (CAM), and computer-aided engineering (CAE) are the technologies used for this purpose during the development of mechanical product with best quality and lowest cost. Students must have knowledge of CAD, CAM, and CAE. Therefore, this course contains syllabus related to CAD, CAM and CAE activities. The syllabus is divided into two sections, each section contains four chapters.

Course objectives:

i. To create an awareness regarding Geometric Modeling activities in Industries.
ii. To create an awareness regarding CAM activities in Manufacturing Industries.
iii. To develop part programming capabilities for CNC machines.
iv. To empower students to learn advanced tools in Automation.
v. To utilize modern tools for design, analysis and manufacturing activities.

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

1. Implement concept of modern product cycle.
2. Apply knowledge of the fundamental mathematical theories for geometric Transformation.
3. Create the geometric model using CAD modeling software.
4. Apply CAE analysis tool for simulation of 1-D component.
5. Implement the concept of GT and CAPP.
6. Apply the concept of FMS.
7. Select appropriate tooling for CNC machine.
8. Develop part programming to operate CNC milling & turning machine to manufacture a Mechanical part.

Section-I

Unit 1: Introduction to CAD / CAM/CAE **No. of Lectures: 03**

• **Prerequisite:** Traditional design and manufacturing phages, Knowledge of manufacturing and machining processes, etc.

• **Objectives:**

1. To understand the modern product cycle and CAD/CAM/CAE.
2. To identify input/output devices.
3. To understand the functions of graphics software.

• **Outcomes:** After completing this unit, students will be able to-

1. Implement concept of modern product cycle.
2. To select appropriate CAD / CAM/CAE software for design, analysis and manufacturing Activities.

• **Unit content:**

Product Cycle and CAD / CAM/CAE, Advantages of CAD / CAM/CAE, Hardware used for CAD/CAM/CAE system, List of input/output devices, Functions of Graphics Software, `Selection of CAD / CAM/ CAE Software.

• **Content Delivering Methods:** Board, Chalk & talk and Power Point Presentation.

Unit 2: Computer Graphics and Geometric Modeling **No. of Lectures: 08**

• **Prerequisite:** Knowledge of basic transformation command from AutoCAD software, Knowledge of engineering graphics and basic curves etc.

• **Objectives:**

1. To understand mathematical method of geometric transformation.
2. To understand the use of homogeneous transformation.
3. To study and implement concept of CAD/CAM data exchange
4. To understand different types of geometric modeling and their use in industry

• **Outcomes:** After completing this unit, students will be able to-

1. Apply knowledge of the fundamental mathematical theories for geometric Transformation.
2. Create the geometric model using CAD modeling software.

• **Unit content:**

Geometric Transformations, Homogeneous Coordinates, Windowing and Viewing Transformations, Coordinate Transformations, Standardization in Graphics Software, CAD / CAM Data Exchange. Introduction to Geometric Modeling and its types, Parametric representation of basic entities like line and circle, Introduction to basic curves - Bezier, B-Spline, NURBS, concept of CSG and Boolean operations, Feature based modeling.

• **Content Delivering Methods:** Board, Chalk & talk, Power Point Presentation, Animations.

Unit 3: Finite element method **No. of Lectures: 04**

• **Prerequisite:** Basic knowledge of strength of material, Machine Design, Applied Mechanics

• **Objectives:**

1. To understand General steps of the Finite Element Method.
2. To derive the stiffness matrix for the 1-D bar element.
3. To select appropriate simulation or analysis software

- **Outcomes:** After completing this unit, students will be able to-
  1. Implement General steps of the FEM
  2. Carry out Structural and thermal analysis of 1-D bar elements

• Unit content:

Definition, Types of analysis, terms used in FEM, types of nodes and elements, General Steps of the FEM, Structural and thermal analysis of 1-D bar elements, Introduction to latest FEA software

• Content Delivering Methods: Board, Chalk & talk, Power Point Presentation, Animations.

Unit 4: Automation **No. of Lectures: 05**

• Prerequisite: Traditional manufacturing phages, Knowledge of manufacturing and machining centers and processes, etc.

• Objectives:

1. To understand the management approach of Group Technology and part classification based on various methods.
2. To study and understand the concept of computer aided process planning and its types.
3. To understand computer integrated manufacturing and its advantages.

- **Outcomes:** After completing this unit, students will be able to-
  1. Implement concept of group technology for making part family.
  2. Develop computer aided process plan for simple mechanical component.

• Unit content:

Concept & Definition of Automation, Types, Advantages and Limitations of Automation, Automation and CAD/CAM, CIM and CAD / CAM, Group Technology, part family, Classification and Codification System, Merits and Demerits of Group Technology, CAPP, Retrieval and Generative type of CAPP, MRP, concept of ERP, concept of Rapid Prototyping,

• Content Delivering Methods: Board, Chalk & talk, Power Point Presentation, Animations.

Unit 5: Fundamentals of NC system **No. of Lectures: 06**

• Prerequisite: Traditional machining processes, Knowledge of manufacturing and machining centers and processes, etc.

• Objectives:

1. To apply steps of NC system.
2. To demonstrate concept of flexible manufacturing system.
3. To explain types of NC system.

• Outcomes: After completing this unit, students will be able to-

1. Implement steps of NC system.
2. Demonstrate concept of flexible manufacturing system.

- **Unit content:**

Evolution of NC and Retrofitting, Elements of NC Manufacturing System, concept of work zero and machine zero, Types of NC systems, Structure, Drives and other devices, Steps in NC Manufacturing, Advantages and Disadvantages of NC Technology, Flexible Manufacturing System (FMS), Elements of FMS, Applications of FMS, Merits and Demerits in FMS.

• **Content Delivering Methods:** Board, Chalk & talk, Power Point Presentation, Animations.

Unit 6: CNC- DNC Technology **No. of Lectures: 03**

• **Prerequisite:** Knowledge of machining processes, Knowledge of manufacturing and Machining centers etc.

• **Objectives:**

1. To classify computerized numerical control system.
2. To describe Direct Numerical Control System.
3. To understand the concept of Adaptive control system.

• **Outcomes:** After completing this unit, students will be able to-

1.Apply concept of adaptive control system.

• **Unit content:**

Classification of CNC machine tools, CNC controllers, Features and Advantages of CNC, Adaptive Control, Advantages of Adaptive Control, Direct Numerical Control, Types of Direct Numerical Control, Advantages and Disadvantages of Direct Numerical Control.

• **Content Delivering Methods:** Board, Chalk & talk, Power Point Presentation, Animations.

Unit 7: Tooling for CNC Machines **No. of Lectures: 03**

• **Prerequisite:** Knowledge of traditional machine tools, Knowledge of selection of correct tools, Knowledge of machine tools and processes etc.

• **Objectives:**

1. To design automatic tool changer and tool holding system.
2. To design modular tooling system and tool magazine.
3. To demonstrate tool setting in CNC

• **Outcomes:** After completing this unit, students will be able to-

1. Design the tooling required for .CNC and VMC machines.

• **Unit content:**

Tool holders, Adapters, Tool magazines, Automatic tool changers, Pallets, Tool setting, Modular tooling.

• **Content Delivering Methods:** Board, Chalk & talk, Power Point Presentation, Animations.

Unit 8: Manual Part Programming **No. of Lectures: 08**

• **Prerequisite:** Knowledge of traditional machine tool, Knowledge machine tools and processes etc

• **Objectives:**

1. To implement G-code and M-code for development of part program for CNC Lathe and Milling machines.
2. To apply concept of machine zero and work zero.
3. To apply concept of subprogram, Do-loop and canned cycle.

• **Outcomes:** After completing this unit, students will be able to-

1. Develop part program for any part drawing.

• **Unit content:**

Principles of an NC Program, Word Address Format (WAF), Machining Formulas, Tool Length and Cutter Diameter Compensation, Canned Cycles for Lathe, Milling and Drilling, Introductory treatment of Subprogram, Subroutines, DO Loop, Macros.

- **Content Delivering Methods:** Board, Chalk & talk, Power Point Presentation, Animations.

- **List of Experiments**

1. Assignment on Modeling & Drafting of any two mechanical components.
2. Assignment on Modeling of simple Assembly of around 3-5 machine components.
3. Assignment on FEA based structural analysis of simple mechanical component.
4. Assignment on FEA based thermal analysis of simple mechanical component.
5. Part programming of one job using CAM software or Programming and manufacturing of one job on CNC lathe or CNC Milling machine.
6. Assignment based on Industrial visit and its report based on CNC/FMS/Automation.

Text books:

1. Introduction to CAD/CAM, Rao P.N., -Tata McGraw Hill Publishing Co.
2. Automation, Production Systems and Computer Integrated Manufacturing, Grover M.P.- Prentice Hall of India
3. Numerical Control -Computer Aided Manufacturing, Kundra, Rao, Tiwari- TM Hill Pub.Co.
4. CAD/CAM/CAE, Chougule N.K.- SCITECH Publications (I) Pvt. Ltd.
5. CAD/CAM/CIM, P. Radhakrishanan.

Reference Books:

1. Theory and Practice, Ibrahim Zeid – CAD/CAM - Tata McGraw Hill Publishing Co.
2. CAD/CAM - Mastering, Ibrahim Zeid –-Tata McGraw Hill Publishing Co.
3. Computer Integrated Design and Manufacturing, D.D. Bedworth, M.R Henderson & P.M. Wolfe- -Tata McGraw Hill Pub. Co.
4. CAD/CAM Theory and Concepts, Kuldeep Sareen, C. Grewal, -S.Chand & Co.Ltd.
5. Computer Graphics by Hearn and Baker.

Solapur University, Solapur

T.E. (Mechanical Engineering) Semester-II

Professional Elective-IV Course-III

ME325 Tool Engineering

Teaching Scheme	**Examination Scheme**
Lectures – 3 Hours/week, 3 Credits	**ESE– 70 Marks**
Tutorial – 2 Hour/week, 1 Credit	**ISE –30 Marks**
	ICA- 25 Marks

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

- **Course Prerequisite:**
  Student shall have knowledge of function of press tool and draw tool, cutting tools and theory of metal cutting etc.

- **Course Objectives:**
  1. To enlighten the students about the basics in mechanics of cutting & non cutting operations.
  2. To explain the concepts, principles & practices in designing various tools.
  3. To explain the students about the basics in economics of cutting & non cutting operations.
  4. To explain the concepts, principles & practices in designing various tooling.

- **Course Outcomes:**
  1. Students are able to do the calculations involved in the mechanics & economics of operations.
  2. Students are able to design & draw the tools & tooling for the given situation & operation.
  3. Students are able to conceive & develop solutions, devices, contrivances to overcome present problems of the real world.

Section I

Unit 1–Theory of metal cutting. **No of lectures – 03**

- **Prerequisite:** Knowledge of trigonometric as well as subject like mathematics and applied mechanics and strength of material.
- **Objectives:**
  1. To work on theory of metal cutting to decide the power requirement.
  2. To study of cutting fluid tool material and tool dynometer.
- **Outcomes:** After completing this unit, student will be able to
  1. Explain/ the power requirement in the metal cutting
  2. Select the proper tool material and cutting fluid in the metal cutting.
- **Unit Content:**
  a) Orthogonal cutting & oblique cutting, Force analysis for orthogonal cutting
  b) Chip formation, types of chips, wedge action, shear plane angle, cutting ratio, shear stress & strain, velocity relationship, Merchants theory, Merchants circle & force relationship
  c) Tool dynamometers- types, applications.
  d) Machinability Index, factors affecting machinability
  e) Tool life- Flank & crater wear, effect of variables on tool life, Taylor's equation of tool life
  f) Coolants- Heat generation, types of coolants.
  g) Tool Materials

- **Content Delivery Methods:** Board, Chalk and talk

Unit 2- Press Tools **No of lectures – 06**

- **Prerequisite:** Knowledge of press tool and draw tool forming process
- **Objectives:**
  To carry out design of press tool & draw tool.
- **Outcomes:** After completing this unit, student will be able to design.
  Design of press tool & draw tool.
- **Unit Content:**
  a) Elements of press tools, types of dies, types of operations.
  b) Design of die for cutting operation, mechanics of shearing, cutting force estimation, punch & die clearance, stock strip lay out, design of punches & die block functioning & place of other elements. Centre of pressure, selection of die set & press
  c) Design of drawing dies, determination of blank size, no. of draws, stage wise component drawing, drawing radii, clearance, estimation of drawing force, time & power
  d) Types of Bending dies, related estimates.
- **Content Delivery Methods:** Board, Chalk and talk

Unit 3– Geometry & Nomenclature of cutting tools **No of lectures – 06**

- **Prerequisite:** Design of cutting tool and material for cutting tool
- **Objectives:**
  1.To know about Geometry of cutting tool
  2.To know about use of various angle and its applications
- **Outcomes:** After completing this unit, student will be able to
  1.Decide the cutting tool for particulars material
  2.Decide the importance of various angle on cutting tool
- **Unit Content:**
  a) Single point cutting tools- Geometry & Tool signature as per ASA system & ORS system, effect of geometry on tool life, cutting force, surface finish.
  b) Types of Multipoint cutting tools like Milling cutters, Drills, Broaches, Reamers
- **Content Delivery Methods:** Board, Chalk and talk

Unit 4– Design of Jigs & Fixtures. **No of lectures – 05**

- **Prerequisite:** Concepts of engineering drawing, machine drawing and machine design.
- **Objectives:**
  1. To decide the locating devices.
  2. To decide clamping devices.
- **Outcomes:** After completing this unit, student -
  1. Should design jog & fixture.
  2. Should design jig and fixture fool proffer.
- **Unit Content:**
  Introduction, necessity & applications, basic concepts
  b) Location & clamping systems- Principle, types, applications
  c) Design of Jigs- Principles of Jig design, types &applications, types of bushes &selection, use of standard parts, design procedure & drawing.
  d) Design of Fixtures- Principles of Fixture design, standard elements & types of fixtures, design of milling fixtures.
- **Content Delivery Methods:** Board, Chalk and talk

Section II

Unit 5– Economics of Tooling **No of lectures – 03**

- **Prerequisite:** Knowledge of engineering management and industrial engineering
- **Objectives:**
  To learn about cost profit EOQ and tool replacement policy
- **Outcomes:** After completing this unit, student will be able to
  To calculate cost and after adding profit decide the sales prize.
- **Unit Content:**
  a) Elements of cost: methods of depreciation
  b) Estimation of total cost & sales price
  c) Break- even analysis for equipment selection
  d) Economics of small tool selection, equipment replacement
  e) Economic Order Quantity for Batch production
- **Content Delivery Methods:** Board, Chalk and talk

Term Work:

(Minimum Six of the following)

1. Study of cutting tools: Classification, Nomenclature, and Geometry
2. Exercise on Theory of metal cutting.
3. Demonstration of Lathe tool & Drill tool dynamometer & calculation of cutting forces.
4. Exercises on Mechanics & Economics of Machining & Tooling
5. Sheet on Press tool design- Cutting & drawing operation, necessary calculation
6. Sheet on Jig design- Exercise & drawing
7. Sheet on Fixture design- Exercise & drawing
8. Industrial visit

• **Text Books:**

1. Text Book of Production Engineering – P.C.Sharma (S.Chand Publication)
2. Machine Tool Engineering – G.R. Nagpal (khanna Publication)
3. Press Tools – P.H.Joshi (S.Chand Publication)
4. Jigs & Fixtures - P.H.Joshi (S.Chand Publication)

• **Reference Books:**

1. Metal cutting Theory & tool design- Mr. Arshinnov (MIR Publication)
2. Fundamentals of Tool design- ASTME Publication
3. Tool design – Donaldson (TMH Publication)
4. Jig & Fixture Design – Kempster (ELBS Publication)
5. Die Design Fundamentals-J.R.Paquin

T.E. (Mechanical) Part – II

ME328 Workshop Practice – V

Teaching Scheme	**Examination Scheme**
Practical- 2hrs/week	**ICA– 25 Marks**
Practical Exam- duration- 6 Hrs.	**POE -50Marks**

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Course Objective:

1) To make the students aware with various skills involved in manufacturing &Assembly.

2) To develop skills to operate different machine tools.

3) To make the students aware of limits, fits & tolerance while manufacturing assembly.

4) To make students aware of operation sequence, speed feed selection for different materials & Operations

Course Outcomes:

1) To create confidence amongst the students in Production / manufacturing activities.

2) Students should get experience about manual skills required to perform machining operations.

3) To create confidence in students while designing limits, fits & tolerances during manufacturing.

4) To create awareness in students regarding time management, work study, method study & tool Engineering

1. A composite job consisting of three components machined from Φ32 mm MS bar. (Excluding commercial components) requiring minimum five operations listed below:

1. Turning 2. Drilling 3. Boring 4. Hand tapping 5. Milling 6. Internal & External V-threading 7. Grinding

2. T. E. (Mechanical Engineering) Syllabus w.e.f. 2016-17 2. The components of the composite job shall carry at least two specified close tolerance operations. In addition to the above, following operations are to be demonstrated during the term. (These are not to be included in the job operations for term work & exams.)

1. Shaping 2. Slotting 3. Grinding 4. Form Turning 5. Knurling 6. Grooving

3. Journal should contain detailed process sheet of above job.

4. Assessment of Workshop Practice-IV-Term work shall be done for 50 % Work or one major Component & Workshop Practice-V-Term work shall be done for remaining work at the end of T.E. (Mech.) Part II.

5. Practical examination of 6 Hrs. duration having component of 2 to 3 parts.

Note: Material specification for practical work & examination is raw material Φ32mm M.S. bar.

Books:

1. Workshop Technology (Volume II) by Raghuvanshi.
2. Workshop Technology (Volume II) by HajraChowdhary.
3. Workshop Technology (Volume II) by W.A.J.Chapman.

Reference Books:

1. Production Technology by P.C.Sharma.
2. Production Technology – HMT Handbook.
3. Production Technology (Volume II) by Gupte-Patel.
4. H Gerling, All about Machine Tools, New Age International, 1995.

SOLAPUR UNIVERSITY, SOLAPUR

Faculty of Engineering & Technology

Credit System Structure of B.E (Mechanical Engineering) wef 2017-18

Semester I: Theory Courses

Sr. No.	Name of Theory Course	Hrs./week				Credits	Examination Scheme			
		L	T	P	D		ISE	ESE	ICA	Total
1	Automatic Control Engineering	3	-	-	-	3	30	70	-	100
2	Operations Research	3	-	-	-	3	30	70	-	100
3	Refrigeration and Air Conditioning	3	-	-	-	3	30	70	-	100
4	Professional Elective - 3	3	-	-	-	3	30	70	-	100
5	Free Elective - I	3	-	-	-	3	30	70	-	100
	Sub Total	**15**	**-**	**-**	**-**	**15**	**150**	**350**	**-**	**500**

Semester I: Laboratory / Tutorial Courses

Sr. No.	Name of Laboratory / Tutorial Course	Hrs./week				Credits	Examination Scheme				
		L	T	P	D		ISE	ESE		ICA	Total
								POE	OE		
1	Automatic Control Engineering	-	-	2	-	1	-	-	-	25	25
2	Operations Research	-	-	2	-	1	-	-	-	25	25
3	Refrigeration and Air Conditioning	-	-	2	-	1	-	-	25	25	50
4	Professional Elective - 3	-	-	2	-	1	-	-	25	25	50
5	Free Elective - I	-	2	-	-	1	-	-	-	25	25
6	Industrial Training	-	-	1	-	1	-	-	25	50	75
7	Project Work– I	-	-	4	-	2	-	-	-	50	50
	Sub Total	-	-	-	-	8	-	-	75	225	300
	Grand Total	**15**	**02**	**13**		**23**	**150**	**425**		**225**	**800**

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

Professional Elective-3: Finite Element Methods, Automobile Engineering, Process Engineering

Free Elective –I: Industrial Robotics, Sugar Engineering, Textile Engineering, and Entrepreneurship Development

SOLAPUR UNIVERSITY, SOLAPUR

Faculty of Engineering & Technology

Credit System Structure of B.E (Mechanical Engineering) wef 2017-18

Semester II: Theory Courses

Sr. No.	*Name of Theory Course*	*Hrs./week*				*Credits*	*Examination Scheme*			
		L	T	P	D		ISE	ESE	ICA	Total
1	Industrial and Quality Management	3	-	-	-	3	30	70	-	100
2	Industrial Engineering	3	-	-	-	3	30	70	-	100
3	Professional Elective - 4	3	-	-	-	3	30	70	-	100
4	Free Elective - II	3	-	-	-	3	30	70	-	100
	Sub Total	**12**	**-**	**-**	**-**	**12**	**120**	**280**	**-**	**400**

Semester II: Laboratory / Tutorial Course

Sr. No.	*Name of Laboratory / Tutorial Course*	*Hrs./week*				*Credits*	*Examination Scheme*				
		L	*T*	*P*	D		*ISE*	*ESE*		*ICA*	*Total*
								POE	*OE*		
1	Industrial and Quality Management	-	-	2	-	1	-	-	-	25	25
2	Industrial Engineering	-	-	2	-	1	-	-	-	25	25
3	Professional Elective - 4	-	-	2	-	1	-	-	25	25	50
4	Free Elective - II	-	2	-	-	1	-	-	25	25	50
5	Project Work – II	-	-	8	-	4	-	-	100	100	200
6	General Proficiency	2	-	-	-	2	-	-	-	50	50
	Sub Total	**2**	**2**	**14**	**-**	**10**	**-**	**150**			**400**
	Grand Total	**14**	**2**	**14**	**-**	**22**	**120**	**430**		**250**	**800**

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

Professional Elective-4: Mechatronics, Computational Fluid Dynamics, Production and Operation Management

Free Elective –II: Software Engineering & cyber security, Agro Machine Engineering, Plastic Engineering and Economics for Engineers

Note :

1. Batch size for the practical /tutorial shall be of 15 students. On forming the batches, if the strength of remaining students exceeds 07, then a new batch shall be formed..

2. Project group for B.E. (Mechanical) Sem. I and Sem. II shall not be of more than **four** students.

3. Practical / Tutorial load indicates the load per batch.

4. ICA assessment shall be a continuous process based on the performance of student in assignment, class test, quizzes, homework, interaction during theory and laboratory session, hand written lab book/ hand written journal, sheet drawing, subject seminar presentation etc. as applicable.

5. For Elective -: To offer a particular subject as an Elective, minimum 15 students should opt for the same. Appropriate Electives Subjects may be added when required.

3. Refrigeration and Air Conditioning

Teaching Scheme:
Lectures: 3 Hrs. / Week

Practical: 2 Hrs. / Week

Examination Scheme:
ISE-30 Marks

ESE-70 Marks

ICA- 25 marks

Oral Exam. 25Marks

Course objective:

1. To Study basic refrigeration cycles and air refrigeration systems.
2. To study different refrigerants and multi pressure refrigeration systems
3. To Study Psychometric properties of air and human comfort conditions
4. To study and design of air conditioning systems

Course outcomes:

At the end of course a student can be able to

1. Analyze basic refrigeration cycles and air refrigeration systems
2. Select proper refrigerant and appropriate refrigeration system based on application
3. Define and estimate psychometric properties
4. Estimate cooling and heating load calculations and design air conditioning system for different applications.

Section – I

1. a)Basic Refrigeration Cycles:

Refrigeration, Units of Refrigeration, Reversed Carnot cycle, Bell-Colemon cycle, Types of Vapour Compression Cycles, Calculations & performance of above cycles, Actual vapour compression cycle. (Numerical Treatment) (7 hrs)

b) Air Refrigeration systems for Air Craft Refrigeration:

Necessity of air cooling for air craft, Simple system, Boot strap system, Regenerative system, Reduced ambient system (Descriptive Treatment) (3hrs)

2. Multi pressure systems:

Introduction, Multistage compression, Flash gas removal, flash inter cooling, complete multistage compression system, Multi evaporator systems (Descriptive Treatment) (3 hrs)

3. Refrigerants:

Classification, Desirable properties, Nomenclature of refrigerants, Selection of refrigerant, Secondary refrigerants, Effect on ozone depletion & Global warming, Total equivalent warming impact (TEWI), Alternative refrigerants, Nan refrigerant (Descriptive Treatment) (3hrs)

4. Vapour Absorption System:

Simple aqua-ammonia vapour absorption system, Practical aqua-ammonia vapour absorption system, Comparison between vapour absorption & vapour compression systems, Lithium Bromide absorption refrigeration systems, Electrolux refrigerator. (Descriptive Treatment) . (4hrs)

Section – II

5. Psychrometry

Moist air as a working substance, Psychrometry properties of air, Use of psychometric tables & charts, Processes, Combinations & calculations, ADP, Coil condition line, Sensible heat factor, Bypass factor, Air washer &it's applications.(Numerical Treatment) (7 hrs)

6. Heating & Cooling Load Calculation:

Representation of actual air conditioning process by layouts & on Psychometric charts, Load analysis RSHF, GSHF, Enumeration & brief explanation of the factors forming the load on refrigeration & air conditioning system (Numerical Treatment) (6hrs)

7. Comfort Conditions & Air Distribution System:

Thermal exchange between human body & environment, Factors affecting comfort, effective temperature comfort chart, Ventilation requirements.

Duct classification, duct material, duct construction, duct design, Methods for duct design, determination of duct size, losses in duct (Theoretical Treatment) (4hrs)

8. Introduction to Cryogenics:

Introduction, Limitation of VCRS For production of low temp., Cascade refrigeration, Linde system for liquefaction of air, production of low temperature by adiabatic demagnetization of paramagnetic salt. (Theoretical Treatment) (3hrs)

Term Work

Group I (Study, Demonstration & minimum four assignment on following topics)

01. Study of Refrigeration methods
02. Study of Refrigeration Equipments
03. Study of Refrigeration systems – domestic refrigerator, Split air conditioning, Ice plant, Deep freezer etc.
04. Study of food preservation, Methods of food freezing
05. Study of charging, leak testing of refrigeration systems
06. Study of non conventional refrigeration systems

Group II (Minimum three experiments on following list)

01. Trial on Refrigeration primer / bench
02. Trial on Air conditioning tutor
03. Trial on mini ice plant
04. Trial on Vapour Absorption system
05. Trial on Heat Pump

Group III

1. Visit to refrigeration plant or Central Air conditioning plan
2. Performance evaluation of any one trial of Group-II by using MATLAB/C Programming

Text Books:

01. 'Refrigeration & Air Conditioning' by C.P. Arora
02. 'Refrigeration & Air Conditioning' by Arora & Domkundwar
03. 'Refrigeration and Air-conditioning' by Khurmi R.S.,Gupta

Reference Books:

01. 'Principle of Refrigeration' by Roy J Dossat
02. 'Air Conditioning Applications & design' by W.P. Jones
03. 'Refrigeration & Air Conditioning' by Stocker

4.2 Automobile Engineering

Teaching Scheme	Examination Scheme
Lecturers: 3 Hrs/ Week	**ISE-30 Marks**
	ESE-70 Marks
Practical's: 2 Hrs/ Week	**ICA-** 25 Marks
	Oral: 25 Marks

Objectives

1. Study basic principles of actual automobile systems
2. Study important systems in an automobile
3. Study recent and modern trends in automobile sector
4. To make students aware about the entrepreneurial opportunities in automobile engineering field.

Outcomes: Learner will be able to…

1. Demonstrate & explain various systems in an automobile
2. Describe importance and features of different elements like axle, differential, brakes, steering, suspension, wheel balancing etc.
3. Explain principle of operation, construction and applications of various sensors used in modern automobile

Section – I

1. Introduction to Automobiles: **04**

Broad classification of Automobiles. Major Components and their functions. Types of vehicle layouts, Front engine rear wheel drive, Front engine front wheel drive, Rear engine rear wheel drive, All wheel drive**,** specifications of vehicles. Types of bodies, Body construction and materials, and safety devices.

2. Performance of Automobiles: **05**

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

3. Transmission System: **08**

Requirements of transmission system, Automobile clutch- requirements, types & functions, Single plate, Multi-plate, Centrifugal, Electromagnetic & Fluid flywheel. Types of automotive gearboxes, Working of sliding mesh, Constant mesh and Synchromesh gearbox, Overdrive, Principle of operation of automatic transmission, Torque converter, Epicyclical gear trains, Propeller shaft, Universal and slip joint, Final drive and its types, Differential, Construction and types of rear axles, Introduction to wheels and tyres.

4. Automobile Electrical Systems: **03**

Automotive batteries, automotive lighting system. Starting system, charging system, Electric horn, Electric fuel Gauge- thermostatic & balancing coil type, Wiper & side indicator circuit, electric Speedo meter.

Section – II

5. Steering System: **06**

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

6. Braking System: **06**

Function of automotive brake system, Types of braking mechanism, internal expanding & Disc brake, Mechanical, Hydraulic & Air brake system, power brakes, Anti lock braking, Calculation of braking force required, stopping distance and dynamic weight transfer.(Numerical)

7. Suspension Systems: **05**

Suspension requirements, Sprung and Un sprung mass, Types of automotive suspension systems. Conventional and Independent, Shock absorber, Types of springs, Hotch- kiss and Torque tube drive, Reaction members-Radius rod, Stabilizer bar, Air suspension system.

8. Modern Trends: **03**

Engine electronic control modules, Introduction to Sensors and actuators used in automobile controls, Electronic Control Unit, traction control devices, fuel cells Hybrid vehicles-Electrical vehicle, solar vehicles.

Term Work

Minimum **six** experiments from Group A and **two** experiment from Group B are to be performed

Group A.

1. Study and demonstration of four wheeler chassis layout. Two-wheel & four wheel drive layouts.
2. Study and Demonstration of working of single plate automobile clutch.
3. Study and demonstration of synchromesh gearbox.
4. Study and demonstration of final drive and differential.
5. Study and demonstration of working Hydraulic braking system.
6. Study and demonstration of front wheel steering geometry and steering mechanism.
7. Study and demonstration of suspension system of a four-wheeler.
8. Study and demonstration of battery and electrical starting system
9. Study and demonstration of (a) Electric horn. (b) Electric fuel Gauge. (c) Flasher unit. (d) Wiper circuit

Group B.

1. Experiment on wheel balancing & front wheel alignment.
2. Visit to servicing station for study of vehicle maintenance, repairs and report.
3. A case study presentation and report covering recent trends in automobiles.

Books Recommended

Text books-

1. Kripal Singh - Automobile Engineering – Standard publisher.
2. Automobile Mechanics -.N. K. Giri
3. Automobile Electrical Equipment -P. S. Kohali

Reference Books:

1. K. Newton and W. Seeds, T.K. Garrett,Motor Vehicle, Elsevier publications
2. Hans Hermann Braess, Ulrich Seiffen, handbook of Automotive Engineering, SAE Publications
3. William H. Crouse. Automotive Mechanics - Tata McGraw Hill Publishing House
4. Joseph Heitner, Automotive Mechanics -C.B.S Publishers And Distributors
5. SAE Manuals and Standard
8. Narang G. B. S - Automobile Engineering - S. Chand and Company Ltd.
9. Singh Kripal - Automobile Engineering –Standard publisher

6. Industrial Training

Teaching Scheme:

Practical: 1 Hour / week

Examination Scheme:

ICA: 50 Marks

Oral Exam: 25 Marks

Course Objectives:

1. To make the students aware of Industrial culture & Organizational setup.
2. To create awareness about technical report writing among the student.

Procedure for Assessment of Industrial Training done by student

- Every student should prepare a report of training done (minimum 15 days) in a prescribed format before end of Part I Semester.
- Format of the report will be decided by the concerned guide.
- The report shall be comprehensive and presented in duplicate, typed on a standard A4 size sheet and bound.
- Every student should give presentation to project guide on industrial Training Report.
- The University oral examination will be based on the term work.
- Guidelines for conducting vocational training practical's

7. Project Work - I

Teaching Scheme	Examination Scheme
Practical: 4 Hrs/ Week	**ICA**: 50 Marks

Course Objectives:

1. Application of the knowledge gained to practical situations.
2. Develop the technical problem solving ability.

Guidelines for Project content & Mark Distribution:	**Marks**
a. Work diary and weekly reporting	20
b. Synopsis	10
c. Progress report submission and presentation	20

Project Term Work:

The term work under project submitted by students shall include:

a. Work diary and weekly reporting:

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

1. Searching suitable project work
2. Brief report preferably on journals/ research or conference papers/ books or literature surveyed to select and bring out the project.
3. Brief report of feasibility studies carried to implement the conclusion.
4. Rough Sketches/ Design Calculations, etc.

b. Synopsis:

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

2. Title of Project
3. Names of Students
4. Name of Guide
5. Proposed work (Must indicate the scope of the work & weekly plan up to March end)
6. Approximate Expenditure (if any)

The synopsis shall be signed by the each student in the group, approved by the guide and endorsed by the Head of the Department.

c. Progress report submission and presentation:

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

4.3 Plastic Engineering

Teaching Scheme:
Lectures: 3 Lectures / weeks

Tutorial: 2 Hours / week

Examination Scheme:
ISE-30 Marks
ESE-70 Marks
ICA- 25 Marks
Oral Exam: 25 Marks

OBJECTIVES

1. To understand the mechanism of polymerization, techniques of polymerization and the significance of different molecular weight averages.
2. To provide the depth knowledge about different kinds of plastic materials based on their structure and properties.
3. To make the students familiar about properties and processing of plastics and use it for different applications.

OUTCOMES

At the end of the course, the student should be able to

1. Select the plastic materials for particular end user application
2. Predict the structure and properties of different kind of plastic material
3. Know the processing of different plastic material based on the end user requirement.

Section I

Unit –I Introduction to Plastics **4**

Definition and Classification of Plastic Materials, Properties of plastics, applications, Testing methods for plastics, additives in plastics, Monomers & Polymers, Polymerization - Types of Polymerization.

Unit –II Processing of Plastics **6**

Injection moulding, Extrusion moulding, sheet forming processes calendaring, Blow moulding, Processing of thermosetting plastics, compression moulding, Transfer moulding, rotational moulding.

UNIT III Welding of Plastics **4**

Hot gas welding, hot tool welding, High frequency induction welding, nuclear welding, Intra-red welding.

UNIT IV Design of Plastic Parts **6**

Tolerances of molded plastics parts, allowances in plastics, Design corners, undercuts, curing time, ribs, minimum wall thickness, design of inserts, cores mould materials,

Section II

UNIT V Design of compression and transfer molds **6**

a) Design and main parts of compression mould, standard insert mould body, design of loading chamber, design of punch, ejectors, stripper guided pin.

b) Technology of transfer mould, types, main parts, automation in transfer mould.

Unit VI Injection Mould Design **6**

Injection mould design, Single, multi cavity, semi-automatic and automatic moulds.

Types of injection mould, detailed structure and working. Feed system, Temperature control system, Ejection System, application.

UNIT VII Cooling of plastic injection mould **5**

Determining the heat quantity dissipated with cooling, heat dissipation with natural cooling, mean temperature, thermal resistance of mold body, summery of dimension and construction of correct cooling system.

UNIT VIII Introduction of advanced Plastics **3**

Introduction to composite plastics, Introduction of polymer degradation and biodegradable plastics, advanced application like Agriculture, Packaging, Building, Transport, Electrical, Electronics, Medical and Furniture

Term Work-

1. Injection mould design for simple component 2 Turns
2. Design of Blow Mould 2 Turns
3. Design of Compression mould 2 Turns
4. Two Case studies for mould manufacturing 2 Turns
5. Visit to Plastic industry (Thermo sets & Thermo Plasts)

Books -

1. J.A.Brydson, “Plastics Materials”, Butter worth Heinemann Oxford,1999
2. Schwartz & good man “Plastics materials and processing”
3. Irwin rubin “Hand book of Plastic Materials and technology”
7. Fred W. Billmeyer, JR., “Text Book of Polymer Science”, John Wiley & Sons,Singapore,1994.

5. Project Work – II

Teaching Scheme:

Practical's: 8 Hrs/ Week

Examination Scheme:

ICA- 100 Marks

Oral Exam: 100 Marks

Guidelines for Project contents & mark distribution:

a) Work diary and weekly reporting	20
b) Project Report	40
c) Presentation	40

Project Report:

Project report should be of 25 to 50 pages (More pages can be used if needed). For standardization of the project reports the following format should be strictly followed.

1. Page size: Trimmed A4
2. Top Margin: 1.00 Inches
3. Bottom Margin: 1.32 Inches
4. Left Margin: 1.5 Inches
5. Right Margin: 1.0 Inches
6. Para Text: Times New Roman 12 point font
7. Line Spacing: 1.5 Lines
8. Page Numbers: Right aligned at footer, font 12 point Times New Roman
9. Headings: New Times Roman, 14 point, Boldface
10. Certificate:

    All students should attach standard format of Certificate as described by the Department. Certificate should be awarded to batch and not individual student Certificate should have signatures of Guide, Principal, and External Examiner. Entire Report has to be segmented chapter wise as per the requirement.

11. Index of Report:

    i) Title Sheet
    ii) Certificate from Guide/ College
    iii) Acknowledgement
    iv) Abstract (Brief content of the work)
    v) List of Figures
    vi) List of Table

1. Introduction (History, Importance of Project Area, Problem identification, Objective of the Project)
2. Literature Review
3. Design/ Experimentation/ Fabrication/ Production/ Actual work carried out for the same.
4. Observation/ Analysis/ Findings/Results
5. Discussion on Results and Conclusion

References:

12. References or Bibliography: References should have the following format

For Books: "Title of Book"; Authors; Publisher; Edition;

For Papers: Authors, Year of Publication, "Title of Paper"; Conference Details/ General Details; Page No.

b) Presentation:

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

(Sample Format for Project Work Diary):

Project Progress Sheet

Activity Week: Date from…… to……..

Description of the Work Performed by the student:

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

……

Space for Drawings:

Constraint / Problem Found:

……

……

……

Activity to be carried out in next week:

……

……

Remarks by the Guide/ Co-Guide:

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Date: Sign of Guide/Co-Guide: