SOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF ENGINEERING & TECHNOLOGY

MECHANICAL ENGINEERING

Syllabus Structure for

S.E. (Mechanical Engineering) w.e.f. Academic Year 2017-18

Choice Based Credit System

SOLAPUR UNIVERSITY, SOLAPUR
FACULTY OF ENGINEERING & TECHNOLOGY
Mechanical Engineering

Programme Educational Objectives and Outcomes

A. Program Educational Objectives (PEOs)

1. To make students competent for professional career in Mechanical & allied fields.
2. To build strong fundamental knowledge amongst student to pursue higher education and continue professional development in Mechanical & other fields
3. To imbibe professional ethics, develop team spirit and effective communication skills to be successful leaders and managers with a holistic approach.
4. To nurture students to be sensitive to ethical, societal & environmental issues while conducting their professional work.

B. Program Outcomes (POs)

A Mechanical Engineering Graduate will be able to –

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and

responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

C. Program Specific Outcomes (PSOs)

1. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
2. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental consideration.
3. **Self Learning:** Graduate with his sound fundamentals is prepared to comprehend applications of the Mechanical engineering through self learning mode.

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
ME216	Professional Elective-I	1	-	-	-	1	-	-	-	-
ME217	Workshop Practices -II	-	-	-	-	-	-	-	-	-
	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	-	-	2	-	1	-	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

Faculty of Engineering & Technology

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

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
ME226	Computer Aided Machine Drawing	1	-	-	-	1	-	-	-	-
	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	-	-	2	-	1	-	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. (MechanicalEngineering) Semester-I
ME211 ANALYSIS OF MECHANICAL ELEMENTS

Teaching Scheme	Examination Scheme
Theory – 3 Hrs. /Week	ESE : 70 Marks
Tutorial– 1Hr. /Week	ISE: 30 Marks
	ICA – 25 Marks

- **Course Introduction:** This course consists of selected topics from the subject Strength of Materials which are helpful for mechanical engineers. It contains basic concepts of stresses & strains which are vital in Design engineering. It covers the topics of simple stresses & strains, torsion of circular shafts, SFD & BMD for beams and Principal stresses & strains in the first section. In its second section, the topics covered are bending & shear stresses in beams, deflection of beams, axially loaded columns and strain energy & impact load. This course emphasizes the fundamentals of various topics under strength of materials necessary for practicing mechanical engineers and inculcates problem solving skill amongst the students.

- **Course Objectives:**

1. To make a student understand concepts of various types of stresses & strains.
2. To make a student determine various stresses & deflections under various loads.
3. To introduce a student to factor of safety, working stress and its importance in design.
4. To introduce a student to concept of strain energy and its significance.
5. To make a student calculate various important parameters for simple mechanical elements Subjected to various types of loads.

- **Course Outcomes:**

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

1. Determinate the stresses, strains of mechanical elements under different loading conditions such Axial, transverse and torsion.
2. Determine the strain energy stored in the mechanical elements and calculate the associated deflection.

SECTION – I

Unit No 01: Unit 1: Simple Stresses and Strains **No. of lectures-06**

- **Prerequisites:** Concept of force in physics, concepts of statics in applied mechanics, simple geometry, and differentiation
- **Objectives:**
  1. To introduce a student to concepts of simple stresses & strains and elastic constants.
  2. To make a student calculate stresses and deformations for simple cases of loadings.
  3. To introduce a student to factor of safety and working stress in design practice.
- **Outcomes:** After completing this unit, a student can
  1. Determine simple tensile, compressive and shear stresses in simple objects under simple cases of loading.
  2. Calculate extensions, compressions using various elastic constants.
  3. Select required factor of safety as per the guidelines and calculate working stress.
- **Unit content:** Concept of stress and strain (tensile, compressive & shear), linear & lateral strains, Volumetric strain, Hooke's law, complementary shear stress, Elastic constants and their relationships, stresses and strains in three dimensions, Stress-Strain diagram for ductile and brittle materials, Determination of stresses, strains and deformation in determinate

homogeneous and composite bars under concentrated loads, self-weight and temperature changes, factor of safety & working stress.

- **Content delivering methods:** Chalk and talk
- **Assessment methods:** Problems on statically determinate & few cases of indeterminate objects of finding simple Stresses & deformations.

Unit No 02: Torsion of Circular Shafts **No. of lectures-04**

- **Prerequisites**: Concept of torque & power in physics, concept of shear stress
- **Objectives:**
  1. To introduce the students to concept of torsion of circular shafts.
  2. To make a student calculate required diameter or length of solid or hollow shafts from given power & speed Rotation using torsion equation.
  3. To make a student calculate torsional shear stress and angle of twist for a single shaft or a connection of shafts in series or in parallel.
- **Outcomes:** After completing this unit, a student can
  1. Determine the required diameter or length of solid or hollow shafts from given power & speed rotation using torsion equation.
  2. Calculate torsional shear stress and angle of twist for a single shaft or a connection of shafts in series or in parallel.
- **Unit content:** Theory of torsion of circular shafts, assumptions, derivation of torsion formulae for solid and hollow circular shafts,
  determination of torsional shear stress and angular twist for solid, hollow, homogeneous and composite circular shafts in power transmission applications, shafts in series and parallel under torsion.
- **Content delivering methods:** Chalk and talk
- **Assessment methods:** Problems on diameter & length calculation of circular shafts using theory of torsion, Problems on determination of torsional shear stress & angle of twist on shaft Connections.

Unit No 03: Shear Force and Bending Moment Diagrams for Beams **No. of lectures-06**

- **Prerequisites:** Types of beams and loads on them, calculating the support reactions of a simply supported beam, Concept of a couple.
- **Objectives:**
  1. To introduce the students to concept of shear force and bending moment & their sign conventions.
  2. To make a student draw SFD & BMD for a given beam under given loads.
  3. To make a student determine points of maximum B.M. , points of contra flexure in a given beam.
  4. To introduce the students to relation between SF, BM & intensity of UDL on a beam.
- **Outcomes: After** completing this unit, a student can
  1. Draw successfully SFD and BMD for a given beam under given loads.
  2. Determine points of maximum B.M. , points of contra flexure in a given beam carrying point loads, UDL or UVL.
  3. Draw successfully SFD and BMD for a given beam under given loads along with couples.
- **Unit content:** Concept and definition of shear force and bending moment in determinate beams due to concentrated loads, UDL, UVL and couples (analytical method only for cantilevers, simply supported and overhanging beams), relation between shear force & bending

moment diagrams and determination of points of contra flexure and point of maximum bending moment.

- **Content delivering methods: Chalk** and talk
- **Assessment methods:** Problems to draw SFD & BMD for cantilevers, simply supported beams and overhanging Beams carrying various types of loads with couples & determination of all salient points.

Unit No 04: Principal Stresses and Strains **No. of lectures-05**

- **Prerequisites:** Concept of tensile, compressive & shear (tangential) stress, two dimensional state of stress, Strain calculation in 2-D state of stress, simple geometry.
- **Objectives:**
  1. To introduce the students to concept of principal planes, principal stresses, maximum shear stress and planes of maximum shear under 2-D state of stress.
  2. To make a student calculate principal stresses maximum shear stress & their planes in a loaded object.
  3. To make a student calculate the normal and tangential stresses on any oblique plane in a loaded object.
  4. To introduce the students graphical Mohr's Circle method to determine various parameters & verify their values using analytical method.
  5. To introduce a student to max. & min. principal strains & their effects.
- **Outcomes: After** completing this unit, a student can
  1. Determine the principal stresses, maximum shear stress & their planes in a loaded object.
  2. Determine the normal and tangential stresses on any oblique plane in a loaded object.
  3. Calculate max. & min. principal strains & corresponding changes in dimensions.
  4. To calculate various parameters using Mohr's Circle method.
- **Unit content:** Normal and shear stresses on any oblique planes, concept of principal planes, principal stresses and maximum shear stress (2-D cases only), planes of maximum shear, derivation of expressions to determine principal stresses, maximum shear stress, positions of principal planes and planes of maximum shear for various cases of loading (2-D only), graphical method of Mohr's circle of stresses, stresses due to combined torsion, bending and axial force on shafts.
- **Content delivering methods:** Chalk and talk
- **Assessment methods:** Problems on determination of principal stresses & max. shear stress, their planes, Problems to calculate normal & tangential stresses on any oblique plane, problems based on principal strains.

SECTION II

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

- **Prerequisites:** Concept of shear force & bending moment at any section of a beam, calculation of moment of inertia of plane sections about X –axis using theorem of parallel axes.
- **Objectives:**
  1. To introduce a student to theory of simple bending and concept of bending stresses.
  2. To make a student determine max. Intensity of bending stresses for a given section and plot its distribution Diagram across a section.
  3. To introduce a student to concept of shear stress acting at any section of a beam and make student calculate its intensity at any level of a given cross-section of a beam.
  4. To make a student draw shear stress distribution diagram across a given cross-section of a beam.

- **Outcomes:** After completing this unit, a student can
  1. Determine max. Intensity of bending stresses for a given section and plot its distribution diagram across a section.
  2. Calculate intensity of shear stress at any level along the section of a beam subjected to a given shear force.
  3. Draw the shear stress distribution diagram across a given cross-section of a beam.
- **Unit content:** Bending Stresses in Beams, Symmetric pure bending of beams, assumptions and sign Conventions. Derivation of flexure's formula, moment of resistance and section modulus for commonly used cross sections (solid & hollow circular, rectangular, symmetrical and unsymmetrical I-sections, T-sections etc.), determination of bending stresses and bending stress distribution diagram for the beams.
- **Shear Stresses in Beams:** Concept of shear stress in beams subjected to bending, derivation of shear stress distribution formula, maximum and average shear stress, determination of shear stresses and shear stress distribution diagram for beams with Commonly used sections like circular, symmetrical and unsymmetrical I-section, T section, L- section etc.
- **Content delivering methods:** Chalk and talk
- **Assessment methods:** Problems on determination of bending stresses, plotting its distribution diagram, Problems on determination of shear stresses at any level & plotting its distribution diagram.

Unit No 06: Slope and Deflection of Beams **No. of lectures-05**

- **Prerequisites:** concept of bending moment for a loaded beam, differential & integral calculus, drawing **BMD** for certain standard cases, finding C.G. of BMD**.**
- **Objectives:**
  1. To introduce a student to concept of slope and deflection in a beam.
  2. To introduce a student to double integration method to determine slope and deflection for certain standard cases of beams carrying point loads and UDL only.
  3. To introduce a student to Moment Area Method to determine slope and deflection for certain standard cases of beams carrying point loads and UDL only.
- **Outcomes:** After completing this unit, a student can
  1. Determine values of slope and deflection at salient points for certain standard cases of beams using double integration method.
  2. Determine values of slope and deflection at salient points for certain standard cases of beams using moment Area method**.**
- **Unit content:** Concept and definitions of slope and deflection, slope and deflection relations by double integration method for cantilevers and simply supported beams subjected to point loads and UDL for standard cases only.Use of moment area method to determine slope and deflection for cantilevers and simply supported beams carrying point loads and UDL only.
- **Content delivering methods: Chalk** and talk
- **Assessment methods: Problems** on determination of slopes & deflections at salient points using double integration method and using moment area method for certain standard cases only.

Unit No 07: Axially Loaded Columns **No. of lectures-05**

- **Prerequisites** : concept of a column or a strut, direct compressive load & stress, determination of moment of inertia about X as well as Y- axes for a given section of a beam, differential equations, simple geometry.

- **Objectives:**
  1. To introduce a student to concept of crippling of a column & crippling load, end conditions of a column.
  2. To make a student determine the crippling load for a given column using Euler's theory of long columns.
  3. To make a student determine the crippling load for a given column using Rankine's theory.
  4. To make a student aware of limitations of Euler's theory and concept of Slenderness ratio.
- **Outcomes:** After completing this unit, a student can
  1. Determine crippling load using Euler's theory for a column with given end conditions.
  2. Determine crippling load using Rankine's theory for a column with given end conditions.
  3. Use the concept of effective length and slenderness ratio of a column.
  4. Calculate safe load for a given column using both the theories and using given factor of safety.
- **Unit content-** Concept of critical load and buckling, crippling and crushing stress, Euler's theory, Assumption made & sign conventions. Derivation of Euler's formulae for buckling load for columns having various end connections, concept of equivalent length, limitations of Euler's formula, Slenderness ratio, safe load on a column, Rankine's formula for critical load of any column, determination of crippling load using Euler's and Rankine's formulae.
- **Content delivering methods: Chalk** and talk
- **Assessment methods: Problems** on determination of Euler's crippling load, Rankine's crippling load for a given column with specified end conditions and calculation of safe load using given F.O.S.

Unit No 08: Strain Energy and Impact Load **No. of lectures-03**

- **Prerequisites:** concept of stress & strain, meanings of gradual, sudden & impact loads, concept potential energy and K.E. , Equations for them in physics, simple geometry, integral calculus.
- **Objectives:**
  1. To introduce a student to concept of strain energy stored in an elastic object.
  2. To make a student calculate the strain energy stored under gradual & sudden loads.
  3. To make a student calculate the strain energy stored under impact load.
  4. To make a student calculate the strain energy stored in a circular shaft under torsion.
  5. To introduce a student to concept of proof stress, proof resilience & modulus of resilience.
- **Outcomes**: After completing this unit, a student can
  1. Determine the strain energy as well as strain energy per unit volume of an object under tensor compression or simple shear under gradual or sudden loads.
  2. Determine the strain energy as well as strain energy per unit volume of an object under impact load.
  3. Calculate the strain energy as well as strain energy per unit volume of a circular shaft under torsion.
  4. Calculate proof stress, proof resilience & modulus of resilience for a given object under load
- **Unit content-**Concept of strain energy or resilience, strain energy in tension and compression for axially loaded members due to gradual. Sudden and impact loads, strain energy due to shear stress, strain energy due to torsion, proof stress and modulus of resilience.

- **In Semester Evaluation (ISE):**

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

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

  ICA shall be based on assignments and tutorial as given below

1. Assignment and tutorial on Simple Stresses and Strains
2. Assignment and tutorial on Torsion of Circular Shafts
3. Assignment and tutorial on Shear Force and Bending Moment Diagrams for Beams
4. Assignment and tutorial on Principal Stresses and Strains
5. Assignment and tutorial on Bending and Shear Stresses in Beams
6. Assignment and tutorial on Slope and Deflection of Beams
7. Assignment and tutorial on Axially Loaded Columns
8. Assignment and tutorial on Strain Energy and Impact Load.

- **Text Books:**

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

- **Reference Books:**

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

Solapur University, Solapur
S.E. (MechanicalEngineering) 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 of Lubricants (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
ME213 ENGINEERING MATHEMATICS-III

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

- **Course Introduction:** This course pivots the fundamental concept and application of thermodynamics, Heat transfer and fluid mechanics in the field of mechanical Engineering. This course introduces basic principles, concept of differential equations, integral transforms, and probability distribution for mechanical application. This course makes the study of mathematics significant from practical point of view.

- **Course Prerequisite:** Student shall have knowledge of differential equation and their various methods of solution types of differential equation, integrations and their properties, probability, function, intervals, basic concept of partial differentiation.

- **Course Objectives:**

1. To make student understand principles, the concepts of differential calculus, complex variables and integral transforms.
2. To make student understand the methods of solutions of engineering mathematics problems.
3. To make student understand probability distributions.

- **Course Outcomes:**
  1. Student can solve ordinary and partial differential equations.
  2. Student can apply the basic concepts for the solution of mechanical engineering problems.
  3. Student can perform probability distributions.
  4. Student can describe complex integrations.
  5. Student can explain Laplace transform techniques and can use for practical applications.

SECTION I

Unit 1– Linear Differential Equations – I **No. of lectures-05**

- **Prerequisite:** Basic definition of derivative and evolution of derivative.
- **Objectives:**
  1. To make student understand derivative and formation of differential equation.
  2. To make student understand different ordinary differential equation and linear differential equation and its application in various fields.
  3. To make student understand complementary function and particular integral.
  4. To make student understand general solution and partial solution of differential equation linear differential equation.
- **Outcomes:** After completing this unit, student can –
  1. Determine derivative.
  2. Solve differential equation with complementary function.
  3. Find out solution of differential equation
- **Unit Content:** Linear differential equations with constant coefficients (without method of variation of parameters)
- **Content Delivery Methods:** Chalk and talk, power point presentation.

Unit 2– Linear Differential Equations – II **No. of lectures-05**

- **Prerequisite:** Definition of differential equation and linear differential equation
- **Objectives:**
  1. To make student understand concept of homogenous differential equation.
  2. To make student understand definition of Legendre's linear differential equation.
  3. To make student understand application of differential equation in mathematical filed
- **Outcomes:** After completing this unit, student can–
  1. Solve example of homogeneous differential equation.
  2. Use application of Legendre's equation in different field of engineering.
  3. Determine application of engineering.
- **Unit Content:** Homogeneous linear differential equations, Legendre's linear differential equations, Applications to Mechanical Engineering problems related to Thermodynamics, Heat transfer and Fluid mechanics.
- **Content Delivery Methods:** Chalk and talk, power point presentation.

Unit 3– Laplace Transform **No. of lectures-06**

- **Prerequisite:** Integration & Derivative with their properties.
- **Objectives:**
  1. To make student understand definition of Laplace Transform & Laplace transform of standard function.
  2. To make student understand different properties of Laplace Transform.
  3. To make student understand Laplace Transform of derivative & integral.
- **Outcomes:** After completing this unit, student can–
  1. Derive examples of Laplace Transform.
  2. Use Properties of Laplace Transform to solve examples.
  3. Use periodic function, unit step function to determine Laplace Transform.
- **Unit Content:** Definition, Laplace Transform of standard functions, Properties- First shifting theorem, Change of scale, Multiplication by tn, Division by t, Laplace Transform of derivative and integral. Laplace Transform of periodic functions, Unit step function and unit impulse function.
- **Content Delivery Methods:** Chalk and talk, power point presentation.

Unit 4– Inverse Laplace Transform **No. of lectures-05**

- **Prerequisite: Definition of** Laplace Transform, Laplace Transform of standard function & properties.
- **Objectives:**
  1. To make student understand Laplace Transform and inverse Laplace Transform.
  2. To make student understand properties of Laplace Transform and inverse Laplace Transform.
- **Outcomes:** After completing this unit, student can –
  1. Solve examples related to inverse Laplace Transform.
  2. Determine properties of inverse Laplace Transform.
  3. Apply Convolution to determine Laplace Transform.
- **Unit Content:** Inverse Laplace transforms methods, Convolution Theorem, Applications to solve linear differential equations with constant coefficients.
- **Content Delivery Methods:** Chalk and talk, power point presentation.

SECTION II

Unit 5- Partial Differential Equations: **No. of lectures-05**

- **Prerequisite:** Basic concept of differentiation partial derivative.
- **Objectives:**
  1. To make student understand order of partial differential equations.
  2. To make student understand solutions of P.D.E. by the method of separation of variables.
- **Outcomes:** After completing this unit, student can –
  1. Solve examples of P.D.E. of first order.
  2. Apply method of separation of variables.
- **Unit Content:** Four standard forms of first order partial differential equations, solution of partial differential equations by the method of separation of variables.
- **Content Delivery Methods:** Chalk and talk, power point presentation.

Unit 6- Probability Distributions: **No. of lectures-05**

- **Prerequisite:** Definition of Probability, Random Variables.
- **Objectives:**
  1. To make understand probability distribution.
  2. To make student understand discrete and continuous random variables.
  3. To make understand Binomial distribution.
  4. To make understand normal & Poisson distribution.
- **Outcomes:** After completing this unit, student can –
  1. Determine discrete & continuous random variables.
  2. Determine probability of function with Binomial distribution.
  3. Apply normal & Poisson distribution to solve examples.
- **Unit Content:** Discrete and continuous random variables, Probability distribution of random variables, Binomial distribution, Poisson distribution, Normal Distribution**.**
- **Content Delivery Methods:** Chalk and talk, power point presentation.

Unit 7- Functions of Complex Variables: **No. of lectures-05**

- **Prerequisite:** Basic Definition of Analytic function, fundamental of complex number, integrations.
- **Objectives:**
  1. To make understand analytic function, cauchy's Rieman equation.
  2. To make student understand harmonic functions, line integral.
  3. To make understand cauchy's integral theorem & cauchy's integral formula.
- **Outcomes:** After completing this unit, student can –
  1. Determine analytic function, cauchy's Rieman equation.
  2. Determine harmonic functions, line integral.
- **Unit Content:** Analytic functions, Cauchy's Riemann equations, Harmonic functions, Line integral, Cauchy's integral theorem, and Cauchy's integral formula.
- **Content Delivery Methods:** Chalk and talk, power point presentation.

Unit 8- Fourier series: **No. of lectures-06**

- **Prerequisite:** Fundamentals of derivative integration, series, intervals.

- **Objectives:**
  1. To make understand Eulers formula & Expansion of function.
  2. To make student understand Even & Odd functions, half range Fourier series.
- **Outcomes:** After completing this unit, student can –
  1. Determine Eulers formula & Expansion of function.
  2. Determine Even & Odd functions, Half range Fourier series.
- **Unit Content:** Definition, Euler's formula, Expansions of function, Change of interval, even and odd functions, half range Fourier series.
- **Content Delivery Methods:** Chalk and talk, power point presentation.

- **In Semester Evaluation (ISE):**
  ISE shall be based upon student's performance in minimum two tests and mid-term Written test conducted & evaluated at institute level.
- **Internal Continuous Assessment (ICA):**
  ICA shall be based on student's performance during tutorial sessions and it consists of minimum Eight Assignments based on above all units.
- **Text Books:**
  1. "A Text of Applied Mathematics Vol. I and Vol. II", J. N. and P. N. Wartikar, Vidyarthi Grah Prakashan, Pune.
  2. "Higher Engineering Mathematics", B. S. Grewal, Khanna Publication, Delhi.
  3. "Advanced Engineering Mathematics", Jaggi and Mathur, Dhanpatrai and Sons, Bhopal.
  4. "A Text of Applied Mathematics", N. P. Bali, Ashok Saxena and N. Ch. S. N. Iyengar, Laxmi Publication, Delhi.
- **Reference Books:**
  1. "Advanced Engineering Mathematics", Kreyzig, John Wiley & Sons, New York.
  2. "Engineering Mathematics", Peter O Neil, CRC Press.
  3. "Fundamental of statistics", S. G. Gupta, Himalaya Publishing House.

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 in fettling 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 Engineering) Semester-I
ME215 MACHINE DRAWING

Teaching Scheme:
Lectures: 3 hrs/week
Drawing: 4 hrs/week

Examination Scheme:
ESE: 70 Marks (4 hrs. duration)
ISE: 30 Marks
ICA: 50 mark , Oral Exam – 25 Marks

- **Course Introduction:** Drawing is called as language of engineers. Drawing, as an art, is the picturisation of the imagination of the scene in its totality by an individual. Machine drawing on the other hand is the scientific representation of an object, according to certain national and international standards of practice. This course consists of selected topics from the subject Machine Drawing and Engineering Graphics which are helpful for mechanical engineers. It contains BIS convention, free hand sketching & Production drawing which are vital in Design engineering. It covers the topics of BIS conventions, free hand sketching, Production drawing, Auxiliary and isometric projections along with assembly and details drawing. This course emphasizes the fundamentals of various topics under machine drawing necessary for practicing mechanical engineers and inculcates problem solving skill amongst the students.

- **Course Prerequisites:** Concepts of Engineering Graphics, Algebra, Geometry. basic concepts of Basic Mechanical Engineering.

- **Course Objectives:**
  1. To understand & use the principles and requirements of drawing practices as per BIS standards
  2. To interpret and apply technique for making assembly from the detail/components
  3. To interpret and apply, limits, fits and tolerances to the various machine elements.

- **Course Outcomes:** By completion of the course the students will be able to:-
  1. able to create drawings as per BIS standards
  2. Enabled to apply technique for assembly drawing from the detail/components.
  3. Able to incorporate limits, fits and tolerances for components on the working/engineering drawings.
- **Note:**
  1. The first angle method of projection should be followed.
  2. The practical & oral examination of Computer Aided Machine Drawing of Semester - II is based on the syllabus of both Machine Drawing & Computer Aided Machine Drawing subjects.

- **Course Curriculum**

Unit 1: Basics of Machine Drawing & B.I.S. Conventions **No. of lectures-02**

- **Prerequisites:** Concept of circle, arc etc. in geometry, concepts of dimensions in geometry.
- **Objectives:**
  1. To introduce a student types of various drawing.
  2. To make a student to understand functional and non functional dimensioning.
  3. To introduce a student dimensioning common features like Circular Arcs, Diameters etc.
- **Outcomes: After** completing this unit, a student will
  1. Able to know types of various drawing.
  2. Able to understand Placing of dimensions, Functional and Non-functional dimensions.
  3. Will understand dimensioning common features like Circular Arcs, Diameters etc.
- **Unit Content:** Types of drawing, Dimensioning **:-** Placing of dimensions, Functional and Non-functional dimensions, Dimensioning common features like: Circular Arcs, Diameters, Holes, Angles, Chamfers, Tapers, Undercut, Repetitive features, Countersunk, Square, Sphere, Across Flat, Threads, etc.

- **Content delivering methods:** Board, Chalk and Talk
- **Assessment methods: Drawing** on Placing of dimensions, functional and non-functional dimensions & dimensioning common features.

Unit 2:- Study of B.I.S. (Bureau of Indian Standards) Conventions No. of lectures-04

- **Prerequisites:** Concept of gears in basic mechanical engineering, concepts of dimensions in geometry.
- **Objectives:**
  1. To introduce student BIS conventions of machine components and drawings sheet sizes.
  2. To make a student to understand BIS conventions of gears and gear assemblies.
  3. To introduce student BIS conventions of materials, types of sections etc.
- **Outcomes:** After completing this unit, a student will
  1. able to understand BIS conventions of machine components and drawings sheet sizes.
  2. able to understand BIS conventions of gears and gear assemblies.
  3. will understand BIS conventions of materials, types of sections etc.
- **Unit Content:** Significance and importance of BIS Conventions, Drawings sheet sizes and layout recommended by BIS. Conventional representation of engineering Materials, Spur helical and bevel gears, worm and worm wheel, rack and pinion, gear assemblies, Type of helical, disc and leaf springs. Internal and external threads, square head, spline shaft, diamond knurling BIS conventions for sectioning, type of sections, exceptional cases, BIS methods of linear- and angular Dimensioning. Symbolic representation of welds as per BIS. Surface finish symbol
- **Content delivering methods:** Board, Chalk and Talk
- **Assessment methods: Drawing** on BIS conventions of various machine components and material. Drawing on BIS conventions of gears and gear assemblies.

Unit 3: Free Hand Sketching of Machine Component No. of lectures-08

- **Prerequisites:** Concept of threads, bearings and riveting in basic mechanical engineering.
- **Objectives:**
  1. To introduce student free hand sketches of various machine components like nut bolt etc.
  2. To make a student to understand free hand sketches of keys, bearing and couplings.
  3. To introduce student pipe joint and standard pipe-fitting.
- **Outcomes**: After completing this unit, a student will
  1. Able to understand free hand sketches of various machine components.
  2. Able to understand free hand sketches of keys, bearing and couplings.
  3. Will understand pipe joint and standard pipe-fitting.
- **Unit Content:** Importance of sketching and entering proportionate dimensions on sketches. Free hand sketches of various types of threads, nut, bolts (square and hexagonal flanged nuts, lock nuts, dome nut, capstan nut, wing nut, castle nut, split pin, square headed bolt, cup headed bolt, T-headed bolt, Rag foundation bolt, stud, washer, Various types of rivets and riveted joints, Various types of keys, Socket and spigot (Cotter joint), Knuckle (pin) joint, Muff coupling, Protected and unprotected Flanged, coupling, universal coupling, solid and bush bearing. Plummer block (pedestal bearing), foot step bearing, Flat and V-belt pulleys, Fast and loose pulleys, speed cone pulleys, Pipe joint for C.I. Flanged, socket and spigot type pipe joint. Union pipe joint and standard pipe-fitting. The applications of above machine components

- **Content delivering methods:** Board, Chalk and Talk
- **Assessment methods: Drawing** on free hand sketches of various machine components. Drawing on pipe joint and standard pipe-fitting.

Unit 4: Auxiliary Projections **No. of lectures-04**

- **Prerequisites:** Concep**t** of projection of line and plane in engineering graphics.
- **Objectives:**
  1. To introduce student auxiliary projection of simple machine components.
  2. To make a student to understand completion of missing view in auxiliary projection.
- **Outcomes:** After completing this unit, a student will
  1. Able to draw auxiliary projection of simple machine components.
  2. Able to complete missing view in auxiliary projection.
- **Unit Content:** Projection on auxiliary vertical and horizontal plane, Auxiliary projection of simple machine Components. Combination with missing view.
- **Content delivering methods:** Board, Chalk and Talk
- **Assessment methods:** Drawing on auxiliary projection of simple machine components. Drawing on completing missing view in auxiliary projection.

Unit 5: Production Drawing: Limits, Fits, & Tolerances **No. of lectures-06**

- **Prerequisites:** Concept of various geometrical shapes in geometry. Concept of limits in algebra.
- **Objectives:**
  1. To introduce student various terminologies in limit system.
  2. To make a student to understand dimensional and geometrical tolerances.
  3. To introduce student surface finish, surface texture and roughness symbol.
- **Outcomes:** After completing this unit, a student will
  1. able to understand various terminologies in limit system.
  2. able to understand dimensional and geometrical tolerances.
  3. will understand surface finish, surface texture and roughness symbol.
- **Unit Content:** Dimensional Tolerances- Introduction to system of limits and fits. Basic concepts. Terminology**,** Tolerances, various types. Necessity of Limit system, Unilateral and Bilateral Tolerances, Relation between Tolerances and Manufacturing Processes, Methods of indicating tolerances on drawings, IT grades, Types of fits, Grades of tolerances, types of Holes & shafts based on fundamental deviations, designation of fit, Systems of fits, Selection of fits, Selection of tolerances based on fits,

  Geometrical Tolerances: - Need of Geometrical Tolerances, Terminology, Tolerances for Single Features such as Straightness, Flatness, Circularity, Cylindricity. Tolerances for Related Features such as Parallelism, Perpendicularity, Angularity, Concentricity, Tolerance Symbol and Value, Indicating Geometrical Tolerances on drawings,

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

  (Numerical/calculations/problems/tasks/examples/theoretical questions on UNIT NO. 5)
- **Content delivering methods:** Board, Chalk and Talk
- **Assessment methods: Drawing** on various terminologies in limit system. Drawing on dimensional, geometrical tolerances and surface finish.

Unit 6: Details and Assembly Drawing **No. of lectures-05**

- **Prerequisites:** Information and applications of various machine components, engine parts in mechanical engineering.
- **Objectives:**
  1. To introduce student to prepare detail drawings from given assembly drawing.
  2. To introduce student to prepare assembly drawings from given detail drawing.
- **Outcomes:** After completing this unit, a student will
  1. able to prepare detail drawings from given assembly drawing.
  2. able to prepare assembly drawings from given detail drawing.
- **Unit Content:** To prepare detail drawings from given assembly drawing. To prepare assembly drawing from given drawing of details. Preparation of detailed drawing from the given details such as: Tools post of centre lathe, Tail stock, Cross head Assembly, Jigs and fixtures, connecting rod and piston of I.C. Engines, Gland and stuffing box and many more suitable/considerations with Moderate difficulty level, etc. Selection and showing of all the symbols & surface finish symbols, fits, tolerances for dimensions to details and assembly drawings.
- **Content delivering methods:** Board, Chalk and Talk
- **Assessment methods: Drawing** on preparation of details drawing from given assembly drawing. Drawing on preparation of assembly drawing from given details drawing.

Unit 7: Isometric Projections **No. of lectures-05**

- **Prerequisites:** Concept of orthographic projection in engineering graphics**.**
- **Objectives:**
  1. To introduce student to understand isometric scale and isometric projections of simple objects.
  2. To understand student to prepare isometric drawing from given orthographic drawing.
- **Outcomes:** After completing this unit, a student will
  1. able to understand isometric scale and isometric projections.
  2. able to prepare isometric drawing from given orthographic drawing
- **Unit Content:** Isometric scale, Isometric projection, Isometric drawing, Circles in isometric view, Isometric views of simple object, Isometric projection from given orthographic views.
- **Content delivering methods:** Board, Chalk and Talk
- **Assessment methods: Drawing** on preparation of isometric drawing from given orthographic drawing
- **Internal Continuous Assessment (ICA):**

  Sheet No. 1: Based on Basic of drawing & dimensioning along with BIS conventions mentioned in Unit No. 1

  Sheet No.2: Based on Free hand sketches, drawing of various machine components mentioned in Unit No. 2

  Sheet No. 3: Based on Auxiliary Projection Drawing.

  Sheet No. 4: Based on Production Drawing.(Dimensional and Geometrical Tolerances)

  Sheet No. 5: To draw details drawing from given assembly (With limits, fits, tolerances)

  Sheet No. 6: To draw assembly drawing from the given details drawing (limits, fits, tolerances)

  Sheet No. 7: Based on Isometric Projections.

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

- **Reference Books:**
  1. IS: SP46- Engineering drawing practice for schools and colleges, B.I.S. Publications.
  2. IS: 696- Code of practice for general engineering drawings B.I.S. Publications.
  3. IS: 2709-Guide for selection of fits, B.I.S. Publications.
  4. IS: 919- Recommendation for limits and fits for Engineering, B.I.S. Publications
  5. IS: 8000- Part I, II. III. TV, geometrical tolerancing of technical drawings -- B.I.S. Publications.

Solapur University, Solapur

S.E. (Mechanical Engineering) Semester-I
ME216 Computer Programming in C++

Teaching Scheme	**Examination Scheme**
Theory – 1 Hrs. /Week	**ICA- 25 Marks**
Laboratory– 2 Hrs. /Week	*** Practical &Oral ESE: 25 Marks (2hrs.)**

- **Course Introduction:** This course provides an introduction to object-oriented software development through C++. It's an extension to C with number of features added. The course introduces concept of class and object. The fundamental feature of OOP's is 'data hiding' which is implemented using class. The course also introduces other features of C++ like data abstraction, data encapsulation, function overloading and inheritance.
- **Course Prerequisite:** Student has completed a course in 'C programming' and shall have an adept knowledge of programming with C.
- **Course Objectives:**
  1. To introduce to student basic features of an object oriented programming language.
  2. To make student to formulate C++ program by applying knowledge of various features like class and object.
  3. To make student to formulate C++ program by applying knowledge of various features like constructor/destructor and inheritance.
  4. To make student to develop and enhance the programming skills amongst the students in general as well as application of it in the field of mechanical engineering.
- **Course Outcomes:** At the end of this course, the student will be able:-
  1. Develop algorithms for solving problems using object oriented language.
  2. Write, compile, debug & execute C++ program by applying knowledge of various features like class and object.
  3. Write, compile, debug & execute C++ program by applying knowledge of various features like constructor/destructor and inheritance.
  4. Apply their knowledge and programming skills to solve various computing problems in the field of mechanical engineering.

Course Curriculum:

Unit 1: Introduction to Object Oriented Programming **No. of lectures-02**

- **Prerequisite**: Fundamentals of C programming.
- **Objectives:**
  1. To make student to understand difference between oriented programming - C and object oriented programming - C++.
  2. To make student to understand different features of object oriented programming.
  3. To make student to write C++ programs using object oriented approach.
- **Outcomes:** After completing this unit, student will be able to
  1. Describe difference between subject oriented programming and object oriented programming.
  2. Explain various features of OOPs..
  3. Write program using input and output streams such as cin and cout.
- **Unit Content:** Basic concepts, Benefits, object-oriented languages, Applications.
- **Content Delivery Methods-** Chalk and talk, power point presentation, programming
- **Assessment Method:** Simple CPP program to display welcome message on output screen.

Unit 2: C++ Programming basics **No. of lectures-06**

- **Prerequisite:** Fundamentals of C programming, Decision and looping control statements.
- **Objectives**1-
  1. To make student to understand operators.
  2. To make student to understand I/O Statement.
  3. To make student to write programs using Decision control statement and looping control statement.
- **Outcomes:** After completion of this unit, student will be able to
  1. Explain different operators.
  2. Describe I/O statement.
  3. Explain decision and looping control statements.
- **Unit Content:** Operators, I / O statements, Control statements- Decision Control Statements, looping control statements
- **Content Delivery Methods:** Chalk and talk, power point presentation, programming
- **Assessment Method:** CPP program based on decision control and looping control statements.

Unit 3: Classes & Objects **No. of lectures-04**

- **Prerequisite:** Fundamentals of C programming and object oriented programming
- **Objectives:**
  1. To make student to understand difference between structure and class.
  2. To introduce to student member functions and scope resolution operator.
  3. To make student to understand declaration of class and, data member and member function.
  4. To make student to understand accessing a member of a class.
- **Outcomes:** After completing this unit, student will be able to
  1. Explain difference between structure and class.
  2. Describe declaration of class and defining the object of a class.
  3. Explain data member and member function.
  4. Describe accessing a member of a class.
  5. Write program using class and object
- **Unit Content:** Introduction, Difference between structures & classes, Declaration of class, defining the object of a class, Data members, Member functions, accessing a member of a class.
- **Content Delivery Methods**: Chalk and talk, power point presentation, programming
- **Assessment Methods**: CPP Program using class and object, CPP program using class and object

Unit 4: Constructor & Destructor Objects **No. of lectures-04**

- **Prerequisite:** Concepts of class, data members and member functions with access specifiers
- **Objectives:**
  1. To make student to understand different types of constructors.
  2. To make student to understand importance and properties of a destructor.
  3. To make student to write program using constructors and destructors.
- **Outcomes:** After completing this unit, student will be able to
  1. Explain importance and properties of a constructor.
  2. Implement different types of constructors.

3. Describe importance and properties of a destructor.
4. Write program using constructors and destructors.

- **Unit Content -** Default constructor, Parameterized constructor, constructor with default parameter, Copy constructor, Dynamic constructor, Destructor.
- **Content Delivery Methods:** Chalk and talk, power point presentation, programming
- **Assessment Methods:** CPP Programs based on different types of constructors, programming on destructors

Unit 5: Functions **No. of lectures-04**

- **Prerequisite:** Concepts of class, data members and member functions with access specifies.
- **Objectives:**
  1. To make student to understand passing arguments.
  2. To make student to understand function overloading function.
  3. To make student to understand inline function and friend function.
  4. To make student to write program using inline and friend function.
- **Outcomes:** After completing this unit, student will be able to
  1. Explain importance function.
  2. Implement functions such as inline and friend function.
  3. Describe importance function overloading.
  4. Write program using inline, friend function and function overloading.
- **Unit Content-**Reference arguments, Overloaded functions, inline function, Function with default arguments, Returning by reference, friend function
- **Content Delivery Methods:** Chalk and talk, power point presentation, programming
- **Assessment Methods:** CPP Programs based on inline function, friend function and function overloading

Unit 6: Inheritance **No. of lectures-05**

- **Prerequisite:** Concepts of class, member functions, Access specifier, and scope resolution operator**.**
- **Objectives:**
  1. To make student to realize necessity of inheritance.
  2. To make student to understand different types of inheritance.
  3. To make student to understand ambiguity in hybrid inheritance and how to overcome it.
  4. To make student to write program using different types of inheritance and virtual base classes.
- **Outcomes:** After completing this unit, student will be able to
  1. Explain importance of inheritance and write its structures.
  2. Implement different types of inheritance.
  3. Explain and implement ambiguity in hybrid inheritance.
  4. Write program using different types of inheritance.
- **Unit Content:** Introduction, Access Specifiers- private, public and protected, derived class & base class, Types of inheritances – Single, Multiple, Multi-level, Hierarchical and Hybrid Inheritance.
- **Content Delivery Methods:** Chalk and talk, power point presentation, programming.
- **Assessment Methods:** CPP Programs based on different types of inheritance

- **End Semester Evaluation (ESE):**
  University 'Practical Oral Examination' at the end of the semester assessing student's programming skills.
- **In Semester Evaluation (ISE):**
  ISE shall be based upon student's performance in minimum three tests conducted & evaluated at institute level
  ISE Test I – Written paper based on Unit test-I of minimum 25 marks
  ISE Test II and ISE Test III- Practical & Oral Examination based on remaining units of minimum 25 mark each.
- **In Semester Continuous Assessment (ICA):**
  ICA shall be based on the following experiments

1. Minimum 2 programs on Input/output & arithmetic expressions, hierarchy of operators, Branching and loop control statements.
2. Minimum 2 programs using inline function & function overloading.
3. Minimum 1 program on structure.
4. Minimum 1 programs on Class & Objects.
5. Minimum 2 programs on Constructor – Destructor.
6. Minimum 2 programs on Inheritance

(***Practical & Oral:** Compilation and execution of any one program on above syllabus)

- **Text Books:**

1. Let us C++ - Yashwant Kanitkar (BPB Publication).

- **Reference Books:**

1. Object Oriented Programming - E. Balguruswami (Tata McGraw hill Publication)
2. Object oriented programming in C++ by Rajesh Shukla (Wiley India Publications)

Solapur University, Solapur

S.E. (Mechanical Engineering) Semester-I
ME216 DOT NET

Teaching Scheme	Examination Scheme
Theory – 1Hrs. /Week	**ICA- 25 Marks**
Laboratory– 2 Hrs. /Week	***Practical & Oral ESE: 25 Marks (2hrs.)**

- **Course Objectives:** C# is a simple, modern, general-purpose, object-oriented programming language developed by Microsoft within its .NET initiative led by Anders Hejlsberg. You can use C# to create Windows client applications, XML Web services, distributed components, client-server applications, database applications, and much, much more. Visual C# provides an advanced code editor, convenient user interface designers, integrated debugger, and many other tools to make it easier to develop applications based on the C# language and the .NET Framework.
- **Course Prerequisite:** C# programming is very much based on C and C++ programming languages, so if you have a basic understanding of C or C++ programming, then it will be fun to learn C#.
- **Course Objectives:**
  1. To introduce .NET Programming using the C# programming language.
  2. To develop basic understanding of the syntactical features of C# programming language and effective use of NET runtime library APIs to develop robust software applications.
  3. To develop ability to design and build Object Oriented and GUI on Windows platform.
- **Course Outcomes:** At the end of this course, the student will be able to:-
  1. Demonstrate the use of .NET framework in building robust software applications using C# programming language.
  2. Design and Develop object oriented application on windows platform.
  3. Implement the concept of Multithreading.

- **Course Curriculum:**

Unit 1: Introduction to .NET Framework **No. of lectures-02**

- **Prerequisite**: Fundamentals of C programming.
- **Objectives:**
  1. To introduce the .NET Architecture.
  2. To strengthen student's concepts of C# Program Execution.
  3. To make student's understand the various layers of .NET Architecture such as CLR, MSIL, CTS and FCL.
  4. To introduce Visual Studio IDE for writing C# programs.
- **Outcomes**: After completing this unit, student will be able to
  1. Write simple C# program on .NET platform.
  2. Use Visual studio IDE for writing C# program.
- **Unit Content:** The .NET architecture , The common language runtime (CLR) , the Microsoft intermediate Language code (MSIL),Just in time Compliers , The framework class library, ,The common language specification, common language type system (CTS), Introduction to Visual Studio .NET and Sharp Develop IDE.

- **Content Delivery Methods:** Chalk and talk, power point presentations, programming
- **Assessment Method**: Simple C# programs like addition of two numbers, factorial.

Unit 2: C# Application Basics and Language fundamentals No. of lectures-03

- **Prerequisite:** Fundamentals of C programming
- **Objectives:**
  1. To strengthen student's concepts of data types, operators.
  2. To make student understand basic structure of C# program.
  3. To make students write programs using loops, Arrays.
- **Outcomes :** After completing this unit, student will be able to
  1. Can explain various data types.
  2. Can write program using loops and arrays.
- **Unit Content –** Creating applications using IDEs, Namespaces , the " using" key word , Basic data types, Operators, Flow control and conditional statements , loops, Arrays.
- **Content Delivery Methods:** Chalk and talk, power point presentations, programming
- **Assessment Method:** Programs based on loops, operators, arrays.

Unit 3: Classes & Objects No. of lectures-06

- **Prerequisite:** Fundamentals of C++ programming
- **Objectives:**
  1. To make student understand what is mean object and class
  2. To make student understand different members of a class like field, properties and methods.
  3. To make student understand access modifies.
  4. To introduce understand garbage collection.
  5. To make student understand structure and string manipulations.
- **Outcomes:** After completing this unit, student will be able to
  1. Create classes and its objects.
  2. Write programs using properties and methods.
  3. Use different access modifies while defining variables, fields, properties etc.
  4. Can implement concept of structure.
- **Unit Content:** Classes and Objects, Constructor overloading, Methods, Fields, Properties, Access Modifiers and Accessibility Levels, Static methods and fields, Garbage Collection, Structures , Classes, String, Naming Conventions, Java vs. C#
- **Content Delivery Methods:** Chalk and talk, power point presentation, programming
- **Assessment Method:** Programming using structure, programming methods with different calling approach, programming on string manipulations.

Unit 4: Object Oriented Programming using C# No. of lectures-04

- **Prerequisite:** Fundamentals of C programming and object oriented programming
- **Objectives:**
  1. To make student realize necessity of inheritance.
  2. To make student understand different types of inheritance.
  3. To make student understand use of virtual and override keyword.
  4. To make student write program using different types of inheritance and polymorphism concepts.
  5. To make student understand compile time polymorphism and run time polymorphism.

- **Outcomes:** After completing this unit, student will be able to
  1. Explain importance of inheritance and write its structures.
  2. Implement different types of inheritance.
  3. Write program using different types of inheritance.
  4. Explain difference between compile time and run time polymorphism.
  5. Implement polymorphism concept.
- **Unit Content:** Objects and Reference Types, Inheritance, Interfaces and, Polymorphism, the "virtual" and "override" keyword, the "base " and "sealed" keyword.
- **Content Delivery Methods:** Chalk and talk, power point presentation, programming
- **Assessment Methods:** Programming based on inheritance, and polymorphism.

Unit 5: Exception Handling **No. of lectures-04**

- **Prerequisite:** Compile Time Errors and Run Time Errors
- **Objectives:**
  1. To make student understand difference between Errors and Exceptions
  2. To make student understand the use of different keywords used for the exception handling.
  3. To make student understand the Exception Handling Mechanism.
  4. To introduce user defined exceptions.
- **Outcomes:** After completing this unit, student will be able to
  1. Explain need of exception handling.
  2. Implement the concept of user defined exceptions.
  3. Write program with the help of Exception handling.
- **Unit Content:** Need for Exceptions, Exception Hierarchy, Handling Exceptions using try - catch-finally Blocks, creating and defining Custom Exceptions, the "throw" keyword.
- **Content Delivery Methods:** Chalk and talk, power point presentation, programming
- **Assessment Methods:** Programming based onException Handling.

Unit 6: Multithreading **No. of lectures-05**

- **Prerequisite:** Concepts of multitasking.
- **Objectives:**
  1. To make student realize necessity of multithreading.
  2. To make student understand difference between multiprocessing and multithreading.
  3. To make student understand how to create threads.
  4. To make student write program based on multithreading.
  5. To make student understand Thread Synchronization.
- **Outcomes:** After completing this unit, student will be able to
  1. Explain importance multithreading.
  2. Implement the concepts of threads.
  3. Implement the concept of Thread Synchronization
- **Unit Content:** What is Multithreading , Multithreading in C#, Static and Instances members of Thread Class, Basic Thread operations, priorities, Thread Synchronization.
- **Content Delivery Methods:** Chalk and talk, power point presentation, programming
- **Assessment Methods:** Programming based on multithreading and thread synchronizing.

- **End Semester Evaluation (ESE):**

  University 'Practical Oral Examination' at the end of the semester assessing student's programming skills.

- **In Semester Evaluation (ISE):**

  ISE shall be based upon student's performance in minimum three tests conducted & evaluated at institute level

  ISE Test I – Written paper based on Unit test-I of minimum 25 marks

  ISE Test II and ISE Test III- Practical & Oral Examination based on remaining units of minimum 25 mark each.

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

  ICA shall be based on the following experiments

1. Minimum 2 programs on arithmetic expressions, hierarchy of operators, Branching and loop control statements.
2. Minimum 1 programs on Class & Objects.
3. Minimum 2 programs on Constructor – Destructor.
4. Minimum 1 program on structure.
5. Minimum 2 programs on Inheritance and Interface.
6. Minimum 2 programs on Exception Handling.
7. Minimum 2 programs on Multithreading.

   (*__Practical & Oral:__ Compilation and execution of any one program on above syllabus)

- **Text Books:**

1. Professional C#, 3rd Edition -Simon Robinson, Christian Nagel, Karli Watson, Jay Glynn, Morgan Skinner, Bill Evjen, Wrox Press - Wiley India.
2. Programming in C#: A Primer 3 Edition -E Balagurusamy, Tata McGraw - Hill Education

- **Reference Books:**

1. C# Language Specification Version 5.0 Microsoft.(E-Resource available at http://www.microsoft.com)
2. C# Programming Guide MSDN, Microsoft. (http://msdn.microsoft.com/en-US/)
3. Microsoft Visual C# Step by Step 2010 - John Sharp, Microsoft Press.

Solapur University, Solapur
S.E. (Mechanical Engg.) Semester-I
ME216 GENERAL PROFICIENCY

Teaching Scheme | **Examination Scheme**
Theory – 1 Hr. /Week | **ICA – 25 Marks**
Laboratory– 2 Hr. /Week | **POE- 25 Marks**

- **Course Introduction:** This course includes a cluster of personal qualities, habits, attitudes that have the potential to make someone a good student and compatible with the requirements of academia. Put simply, they are the ways in which you talk, you move around, listen and present yourself. Students who possess such skills are more adept and academic savvy. They are able to gain a further understanding of tasks and successfully engage with them, enabling them to gain more control over their learning. Along with playing an important role in the development of students' overall personality and performance, this course also amount to good skills in communication; presenting information in a clear and concise manner; team-building ability; leadership; time management; group discussions; and interviews and interpersonal skills. All of which are important for students' academic development and growth.

- **Course Prerequisite:** The students need to have basic knowledge of communication language- oral and writing skill.

- **Course Objectives :**

1. To nurture student's effective presentation skills
2. To make students communicate effectively in writing for a variety of purposes.
3. To develop the skills in interpersonal communication and in expressing the views in a clear and succinct manner.
4. To inculcate soft skills in students for personal and professional success.

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

1. Use a structured presentation methodology to prepare presentation material and effective visual aids.
2. Write abstract, review article and literature survey.
3. Participate dynamically in group discussion and can face mock personal interview successfully
4. Exhibit various soft skills like email writing, task management, elevator pitch, SWOT analysis etc.

- **Course Curriculum**

Unit No 01: Presentation Skills **No. of lectures-04**

- **Prerequisite:** Basic communication skill (oral and written).
- **Objectives:**
  1. To make student plan, design and deliver an effective presentation.
  2. To make student plan, design and present a poster using suitable software.
- **Outcomes:** After completing this unit, student
  1. Can prepare appropriate slides and deliver effective presentation.
  2. Can design a poster using software and can present the poster effectively.
- **Unit content:** Presentation- Effective Planning, Preparing the slides, use of animation in slides, Use of smart art, charts, tables, Delivering, Poster Presentation- Designing a poster on given topic using suitable software, Presentation of poster.
- **Content Delivering Methods:** Chalk and talk/ presentation/Videos
- **Assessment Methods:** Preparation and delivery of presentation, Preparation of a poster

Unit No 02: Writing Skills **No. of lectures-04**

- **Prerequisite:** Basic writing skill
- **Objectives:**
  1. To make student write abstract of an article
  2. To make student write review of book or research paper.
  3. To make students search for literature of specific topic and write a literature survey.
- **Outcomes:** After completing this unit, student
  1. Can write an abstract of given article.
  2. Can write a review article of the given book or research paper.
  3. Can search the literature of specific topic using various resources and write a literature survey.
- **Unit content:** Abstract writing- Abstract of research paper/ project report- What is abstract, need of abstract, contents of abstracts, Writing review article- Need of review, book review, research paper review, Searching for literature and making literature survey- Sources to find the concerned literature, comparing, analyzing, and evaluating the contents.
- **Content Delivering Methods:** Chalk and talk/presentation/video/ actual demonstration
- **Assessment Methods:** Writing abstract, Writing a review article**,** Writing literature survey

Unit No 03: Interview and Group Discussion skills **No. of lectures-04**

- **Prerequisite:** Basic communication skills (Oral and written)
- **Objectives**:
  1. To make student prepare for personal interview.
  2. To make student prepare for participation in group discussions.
- **Outcomes**: After completing this unit, student can
  1. Prepare for the personal interview right from background study, attire to frequently asked questions.
  2. Participate in group discussions effectively.
- **Unit content:** Interview- Personal interview, telephonic interview, preparation for the interview, attire, gestures, postures, frequently asked questions, Group Discussion-Introduction and definitions of a GD, Purpose of a GD, Types of GD, Strategies in a GD , Conflict management, Do's and Don'ts in GD, Preparation for a GD
- **Content Delivering Methods:** Chalk and talk/ Presentation/ Video
- **Assessment Methods:** Mock Interview, Mock Group Discussion

Unit No 04: Soft Skills **No. of lectures-04**

- **Prerequisite:** Basic communication skills (Oral and written)
- **Objectives:**
  1. To make students write proper emails.
  2. To make student plan and execute tasks.
  3. To make students prepare for elevator pitch.
  4. To make students analyze themselves and identify their capability and competence.
- **Outcomes:** After completing this unit, student can-
  1. Write proper emails on given subject/situation.
  2. Make thorough plan and execute the tasks effectively.
  3. Prepare and present elevator pitch on given situation/case.
  4. Can make self analysis (SWOT) and identify their capability and competence.

- **Unit content:** Email writing- Writing appropriate subject, proper salutation, state your purpose, closing remarks, proof reading before sending, Task Management- case studies Developing the plan, identifying loopholes/ risk factors, corrective action plan, building a team, communicating and delegating the work, executing and evaluating the task, Elevator pitch- What is elevator pitch, Why is it needed, How do you write an elevator pitch. For a good elevator pitch, consider-Problem, solution, target market, competition, team, financial summary, SWOT Analysis- Self analysis- Identifying the strengths, weakness, Opportunities and Strength, Identify to which kind of job are you suitable for.
- **Content Delivering Methods:** Chalk and talk/Presentation/Video
- **Assessment Methods:** Writing email**,** Preparation of task plan/ event plan, Write/ Present an elevator pitch- given case study, writing self SWOT analysis.
- **Internal Continuous Assessment (ICA) –**

  ICA shall be based on performance of the student during the laboratory sessions in Covering minimum 10 exercises out of the following exercises:

1. Write a resume for various purposes.
2. prepare a power point presentation (slides) on a given topic
3. Self analysis (SWOT)
4. Write the short term and long term goals
5. Letter writing (Leave application, Job application, and Enquiry letter)
6. Write a review article (Book Review/ Research paper review)
7. Searching for literature and making literature survey
8. Write a summary/abstract of the given article
9. Group Discussion
10. Personal interview (Mock)
11. Email writing
12. Field survey for real time application of advanced technology in the society.
13. Task management- case studies
14. Elevator pitch
15. Poster Presentation

Note–Students shall be encouraged to use internet and ICT tools for compilation, analysis, article writing and presentation.

- **Text Books:**

1. Soft Skills: An Integrated Approach to Maximize Personality, Gajendra Singh Chauhan & Sangeeta Sharma, Willy Indian Pvt. Ltd.
2. Soft Skills for Mangers, Dr. T. Kalyana Chakravarthi & Dr. T. Latha Chakravarthi, Biztantra Publication
3. Elevator Pitch Essentials: How to Get Your Point Across in Two Minutes or Less, Chris O'Leary, the Limb Press.
4. Research Methodology-A step by step guide for beginners, Ranjit Kumar, SAGE Publication

- **Reference Books:**

1. Soft Skill, K. Alex, S. Chand Publications New Delhi
2. Soft Skills-A Text book for Undergraduates, Ajay R Tengse, Orient Black Swan
3. Managing Soft Skills for Personality Develop men, B N Ghosh, McGraw Hill Publication
4. Research Methodology, C. R. Kotahri, New Age International Publications

Note: Videos from YouTube or any other source having the mentioned content or papers from authentic journals may also be referred.

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. 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)
4. 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)
5. 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)
6. Demonstration Study of sheet metal operations like bending, shearing, lancing, perforating, punching etc...
7. One sheet metal job consisting of at least 3 operations. (2 Turns)
   (Either performed manually or on press) Demonstration:

or

7. 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
ME221 THEORY OF MACHINES - I

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

- **Course Introduction:** In Theory of Machines the emphasis shifts from studying general concepts with illustrative examples to developing methods and performing analyses of real designs. This shift in emphasis is important, since it entails dealing with complex mechanisms and utilizing different tools to analyze these mechanisms. The objective of Theory of machine – I is to develop *various means of transforming motion* to achieve a specific one needed in applications. The Theory of Machines is one of the core course in the Mechanical Engineering curriculum, as well as one of the traditional course, dating back to the last century. The teaching of this course has, followed the well-established topics, which, in a nutshell, were some general properties, and then analytical and graphical methods of position, velocity, and acceleration analysis of simple mechanisms. In the last decade, computer technology and new software tools have started making an impact on how the course of kinematics and dynamics of machines and mechanisms can be more interesting.
- **Course Prerequisite:**
  Fundamentals of trigonometry and geometry, vector algebra, differentiation, integration, system of forces, graphics principals.
- **Course Objectives:**
  1. To use principles of kinematics and dynamics in different mechanisms and machines
  2. To select suitable mechanisms for a particular application.
  3. To understand the various cam motion profiles and follower mechanism
  4. To facilitate students to understand the friction in various machine elements.
- **Course Outcome:** At the end of this course, the student will be able to
  1. Differentiate mechanism and machine and also explain types of mechanism.
  2. Do kinematic analysis of given mechanism.
  3. Determine the various forces in slider crank mechanism.
  4. Draw cam profile for different followers and their motions.
  5. Determine the frictional force and identify its applications.
  6. Analyze various parameters and characteristics of governors.

- **Course Curriculum:**

SECTION I

Unit No 01: Simple Mechanisms **No. of lectures-04**

- **Prerequisite:** Fundamentals of kinematic and motions, degrees of freedom, differential equations.
- **Objectives**:
  1. To determine degrees of freedom for a link and kinematic pair.
  2. To describe kinematic pair and determine motion.
  3. To distinguish and categories different type of links.
  4. To know inversions of different kinematic chains.
  5. To understand utility of various mechanisms of four bar kinematic chain.

- **Outcomes:** After completing this unit, student will be able to,
  1. Differentiate mechanism and machine and also
  2. Explain types of mechanism.
- **Unit Content** Kinematic links, kinematic pairs, classification, kinematic chain, degrees of freedom, Types of constrained motion, Kutzbach's and Grubler's criteria for plane mechanisms, structure, mechanism & machine, Grashoff's law for four bar mechanism, Inversion, Inversions of Four bar chain, Single slider crank chain and double slider crank chain.
- **Content Delivering Methods:** Board, Chalk and Talk, Animated videos.
- **Assessment Methods:** Questions based on definitions of kinematic links, kinematic pairs, kinematic chain, various constrained motion, mechanisms, structure, machine etc. Explanations of Kutzbach's and Grubler's criteria Grashoff's law Inversions of Four bar chain.

Unit No 02: Velocity in Mechanisms No. of lectures-05

- **Prerequisite:** Fundamentals of vector algebra, displacement, velocity, trigonometry
- **Objectives:**
  1. To chose the suitable method to calculate velocity in given mechanism.
  2. To analyze the kinematics of a rigid body undergoing planar translation or rotation about a fixed axis in mechanism.
- **Outcomes:** After completing this unit, student can
  1. Find angular and leaner velocity of any point in given mechanism.
  2. Do kinematic analysis of given mechanism.
- **Unit content:** Velocity and acceleration in mechanisms, Velocity analysis in mechanisms by following graphical methods. 1) Instantaneous centre method.2)Relative velocity
- **Content Delivering Methods:** Board, Chalk and Talk.
- **Assessment Methods:** Questions based on Definition Explanation, Derivation. Problems on instantaneous centre method, relative velocity method.

Unit No 03: Acceleration in Mechanisms No. of lectures-05

- **Prerequisite:** Fundamentals of vector algebra, displacement, velocity, acceleration, trigonometry.
- **Objectives:**
  1. Chose the suitable method to calculate velocity and acceleration in given mechanism.
  2. Analyze the kinematics of a rigid body undergoing planar translation or rotation about a fixed axis in mechanism.
- **Outcomes:** After completing this unit, student will be able to
  1. Find angular and leaner velocity and acceleration of any point in given mechanism.
  2. Do kinematic analysis of given mechanism.
- **Unit content:** Acceleration in mechanisms, Acceleration analysis in mechanisms by following graphical methods 1) Relative acceleration method, Corioli's component of acceleration.
  2) Klein's construction method for slider cranks mechanism.
- **Content Delivering Methods:** Board, Chalk and Talk.
- **Assessment Methods:** Questions based on Definition Explanation, Derivation. Problems on Relative acceleration method, Corioli's component of acceleration, Klein's construction method for slider crank mechanism.

Unit No 04: Kinetic Analysis of Mechanisms **No. of lectures-05**

- **Prerequisite:** Basic force equilibrium methods, force resolution, basic trigonometric formulas. Fundamentals of slider crank mechanism.
- **Objectives:**
  1. Understand the force-motion relationship in components subjected to External Forces
  2. Understand inertia forces and their effect that exist in machines
  3. Analyses the force-motion characteristics of standard mechanisms.
- **Outcomes:** After completing this unit, student will be able to -
  1. Determine the inertia forces in slider crank mechanism.
  2. Determine the various forces in slider crank mechanism.
  3. Calculate net force available to generate torque on crank.
  4. Find the dynamically equivalent system of two masses.
- **Unit content:** Analytical method for velocity & acceleration in slider crank mechanism, inertia force & torque, D'Alembert's principle, dynamically equivalent system, forces analysis of reciprocating engine mechanism.
- **Content Delivering Methods:** Board, Chalk and Talk.
- **Assessment Methods:** Questions based on Explanation, Derivation. Problems on acceleration in slider crank mechanism, inertia force & torque, dynamically equivalent system, force analysis of reciprocating engine mechanism.

SECTION II

Unit No 05: Cams **No. of lectures-05**

- **Prerequisite:** Types of curves and their applications, motion equations, differential equations.
- **Objectives:**
  1. To understand different types of cams and cam followers
  2. To design different types follower motions.
  3. To construct different types of cam profile from given data.
- **Outcomes:** After completing this unit, student will be able to,
  1. Select the cam and follower for the specific application.
  2. Select the desired motion of follower for smooth operation of cam and follower.
  3. Draw cam profile for different followers and their motions..
- **Unit content:** Types of cams and followers, cam nomenclature, Follower motions, displacement, velocity and acceleration diagrams for following motions of the follower 1) Uniform velocity 2) Simple harmonic motion 3) Uniform acceleration & retardation. 4) Cycloidal motion v) Oscillatory follower, Construction of cam profile for radial cams with different types of followers, spring load on follower, jumping of follower.
- **Content Delivering Methods:** Board, Chalk and Talk, Power Point Presentation, Simulation.
- **Assessment Methods:** Questions based on Definition Explanation, Derivation. Problems to design a cam profile with various followers and their motions.

Unit No 06: Friction **No. of lectures-06**

- **Prerequisite:** Basic force equilibrium methods, force resolution, basic trigonometric formulas. Types of screw threads, differential equations, basics laws of derivative and integration.
- **Objectives:**
  1. To understand different types of friction and physics of friction between two bodies

2. To design Screw Jack, pivot & collar Bearings.
3. To understand working of friction clutches like single disc, multiple disc clutches Cone clutch, centrifugal clutch.

- **Outcomes:** After completing this unit, student can
  1. Select the threads for screw jack application.
  2. Find the torque require the load with screw arrangement.
  3. Determine the torque transmitted by friction clutch.
  4. Determine the frictional force and identify its applications.
- **Unit content:** Types of friction, laws of friction, friction between screw and nut, screw jack with square and V - treads, torque required to lift or lower the load, efficiency of screw jack, Overhauling & self locking screws, Friction in pivot & collar bearings, friction circle. Friction clutches – single disc, multiple disc clutches, cone clutch, centrifugal clutch, design considerations of clutch.
- **Content Delivering Methods:** Board, Chalk and Talk.
- **Assessment Methods:** Questions based on Definition, Explanation, Derivation, Problems on torque required to lift or lower the load, efficiency of screw jack, Friction in pivot & collar bearings, Friction clutches.

Unit No 07: Brakes **No. of lectures-03**

- **Prerequisite:** Basic force equilibrium methods, force resolution, basic trigonometric formulas, differential equations, basics laws of derivative and integration.
- **Objectives:**
  1. To understand different types brakes used in actual practice such as band brake, band & block brake, internal & external shoe brakes.
  2. To design brakes for specific application.
  3. To understand design considerations of brakes.
- **Outcomes:** After completing this unit, student can
  1. Select the braking system for required application.
  2. Find the frictional torque require in braking system.
- **Unit content:** Classification of brakes, Band brake, band & block brake. Internal & external shoe brakes, design considerations of brakes.
- **Content Delivering Methods:** Board, Chalk and Talk.
- **Assessment Methods:** Questions based on design considerations of brakes definition, explanation, derivation, problems on Band brake, band & block brake.

Unit No 08: Governors **No. of lectures-04**

- **Prerequisite:** Basic force equilibrium methods, force resolution, basic trigonometric formulas, differential equations, basics laws of derivative and integration.
- **Objectives:**
  1. To understand the principles, use and application of different governors
  2. To determine sensitivity, stability & isochronisms of various governors.
- **Outcomes:** After completing this unit, student will be able to -
  1. Determine the dynamic forces in governors.
  2. Design governors like Watt, Porter and Hartnell governors for sensitivity, stability & isochronisms.
  3. Calculate the governor effort.
  4. Calculate the power and controlling force diagram of governors.

- **Unit content:** Types of governors Watt, Porter & Hartnell governors, sensitivity, stability & isochronisms, Hunting of governor, governor effort, power and controlling force diagram of governors.
- **Content Delivering Methods:** Board, Chalk and Talk, Power Point Presentation, Simulation.
- **Assessment Methods:** Questions based on Definition, Explanation, Derivation, Problems on Watt, Porter & Hartnell governors, sensitivity, stability & isochronisms of governors.

- **In Semester Evaluation (ISE):**
  ISE shall be based upon student's performance in minimum two tests & mid-term written test conducted and evaluated at institute level.
- **Internal Continuous Assessment (ICA)**
  1. Demonstration of Grashoff's law for four bar mechanism.
  2. Problems on instantaneous centre method.
  3. Velocity & acceleration problems by relative velocity & acceleration method on drawing sheet.
  4. Problems on Klein's construction on drawing sheet.
  5. Drawing the cam profile by plotting displacement, velocity & acceleration diagrams on drawing sheet.
  6. Torque require to lower and rising load with screw jack.
  7. Study of friction clutches.
  8. Experiment on Watt, Porter & Hartnell governors to study governor characteristics.
- **Text Books:**
  1. Ballaney P. L., Theory of Machines, Khanna Publications, New Delhi.
  2. Khurmi R. S. & Gupta J. K., Theory of Machines, S. Chand publications, New Delhi.
  3. Bansal R. K., Theory of Machines, Laxmi publications, New Delhi.
  4. V.P. Singh, Theory of Machines, Dhanpat Rai & Sons Co. Pvt. Ltd., Delhi.
- **Reference Books:**
  1. Rattan S. S., Theory of Machines, Tata Mc Graw Hill publication, New Delhi.
  2. Shigley J., Theory of Machines & Mechanisms, Mc Graw Hill International students' edition.
  3. Thomas Bevan, Theory of Machines, CBS publication, New Delhi

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-II
ME223 FLUID MECHANICS

Teaching Scheme	**Examination Scheme**
Lectures :3 Hrs/Week	**ISE:30 Marks**
	ESE: 70 Marks
Practical :2 Hrs/Week	**ICA : 25 Marks**
	Oral Exam.25 Marks

- **Course Prerequisite:** This course is directed towards the behavior of fluid at rest or in motion. It also deals with forces on fluids which are at rest or in motion. This course also gives knowledge to solve the problems of fluid flows through the pipes. The course is important in understanding different forces acting on immersed bodies & in tern in design parameters of aero plane, ships etc. In the last decade computer technology & new software tools have started making an impact on how the course of Fluid Mechanics can be more interesting.

- **Course Prerequisite:** Student shall have knowledge of mathematics, basic properties of fluids, Engg. Mechanics, Engg. Physics, Basic Mechanical Engineering.

- **Course Objective:**
  1) To understand principles of fluid mechanics governing the behavior of fluid at rest and motion
  2) To provide the student the necessary analytical skills to solve and analyze a variety of fluid mechanics related problems.

- **Course outcomes:**
  During the study of this course the students will be able to
  1) Define different terms of fluid mechanics
  2) Apply knowledge of fluid mechanics to solve problems related to fluid at rest and fluid in motion.
  3) Evaluate parameters related to static and moving fluid.

SECTION I

Unit No 01: Fluid statics **No. of lectures-04**

- **Prerequisite:** Properties of Fluids, Fundamentals of Engg. Mechanics, Basic Mechanical Engineering.
- **Objectives:**
  1. To understand concept of total pressure & centre of pressure.
  2. To describe the principle of buoyancy & equilibrium conditions.
  3. To illustrate concept of Meta centre & Metacentric Height.
- **Outcomes:** After completing this unit,
  1. Students will able to Calculate total pressure & centre of pressure for different immersed surfaces.
  2. Students will able to explain the concept of buoyancy & Archimedes Principle.
  3. Students will able to understand the stability of Floating & Submerged bodies.
- **Unit Content:** Center of pressure, Total pressure on immersed surfaces – horizontal,vertical, inclined & curved surfaces, The principle of buoyancy, Archimedes principle, conditions of equilibrium for submerged & floating bodies, discussions on stability, Meta-center & metacentric height.
- **Content Delivery Methods:** Chalk and talk, power point presentation, videos.

- **Assessment Methods:** Questions based on Centre of pressure & total pressure for different surfaces & Stability of submerged bodies. Numericals on Centre of pressure & total pressure on various surfaces.

Unit No 02: Fluid kinematics **No. of lectures-06**

- **Prerequisite:** Basics of Properties of Fluid, Fundamentals of Engg. Mechanics.
- **Objectives:**
  1. To differentiate the types of fluid flows.
  2. To understand the concept of streamlines, streak lines & path lines.
  3. To compute kinematical properties of fluid flow.
- **Outcomes:** After completing this unit,
  1. Students will able to understand description of fluid flow methods.
  2. Students will able to determine velocity & acceleration of a fluid flow.
  3. Students will able to describe the types of fluid flow.
  4. Students will able to understand kinematical analysis of fluid flow.
- **Unit Content:** Langrangian & Eulerian method of description of fluid flow, Types of flow – steady & unsteady flow, uniform & non-uniform, laminar & turbulent, one, two and three dimensional, rotational & irrigational, compressible & incompressible. Streamlines, path lines & streak lines, trajectory of liquid jets, velocity components, local & convective acceleration, velocity potential function, equipotential lines, Laplace equation governing potential flow, stream function, continuity equation in Cartesian co-ordinates.
- **Content Delivery Methods:** Chalk and talk, power point presentation, video.
- **Assessment Methods:** Questions based on description of fluid flow methods to determine velocity & acceleration of a fluid flow & kinematical analysis of fluid flow.

Unit No 03: Fluid dynamics **No. of lectures-06**

- **Prerequisite:** Basics of Properties of Fluid, Fundamentals of Engg. Mechanics, Basic laws related to mass conservation & energy conservation
- **Objectives:**
  1. To derive Bernoulli's energy equation.
  2. To analyze different flow measurement devices.
  3. To determine hydraulic coefficient of an orifice.
- **Outcomes:** After completing this unit,
  1. Students will able to derive Euler's & Bernoulli's energy equations
  2. Students will able to analyse different flow measurement devices
  3. Students will able to determine hydraulic coefficient of an orifice
- **Unit Content:** Euler equation along a stream line & Bernoulli's equation, applications of Bernoulli's Theorem: Pitot tube, venturi meter, orifice meter. Flow through sharp edged small circular orifices, Determination of hydraulic coefficients of an orifice.
- **Content Delivery Methods:** Chalk and talk, power point presentation, videos.
- **Assessment Methods:** Questions based on Euler's & Bernoulli's energy equations, analysis of different flow measurement devices, determination of hydraulic coefficient of an orifice.

Unit No 04: Laminar flow **No. of lectures-03**

- **Prerequisite:** Basics of Properties of Fluid, Fluid Kinematic

- **Objectives:**
  1. To realize applications of laminar flow
  2. To analyze laminar flow between parallel plates
  3. To illustrate laminar flow through circular pipes
- **Outcomes:** After completing this unit,
  1. Students will able to describe applications of laminar flow
  2. Students will able to analyze laminar flow between parallel plates.
  3. Students will able to analyze laminar flow through circular pipes.
- **Unit Content:** Laminar flow between parallel plates, laminar flow through circular pipes, relation between pressure & shear forces.
- **Content Delivery Methods:** Chalk and talk, power point presentation, video
- **Assessment Methods:** Questions based on Laminar flow between parallel plates, laminar flow through circular pipes, relation between pressure & shear forces.

SECTION II

Unit No 05: Flow through pipes **No. of lectures-08**

- **Prerequisite:** Basics of Properties of Fluid, Fundamentals of Engg. Mechanics, Fluid Dynamics.
- **Objectives:**
  1. To describe different energy losses in a pipe flow.
  2. To analyze parallel & series pipeline connection.
  3. To determine power required in fluid transmission
- **Outcomes:** After completing this unit,
  1. Students will able to describe different energy losses in a pipe flow
  2. Students can able to calculate energy losses for a pipe flow system
  3. Students will able to analyze parallel & series pipeline connection
  4. Students will able to determine power required in fluid transmission
- **Unit Content:** Major & minor Energy losses, Darcy-Weisbach & Chezy's equation, loss of head in pipe connections & fittings, equivalent pipe, hydraulic gradient & total energy line, flow through pipes in series &parallel. Siphon pipe, efficiency of power transmission, maximum transmission of fluid power through a given pipe.
- **Content Delivery Methods:** Chalk and talk, power point presentation
- **Assessment Methods:** Questions based upon Major & minor Energy losses, Darcy-Weisbach & Chezy's equation, equivalent pipe, hydraulic gradient & total energy line, flow through pipes in series & parallel. Siphon pipe, efficiency of power transmission & maximum transmission of fluid power through a given

Unit No 06: Dimensional Analysis & Similitude, Boundary Layer Theory: No. of lectures-06

- **Prerequisite:** Basics of Properties of Fluid
- **Objectives:**
  1. To illustrate about Buckingham's π theorem for fluid flow analysis.
  2. To describe the dimensions of different fluid properties.
  3. To understand concept of Boundary layer & it's separation
- **Outcomes:** After completing this unit, student can –
  1. able to describe the dimensions of different fluid properties.
  2. able to apply Buckingham's π theorem for fluid flow analysis.
  3. able to explain concept of Boundary layer & it's separation.

- **Unit Content:** Buckingham's Π theorem, similitude, modeling. Introduction to boundary layer theory, Displacement & momentum thickness, boundary layer separation & control.
- **Content Delivery Methods:** Chalk and talk, power point presentation & Videos.
- **Assessment Methods:** Questions based on Buckingham's π theorem, concept of similitude, modeling, & based on boundary layer separation & control.

Unit No 07: Drag & lift on immersed bodies **No. of lectures-04**

- **Prerequisite:** Basics of Properties of Fluid, Boundary Layer Theory.
- **Objectives:**
  1. To make student to understand the concept of Drag & Lift.
  2. To calculate drag & lift on immersed bodies
- **Outcomes:** After completing this unit,
  1. Students understand the concept of Drag & Lift
  2. Students will able Calculate drag & lift on immersed bodies
- **Unit Content:** Drag on bodies, effect of viscosity on drag, Development of lift on thin flat plate, airfoil shapes, lift & drag on airfoil, stall on airfoil
- **Content Delivery Methods:** Chalk and talk, power point presentation, video
- **Assessment Methods:** Questions based on concept of Drag & Lift & concept of Development of lift on thin flat plate.

Unit No 08: Introduction to Computational Fluid Dynamics **No. of lectures-02**

- **Prerequisite:** Basics of Properties of Fluid, Fundamentals of Engg. Mechanics, fluid behaviour
- **Objectives:**
  1. To introduce applications of CFD software.
  2. To understand different CFD softwares & models.
  3. To illustrate the steps in CFD analysis.
- **Outcomes:** After completing this unit,
  1. Students will able to describe the applications of CFD software
  2. Students will able explain different CFD softwares & models
  3. Students will able to descretise the different CFD equations
- **Unit Content:** Introduction, governing equation, discretisation of equations, Grid generation, method of solution & an example case, CFD models & software
- **Content Delivery Methods:** Chalk and talk, power point presentation, video
- **Assessment Methods:** Questions based on applications of CFD software, different CFD software & models & based on different steps in CFD analysis.

- **Internal Continuous Assessment (ICA)**
  Compulsory: Any two of the following assignments
  1. Numerical & theoretical assignment on basics of fluid mechanics (Properties of fluids).
  2. Study of Manometers.
  3. Introduction to CFD

Candidates should conduct at least seven practical among the following in the laboratory and submit the report of their work as term work.

1. Flow visualization by plotting streamlines (Halleshaw apparatus)
2. Determination of meta centric height
3. Pipes in series & parallel.
4. Verification of Bernoulli's theorem.
5. Calibration of venturimeter.
6. Calibration of orifice meter.
7. Reynold's experiments.
8. Determination of coefficient of friction for pipes of different materials.
9. Determination of velocity profile for laminar flow through circular pipe.

- **Text Books**

1. Dr. P.N. Modi and Dr. S.M. Seth - Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Book House.
2. Dr. R.K. Bansal - Fluid Mechanics and Hydraulic Machines - , Laxmi Publication Pvt. Ltd., New Delhi.
3. Streeter, Wylie, Bedford - Fluid Mechanics, McGraw Hill Publication.

- **Reference Books**

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

Solapur University, Solapur
S. E. (Mechanical Engg.) Semester-II
ME224 ELECTRICAL AND ELECTRONICS TECHNOLOGY

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

- **Course Introduction:**

This course focuses on the fundamental concepts and applications of electrical machines and concept of digital electronics in the field of Mechanical engineering. The course introduces basic working principles, construction details and characteristics of DC motors, AC motors, & its selection criteria for industrial applications. The course intends to cover various types of electrical heating and welding processes. Due to wide applications of digitalization the course also covers the knowledge of basic functioning of digital circuits, signal conditioning and its use in the working of microcontroller.

- **Course Prerequisite:** Student shall have knowledge of magnetic, electromagnetic fundamentals, types of electrical supply and electrical heating. He shall also have knowledge about basic electronics, binary number system and logic gates.

- **Course Objectives:**

1. To understand essential concepts and applications of electrical motors in mechanical Engineering.
2. To understand concept of electrical heating and welding.
3. To understand and analyze digital circuits.
4. To understand working of signal conditioner and operational amplifiers.
5. To understand concept of microcontroller and its applications.

- **Course Outcomes:**

1. By completion of the course the students will be able to:-
2. Students are able to develop the capability to identify and select suitable DC motors / AC motors for given applications in mechanical engineering
3. Students can determine starting and speed-torque characteristics of electrical motors.
4. Students can apply concept of electrical heating and welding in manufacturing processes.
5. Students can incorporate the concept of signal conditioning, operational amplifier and digital circuits.
6. Students can demonstrate the knowledge of basic functioning of digital circuits and its use in the working of microcontroller.

- **Course Curriculum**

SECTION I

Unit 1: Direct Current Motors **No. of lectures-07**

- **Prerequisite:** Basics of magnetic circuit, Faraday's laws of electromagnetic induction, Fundamentals of motors..
- **Objectives:**

1. To make student understand construction, working principle, types and applications of various dc motors, dc servo motor, Stepper motor and brushless dc motor.
2. To make student understand the significance of back emf.
3. To make student understand different methods of speed control and characteristics of dc motors.
4. To make student realize the necessity of starters and types of starters for dc motors.

- **Outcomes:** After completing this unit, student can –
  1. Explain construction, working principle and applications of different dc motors, dc servo motor, Stepper motor and brushless dc motor.
  2. Determine starting and speed-torque characteristics of dc motors.
  3. Describe necessity and types of starters for dc motors.
  4. Select a suitable DC motor for specific application.
- **Unit Content:** Principle of motor action, Significance of back emf, Comparison of generator and motor action, types, characteristics and application (series, shunt and compound), torque equation of direct current motors, Methods for speed control of D.C shunt and series motors, necessity and types of starters (Three point, four point starter). (Simple numerical on torque and speed control.), Working, construction and applications of DC servo motor, Stepper motor (VR type and PM type), and brushless dc motor.
- **Content Delivery Methods:** Chalk and talk, power point presentation, videos.
- **Assessment Methods:** Questions based on explanation of working, characteristics, speed control methods, starters, and applications of different dc motors, questions based on explanation of working, characteristics and applications of dc servo motor, Stepper motor and brushless dc motor, numerical on torque and speed control.

Unit 2: Alternating Current Motors and Selection of Motors No. of lectures-07

- **Prerequisite:** Basics of magnetic circuit, fundamentals of three phase ac supply & motor.
- **Objectives:**

1. To make student understand construction, working principle, types & applications of three phase induction motor, universal and AC servo motor.
2. To make student understand different conditions of torque, slip torque characteristics and power measurement of three phase induction motor.
3. To make student realize the necessity of starters and types of starters for three phase induction motor.
4. To introduce to student the concept of group and individual drive and selection criteria of motor for different applications.

- **Outcomes:** After completing this unit, student can–
  1. Explain construction and working principle, types & applications of three phase induction motor, universal and AC servo motor.
  2. Determine torque equations, starting, speed-torque characteristics and power measurement for three phase induction motor.
  3. Describe the concept of group and individual drive and selection criteria of motor..
- **Unit Content:** Concept of rotating magnetic field, working principle, construction and types of three phase induction motor, concept of slip, Torque equation, starting torque and running torque, condition for maximum starting torque, and maximum running torque, torque slip characteristics, (Numerical exercises on torque and slip.), Power measurement of Induction Motor by two wattmeter method, types of starters -direct online, resistance starter, auto transformer starter, star delta starter, Working, construction and applications of universal and AC servo motor, Group and individual drive, selection criteria of motors on various performances.
- **Content Delivery Methods:** Chalk and talk, power point presentation, video.
- **Assessment Methods:** Questions based on construction, working principle, types & applications of three phase induction motor, universal and AC servo motor, questions based on

different conditions of torque, slip torque characteristics, starters and power measurement of three phase induction motor, numerical on torque and slip.

Unit 3: Electrical Heating and Welding **No. of lectures-06**

- **Prerequisite:** Basic Electrical Engineering.
- **Objectives:**
  1. To make student to realize the concept of electrical heating and modes of heat transfer.
  2. To make student to able to understand different types of electrical heating such as direct and indirect resistance and induction heating, dielectric heating, electrical arc heating.
  3. To make student to apply the concept resistance and arc welding.
- **Outcomes:** After completing this unit, student can–
  1. Explain the advantages of electrical heating and design of heating element.
  2. Able to determine construction, working and applications of various types of furnaces/ heating equipments.
  3. Describe different types of welding.
- **Unit Content:** Introduction to electrical heating, advantages, modes of heat transfer, Types of electrical heating equipment-direct and indirect resistance heating, direct and indirect induction heating, dielectric heating, electrical arc heating, properties of heating element, design of heating element, (Numerical exercises on design of heating element.), Electrical welding, resistance and arc welding.
- **Content Delivery Methods:** Chalk and talk, power point presentation, video.
- **Assessment Methods:** Questions based on construction, working concept & applications of types of electrical heating equipment, modes of heat transfer, questions based on different types of welding, numerical on design of heating element.

SECTION II

Unit 4: Digital circuits **No. of lectures-06**

- **Prerequisite:** Basic Electronics.
- **Objectives:**
  1. To make student understand operation and various types of flip-flops.
  2. To make student to design various shift registers and counters.
  3. To make student familiar with memory and its types.
- **Outcomes:** After completing this unit, student can –
  1. Explain design and operation of various flip-flops.
  2. Design different shift registers and counters.
  3. Explain memory and its types.
- **Unit Content:** Flip flop(S-R, J-K, D and T), (SISO, SIPO, PISO, PIPO and universal shift register), Memory and counters (synchronous and asynchronous – Ring, Ripple and Up-down).
- **Content Delivery Methods:** Chalk and talk, power point presentation, simulations **.**
- **Assessment Methods:** Questions based upon implementation of different flip-flops and excitation tables, question based on design of counters and shift registers, short note on memory.

Unit 5: Signal Conditioning Fundamentals **No. of lectures-07**

- **Prerequisite:** Basic Electronics.
- **Objectives:**
  1. To introduce the student about need of signal conditioning and basics of operational amplifier.

2. To make student to derive closed loop voltage gain for – non inverting and inverting amplifier configurations.
3. To make student understand various applications of operational amplifier.
4. To make student recognize need of ADC and DAC, its types and IC details.

- **Outcomes:** After completing this unit, student can –
1. Explain need of signal conditioning and different parameters for ideal and practical op amps.
2. Derive closed loop gain equation and explain various applications of operational amplifier.
3. Explain various DAC and ADC techniques, can compare them and use IC.

- **Unit Content:** Need for signal conditioning, Definition & Symbol, Ideal Characteristic, Block diagram representation of Op-amp, Electrical amplification (gain), Operational amplifier as an adder, subtract or, integrator, differentiator, comparator, instrumentation amplifier, Analog to digital converter (successive approximation, single slope, dual slope and IC0809), digital to analog converter (weighted, R-2R Ladder, and IC0808).
- **Content Delivery Methods:** Chalk and talk, power point presentation, simulations**.**
- **Assessment Methods:** Questions based on necessity of signal conditioning, characteristic and block diagram representation of operational amplifier, questions based on various applications of operational amplifier, questions based on DAC and ADC techniques and their comparison.

Unit 6: Microcontroller 8051 and its Industrial applications No. of lectures-07

- **Prerequisite:** Basic Electronics.
- **Objectives:**
1. To introduce the student about difference between microprocessor and microcontroller.
2. To make student to understand architecture and features, addressing modes, instruction set and interrupts of 8051.
3. To make student understand interfacing of various sensor and devices with microcontrollers.

- **Outcomes:** After completing this unit, student can –
1. Explain difference between microprocessor and microcontroller.
2. Able to describe architecture and features, addressing modes, instruction set and interrupts of 8051.
3. Demonstrate the knowledge of interfacing of various sensor and devices with microcontrollers.

- **Unit Content:** Difference between microprocessor and microcontroller, Architecture and features, Addressing modes, instruction set (Data transfer, arithmetic, logical), interrupts of 8051, Interfacing of temperature sensor LM 35, strain gauge load cell, RPM meter and position sensor with microcontrollers.
- **Content Delivery Methods:** Chalk and talk, power point presentation, simulations**.**
- **Assessment Methods:** Questions based on comparison of microprocessor and microcontroller, questions based on architecture, features, addressing modes, instruction set and interrupts of 8051, questions based on interfacing of various sensor and devices with microcontrollers.
- **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 Minimum four experiments from each section of following:
- **Section-1**
1. Speed control of dc shunt motors by flux control method.
2. Speed control of dc shunt motors by armature voltage control method.
3. Brake load test on dc motor.

4. Study of starters used for dc shunt motors.
5. Load test on three phase induction motor.
6. Study of starters used for three phase induction motor.

- **Section-2**

1. Operational Amplifier as adder and subtractor.
2. Operational Amplifier as differentiator and Integrator.
3. Operational Amplifier as level detector (Comparator).
4. Implementation of Flip flops using basic gates using simulation software.
5. Implementation of counters and registers using simulation software.
6. Implementation of simple arithmetic and logical operations using simulation software/IC 8051

- **Text Books:**

1. Text book of Electrical technology Volume II, 21st revised edition, B.L. Theraja, S. Chand publications.
2. Digital Design, 3/E, by M. Morris Mano (PHI).
3. Modern Digital Electronics, 3/E, by R. P. Jain (TMH).

- **Reference Books:**

1. Electrical Power, S.L. Uppal, 13th edition, Khanna Publishers, Delhi.
2. Fractional and sub-fractional horse power electric motors, Veinott and Martin 4th Edition McGraw-Hill Publications Electrical and Mechanical Engineering Series.
3. Op-amps and Integrated circuits, 4th edition By Ramakant Gaikwad (PHI).
4. Digital Principles & Applications, 6/E, by Leach, Malvino.
5. Kenith J Ayala, 8051 Microcontroller Architecture Programming and Applications.

Microcontrollers: Theory and application by Ajay Deshmukh

Solapur University, Solapur

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

ME225 Computational Technique and Numerical Methods

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

- **Course Introduction**

  In introductory calculus and linear algebra courses, the focus is mainly on analytic solutions to problems and the purpose is to gain a working knowledge of mathematical tools and theory in the process. However most real world problems do not have closed form analytic solutions. Instead one has to use computer algorithms to calculate numerical solutions. In this course math knowledge will be combined with a little bit of programming and study a selection of numerical algorithms applicable to a wide range of everyday problems. The course builds on knowledge of linear algebra and calculus courses, and extends students knowledge so that students can compute numerical solutions to many problems for which there is no closed form algebraic solution.

- **Course Objectives**
  1. To recognize the difference between analytical and Numerical Methods.
  2. To learn the numerical methods to solve algebraic, and differential equations.
  3. To learn the numerical methods to perform regression and interpolation.
  4. To build the foundation for engineering research.
  5. To write a computer program for the numerical methods.

- **Course Outcome**
  1. Demonstrate understanding of common numerical methods & how they are used to obtain approximate solutions to intractable mathematical problems.
  2. Apply numerical method to obtain approximate solution to mathematical problem.
  3. Derive numerical methods for various mathematical operations & tasks, such as interpolation, differentiation, integration, the solution of linear & non linear equations, and the solution of differential equations.
  4. Analyse & evaluate the accuracy of common numerical methods.
  5. Implement numerical methods in C/ C++ /Matlab.

SECTION I

Unit 1: Errors and Approximations **No. of lectures-07**

- **Prerequisite:** Fundamentals of Calculus, Algebra.
- **Objectives:**
  1. To learn the concept of Mathematical Modelling.
  2. To learn the different types of errors occurring in numerical computation.
  3. To learn the different methods to find roots of Algebraic, Transcendental & Polynomials Equations.
  4. To write a computer program of Bisection Method, False position Method & Newton Raphson method.
- **Outcomes:** After completing this unit, student can
  1. Find roots of Algebraic, Transcendental &Polynomials Equations.
  2. Implement numerical methods in C/C++ /Matlab.
- **Unit Content:** Mathematical Modelling: Basic concept of Mathematical modelling, Deriving mathematical model for common physical system (Falling parachutist, Pendulum, Deflection

of Beam etc.), Types of Errors: Absolute, Relative, Truncation, Round off Error, Total Numerical Error, Concept of convergence-relevance to numerical methods., Roots of Algebraic and Transcendental Equations: i) Bracketing Methods: Bisection, False Position method. ii) Open Methods: Simple Fixed Point Iteration, The Newton-Raphson Method, Secant Method, Multiple Roots, Iterative method for Non Linear Equations, Roots of Polynomials: Muller's Method.

- **Content Delivery Methods:** Chalk and talk, power point presentation, simulations

Unit 2: Linear Simultaneous Equations: **No. of lectures-06**

- **Prerequisite:** Matrices.
- **Objectives:**
  1. To introduce methods to solve simultaneous linear algebraic equations.
- **Outcomes:** After completing this unit, student can
  1. Solve simultaneous linear algebraic equations.
- **Unit Content:** Gauss elimination method, Gauss Jordan Method, LU decomposition method, Gauss Seidel Method, Jacobi iteration Method.
- **Content Delivery Methods:** Chalk and talk, power point presentation, simulations

Unit 3: Curve Fitting & Interpolation **No. of lectures-07**

- **Prerequisite:** Least squares regression requires information from the field of statistics like the concepts of the mean, standard deviation, residual sum of the squares, normal distribution.
- **Objectives:**
  1. To learn the curve fitting techniques.
  2. To learn the interpolation methods.
  3. To write a computer program of least square technique.
- **Outcomes:**
  After completing this unit, student can
  1. Be able to fit a curve for given data using least square technique.
  2. Find approximate value of the function which is not known explicitly.
  3. Implement least square technique in C/ C++ /Matlab.
- **Unit Content**
  Least square technique: Straight line, Power equation, Exponential equation and Quadratic equation, Interpolation: Lagrange's interpolating polynomials, Newton's Divided Difference Interpolating polynomials.
- **Content Delivery Methods:** Chalk and talk, power point presentation, simulations

SECTION II

Unit 4: Numerical Integration **No. of lectures-06**

- **Prerequisite:** Integral calculus.
- .**Objectives:**
  1. To learn the different numerical integration methods.
  2. To write a computer program for Newton Cotes Integration Formula.
- **Outcomes:** After completing this unit, student can
  1. Find integrations of complicated functions using numerical methods of integration.
  2. Implement Newton Cotes Integration Formula in C/ C++ /Matlab .

- **Unit Content** Newton Cotes Integration Formula: Trapezoidal rule, Simpson's Rule (1/3rd and 3/8th), Double integration, Integration of Equation: Gauss Quadrature 2 point and 3 point method.
- **Content Delivery Methods:** Chalk and talk, power point presentation, simulations

Unit 5: Numerical Differentiation **No. of lectures-06**

- **Prerequisite:** Differential calculus.
- **Objectives:**
  1. To make student understand derivation of Differentiation formulae.
  2. To introduce methods to solve Ordinary Differential Equation.
- **Outcomes:** After completing this unit, student can -
  1. Solve ODE using appropriate numerical method.
- **Unit Content:** Numerical differentiation: Differentiation formulae forward difference, Central difference, backward difference, Richardson extrapolation, Ordinary Differential Equation: Taylor series method, Euler Method, Modified Euler Method (Iterative), Runge Kutta 2^{nd} & 4^{th} order Method, Solution of Simultaneous differential equations (No Numerical on Simultaneous differential equations).
- **Content Delivery Methods:** Chalk and talk, power point presentation, simulations

Unit 6: Partial Differential Equations [PDE] **No. of lectures-08**

- **Prerequisite:** Differential calculus.
- **Objectives:**
  1. To introduce with different types of PDE.
  2. To learn explicit & implicit methods of solving PDE.
- **Outcomes:** After completing this unit, student can –
  1. Solve the parabolic equation.
- **Unit Content:** Finite Difference: Elliptic equation with Dirichlet boundary condition, Finite Difference: Parabolic equation solution by explicit method (1D), implicit method (No numerical on implicit method).
- **Content Delivery Methods:** Chalk and talk, power point presentation, simulations**.**

- **In Semester Continuous Assessment (ICA):**
  Minimum eight Assignments based on above mentioned syllabus which includes problems on numerical methods.
  Algorithms, flow charts & codes of the following numerical methods using C or C++ or Matlab.
  1.Program on Roots of Equation (Any Two)
    a) Bisection Method.
    b) False position Method.
    c) Newton Raphson method.
  2.Program on Numerical Integration (Any Two)
    a) Trapezoidal rule.
    b) Simpson's $1/3^{rd}$ Rule.
    c) Simpson's $3/8^{th}$ Rule.
  3.Program on Curve Fitting using Least square technique.(Straight Line)
  Only Algorithms for above numerical methods can be asked in theory examination.

- **Text Books**
  1. Steven C. Chapra, Raymond P. Canale, Numerical Methods for Engineers, 4/e, Tata McGraw Hill Editions
  2. Dr. B. S. Garewal, Numerical Methods in Engineering and Science, Khanna Publishers'
  3. Steven C. Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientist, Tata Mc-GrawHill Publishing Co-Ltd
  4. Rao V. Dukkipati, Applied Numerical Methods using Matlab, New Age International Publishers.
- **Reference Books**
  1. Advanced Engineering Mathematics - Erwin Kreyszig.
  2. Gerald and Wheatley, Applied Numerical Analysis, Pearson Education Asia.
  3. E. Balagurusamy, Numerical Methods, Tata McGraw Hill.
  4. P. Thangaraj, Computer Oriented Numerical Methods, PHI.
  5. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI.
  6. Robert J. Schilling, Sandra L. Harris, Applied Numerical Methods for Engineers using MATLAB and C - Cengage Publications.

Solapur University, Solapur
S. E. (Mechanical Engg.) Semester-II
ME 225 SIMULATION TECHNIQUES

Teaching Scheme	**Examination scheme**
Theory 03hrs/week	**ESE-70 Marks**
Practical 02hrs/week	**ISE-30Marks**
	ICA-25Marks

- **Course Introduction: -**

Simulation is one of the most powerful tools available to decision-makers responsible for the design and operation of complex processes and systems. It makes possible the study, analysis and evaluation of situations that would not be otherwise possible. In an increasingly competitive world, simulation has become an indispensable problem solving methodology for engineers, designers and managers. Simulation is the process of designing a model of a real system and conducting experiments with this model for the purpose of understanding the behavior of the system and /or evaluating various strategies for the operation of the system. Thus it is critical that the model be designed in such a way that the model behavior describes the response behavior of the real system to events that take place over time.

- **Course Objective: -**
  1. To learn different simulation methods used in mechanical engineering applications.
  2. To develop analytical skills in simulation of mechanical systems.

- **Course Outcome: -**After learning the subject student should be able to
  1. Analyze the output of simulated systems
  2. Evaluate the parameters of mechanical systems using simulation methods.

SECTION I

- **Unit 1: Concepts of Simulation** **No. of lectures-04**

Introduction, Systems - Continuous& Discrete, Types of Models, System Simulation &Computer Simulation, Comparison of Simulation and Analytical Models, Steps In Simulation Study, Application Areas with Examples

- **Unit 2: Random Numbers** **No. of lectures-05**

Random Numbers, Random Number Tables, Pseudo Random Numbers, Generation of Random Numbers- Study of Different Generators, Testing - Uniformity Test, Chi-Square Test, Auto Correlation, Poker Test

- **Unit 3: Monte Carlo Method** **No. of lectures-05**

Monte Carlo Method - Different Examples, Normally Distributed Random Numbers, Monte Carlo vs. Stochastic Simulation, Example of Stochastic Model

- **Unit 4:: Simulation of Continuous Systems** **No. of lectures-06**

Introduction, Problems, Simulation of Reactions, the Runge-Kutta Method, Simulation of Amplifier Circuit, Serial Chase Problem, Simulation of Exterior Ballistics, Analog Simulation

SECTION II

- **Unit 5: Statistical Studies** **No. of lectures-03**

Stochastic Activities, Discrete Probability Function, Cumulative Distribution Functions, Continuous Probability Function, Measures of Probability, Bernoulli Trial, Binomial Distribution, Geometric, Hyper-Geometric Distributions, Poisson Distribution, Empirical Distribution

- **Unit 6: Design Of Simulation Experiment & Output Analysis** **No. of lectures-08**

Validation of Simulation Models, Interactive Process, Calibration & Validation Models, Design of Simulation Experiment, Length of Simulation Run, Replications, Variance Reduction Techniques (VRT), Distributed Simulation, Regression Analysis, Scatter Diagram, Method of Least Squares, Standard Error Estimation, Multiple Regression, Coefficient of Correlation, Analysis Of Variance (ANOVA)

- **Unit 7: Simulation Problems** **No. of lectures-03**

  Introduction, Simulation of - A Counter Service, Maintenance &Replacement, Profit Analysis, Inventory, Manufacturing System, Car Wash Station, etc

- **Unit 8: Mechanical Applications of Simulation** **No. of lectures-06**

  Simulation of Mechanical Systems: Building of Simulation Models, Simulations of Translational & Rotational Mechanical Systems, Simulation of Hydraulic Systems. Simulation of Manufacturing Systems: Simulation of Waiting Line Systems, Job Shop with Material Handling & Flexible Manufacturing Systems

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

  - Any 8 Assignments on simulation techniques of above chapters.

- **Text Books: -**

1. D. S. Hira, "System simulation", S. Chand & co. Ltd, New Delhi 2001.
2. Jerry Banks & John S. Carson Barry L. Nelson, DaridNicol "Discrete event system simulation", Third Edition, Prentice Hall India, 2002.
3. Geoffrey Gordon "System Simulation", Third Edition, Prentice Hall India, 2002.

- **Reference Books: -**

1. Robert E Shannon, "System Simulation the art & Science", Prentice Hall New Jersey, 1995.
2. J. Schwarzenbach& K. F. Gill Edward Arnold "system modeling & Control."

Solapur University, Solapur
S. E. (Mechanical Engg.) Semester-II
ME226 COMPUTER AIDED MACHINE DRAWING

Teaching Scheme	**Examination Scheme**
Theory : 1 Hr/week	**ICA : 50 marks**
Laboratory : 2 Hrs/week	**POE : 50 marks**

- **Course introduction:**

Computer Aided Design (CAD) & Computer Aided Manufacturing (CAM) has become a vital tool in modern day manufacturing industry. Basically, it deals with using computer systems (or workstations) for creating component models, analyzing component as per working conditions, optimizing the component designs and for generating programs which are input to CNC Machines that carry out the machining of the machine components. Individual parts manufactured, are further assembled to form a machine. A very basic step in the process is to model the machine component accurately in the CAD/CAM software packages available. This course introduces the preliminary commands, procedures, programming used in such softwares. Use of softwares in the engineering design & manufacturing increases the productivity of the designer, improves the quality of design, improves communications through documentation, and creates a database for manufacturing. The course helps in skill development as per the need of the modern day industry & thus, enhances the employability.

- **Course Prerequisite:** Fundamentals of geometry, engineering graphics, machine drawing, knowledge of BIS standards, handling of basic computer software tools, preliminary programming skills.

- **Course Objectives:**
  1. To develop the ability of using a software for drafting purpose
  2. To provide introduction of different drafting and modeling techniques
  3. To develop a pre-requisite for higher courses like CAD/CAM & FEM
  4. To provide introduction of parametric programming.

- **Course Outcomes:** At the end of this course students will be able to:
  1. Classify the drafting & modeling techniques.
  2. Use software package for different drafting & modeling requirements of industry.
  3. Perform preliminary steps required while working on high-end CAD/CAM softwares.
  4. To develop logical programs required for parametric modeling.

- **Course Curriculum**

UNIT-1 Basics of Computer Aided Drafting **No. of lectures-03**

- **Prerequisite:**

  Fundamentals of geometry, input/output devices of a computer, are dimensioning as per BIS standards.

- **Objectives:**
  1. To know the different software packages & their capabilities.
  2. To know CAD software package interface.
  3. To understand basic draw commands used for 2-D drawings.
  4. To understand basic modify commands used for 2-D drawings.
  5. To know the dimensioning options available in the software package.

- **Outcomes:** After completing this unit, student will be able to,
  1. Describe importance & application of computers in manufacturing industry.
  2. Apply different draw & modify commands available in software package.

3. Draw simple drawings in 2-D.
4. Apply dimensioning tools to drawings of machine components.

- **Unit content:** Introduction to Computer Aided Drafting – Introduction, Significance, Packages, Applications, User interface of the drafting package, status bar, different toolbars, viewing options, zoom, pan, layers & properties, etc, Draw commands (2D) : line, polyline, circle, arc, ellipse, polygon, hatch, region, etc, Edit & Modify commands (2D) : erase, scale, rotate, copy, move, trim, fillet, chamfer, extend, mirror, etc, Text commands, dimensioning: dimension style, dimensioning common features.
- **Content Delivering Methods:** Chalk & talk, demonstration on suitable software package
- **Assessment Methods:** Class quiz, Exercise on drawing simple 2-D drawings

UNIT-2 Computer Aided Drafting (2D) No. of lectures-02

- **Prerequisite:** Fundamentals of engineering graphics (orthographic & isometric projections), machine drawing, BIS standards of sheet layout & dimensioning.
- **Objectives:**
  1. To choose commands & settings as per requirement of the task.
  2. To draft orthographic views of machine components in software package.
  3. To draft isometric views of machine components.
  4. To apply dimensioning techniques specified by BIS.
  5. To plot drawings as per BIS standards of sheet layout.
- **Outcomes:** After completing this unit, student will be able to,
  1. Apply suitable commands & settings to accomplish the task of drawing orthographic & isometric views of machine components.
  2. Apply dimensioning as per BIS standards.
  3. Plot the drawings completed in software package as per BIS standard of sheet layout.
- **Unit content:** Drafting 2D machine components, Isometric Drawing : Snap Settings, Isoplane, Isocircle, Isometric drawings of machine components, Plotting options available in the drafting package
- **Content Delivering Methods:** Demonstration on suitable software package
- **Assessment Methods:** Exercise on drafting orthographic & isometric views of machine components.

UNIT-3 Details and assembly drawing (2D) No. of lectures-02

- **Prerequisite:** Fundamentals of detailed & assembly drawings (part drawings, mating of parts, tolerancing, etc), 2-D drafting commands, plotting of drawings.
- **Objectives:**
  1. To draft individual parts of assembly in 2D.
  2. To prepare assembly drawing from the part drawings.
  3. To provide tolerances & prepare bill of materials.
- **Outcomes:** After completing this unit, student will be able to,
  1. Apply 2-D commands for preparing detailed part drawing & assembly drawings.
  2. Deploy tolerances on different mating parts.
  3. Apply text commands & create bill of materials, title block on the sheet
  4. Plot & document the assembly & detailed drawing as per requirements of industry.
- **Unit content:** To prepare detailed part drawings of an assembly, To prepare assembly drawing from the prepared part drawings, Plotting of Part & assembly drawings including fits & tolerances

- **Content Delivering Methods:** Demonstration on suitable software package.
- **Assessment Methods:** Exercise on drafting detailed part drawings & assembly drawings of a unit comprising of 8-12 components.

UNIT-4 Computer aided drafting (3D) No. of lectures-03

- **Prerequisite:** Fundamentals of 3-D geometries, primitive solids, visualization of 3-D views.
- **Objectives:**
  1. To understand capabilities & limitations of 3-D modeling techniques.
  2. To view components in 3 dimensions.
  3. To learn basic 3-D modeling commands.
  4. To understand Boolean operations used in 3-D modeling.
- **Outcomes:** After completing this unit, student will be able to,
  1. Describe different 3-D modeling techniques.
  2. Choose suitable modeling technique for a given task.
  3. Create 3-D models of primitive solids.
  4. Apply solid commands & Boolean operations to create 3-D models of simple machine components.
- **Unit content:** Introduction to modeling: Wireframe, Solid, Surface Modeling, Three dimensional drawing: UCS & three dimensional co-ordinates, Viewing in three dimensions, Solid modeling commands: primitive solids, extrude, revolve, sweep, loft, press pull, etc, Solid editing commands: 3D-rotate, 3D-Move. 3D-Scale, Boolean operations, Slice, Sections, etc.
- **Content Delivering Methods:** Demonstration on suitable software package.
- **Assessment Methods:** Class quiz & Exercise on 3-D modeling of primitive solids & simple machine components

UNIT-5 Interpenetration of Solids (3D) No. of lectures-01

- **Prerequisite:** Fundamentals of modeling primitive solids, Boolean operations, different plane orientations in 3D.
- **Objectives:**
  1. To understand importance of penetration curves in manufacturing industry.
  2. To model primitive solids in different 3-D planes.
  3. To obtain the penetration curves
- **Outcomes:** After completing this unit, student will be able to,
  1. Describe significance of penetration curves in manufacturing industry.
  2. Create 3-D models of primitive solids as per conditions given.
  3. Obtain & plot the penetration curves.
- **Unit content:** Introduction,Meaning, significance & applications of interpenetration of solids, Modeling of primitive solids in different orientations, Penetration of one solid into another using Boolean operations & different combinations, Obtaining different views & penetration curves using options available, Plotting the views
- **Content Delivering Methods:** Demonstration on suitable software package, animations/videos exhibiting basics & importance of penetration of solids/surfaces.
- **Assessment Methods:** Exercise on obtaining penetration curves in interpenetration of primitive solids.

UNIT-6 Auxiliary Projections (3D) **No. of lectures-01**

- **Prerequisite:** Fundamentals of auxiliary projections, modeling machine components by performing Boolean operations
- **Objectives:**
  1. To understand importance of auxiliary projections in manufacturing industry.
  2. To model machine components with inclined surfaces in 3-D.
  3. To obtain the auxiliary views, true shape of the inclined surface.
- **Outcomes:** After completing this unit, student will be able to,
  1. Describe significance of auxiliary views in manufacturing industry.
  2. Create 3-D models of machine components with inclined features.
  3. Obtain & plot the auxiliary views & true shape.
- **Unit content:** Introduction: Meaning, significance & applications of auxiliary views, modeling of machine components having inclined features using 3D-commands, Obtaining different views of component & true shapes of inclined surfaces, Plotting the views.
- **Content Delivering Methods:** Demonstration on suitable software package, animations/videos exhibiting basics & importance of auxiliary views.
- **Assessment Methods:** Exercise on obtaining auxiliary views of machine components.

UNIT-7 Details and assembly drawing (3D) **No. of lectures-02**

- **Prerequisite:** Fundamentals of 3-D modeling, study of internal & external features of machine components.
- **Objectives:**
  1. To understand importance of part models & assembly models in analysis & manufacturing using computers.
  2. To prepare part models of individual machine components.
  3. To assemble part models to form 3-D assembly of the unit.
- **Outcomes:** After completing this unit, student will be able to,
  1. Apply the skill set developed to form part models & assembly models.
  2. Model prototypes of their mini-projects, projects, experimental set-ups, etc.
- **Unit content:** To prepare 3D models of individual parts of an assembly, To prepare 3D assembly from the prepared models of individual parts, Plotting of 3D Part models & 3D assembly models.
- **Content Delivering Methods:** Demonstration on suitable software package, animations/videos exhibiting the 3-D modeling & assembling of machine units.
- **Assessment Methods:** Exercise on preparing part models & assembly models of a unit comprising of 6-10 components.

UNIT-8 Lisp programming **No. of lectures-02**

- **Prerequisite:** Understanding of the sequence of operations in every command of the CAD package, fundamental structure of a computer program.
- **Objectives:**
  1. To understand importance of programming in reducing operation time on computers.
  2. To know fundamentals of Lisp program.
  3. To construct & execute Lisp programs as per requirement.
  4. To introduce parametric programming.

- **Outcomes:** After completing this unit, student will be able to,
  1. Describe importance of programming in CAD/CAM.
  2. Construct & execute Lisp programs for reducing operation time.
  3. Apply concept of parametric programming for simple machine components.
- **Unit content:** Introduction: Concept, significance & applications of Lisp Programming, Structure of a program, steps to write, load & execute a lisp program in the software package, Data types: sting, integer, real, list, etc, Mathematical operations : addition, subtraction, multiplication, division, exponential, trigonometric functions, List filtering functions : CAR, CADR, CDR, CADDR, etc, Polar functions, Lisp programming based on above contents & Introduction to parametric programming.
- **Content Delivering Methods:** Chalk & talk, demonstration on suitable software package.
- **Assessment Methods:** Class quiz & Exercise on different programs.

- **End Semester Examination (ESE) :** 50 marks
  'Practical and Oral Examination' at the end of the semester will be conducted to assess students on the grounds of skill development & their ability to apply the knowledge.
- **Internal Continuous Assessment (ICA):** 50 marks

  A] Following sheets to be completed in suitable computer aided drafting package (Printouts / plots should be taken)
  1. Sheet based on computer aided drafting of simple machine components
  2. Sheet based on computer aided drafting of isometric projection of machine components
  3. Sheet based on Computer Aided Drafting (2D) of details & assembly drawing (assembly of 8-12 components)
  4. Sheet based on interpenetration of solids (3D)
  5. Sheet based on auxiliary projection (3D)
  6. Sheet based on Computer Aided Drafting (3D) of details & assembly drawing (assembly of 6-10 components)

  B] Following program on lisp programming to be written & executed in suitable package. (Printouts of the programs & output results should be taken)
  1. Introductory Programs
  2. Program based on mathematical operations
  3. Program based on list filtering
  4. Program based on polar function
  5. Simple Program based on parametric programming
- **Text Books:**
  1. Ajeet Singh, "Working with AutoCAD 2000", Tata McGraw Hill.
  2. George Omura, "ABC of Autolisp " BPB Publications, New Del. P.S. Gill, Machine Drawing., S.K. Kataria and Sons , Delhi.
  3. N. D. Bhatt,. Machine Drawing. Charotor Publication House, Bombay.
  4. N. Sidheshwsr .P. Kannaiah & V.V.S. Sastry. Machine Drawing, Tata McGraw Hill, New Delhi.
  5. K. L. Narayana, P. Kanniah, & K.V. Reddy, "Machine Drawing".SciTech Publications (India Pvt. Ltd.) Chennai.

- **Reference Books:**
  1. IS: SP46- Engineering drawing practice for schools and colleges, B.I.S. Publications.
  2. IS: 696- Code of practice for general engineering drawings B.I.S. Publications.

3. IS: 2709-Guide for selection of fits, B.I.S. Publications.
4. IS: 919- Recommendation for limits and fits for Engineering, B.I.S. Publications.
5. IS: 8000- Part I, II. III. TV, geometrical tolerancing of technical drawings, B.I.S. Publications.

Solapur University, Solapur
S. E. (Mechanical Engg.) Semester-I
ME227 WORKSHOP PRACTICE – III

Teaching Scheme: **Examination Scheme:**
Practical: 2 Hours / week **ICE: 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 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.