COEP Technological University Pune

(A Unitary Public University of Govt. of Maharashtra)

School of Mechanical Engineering
Syllabus

FY-SY-B. Tech
Mechanical Engineering

(Effective from: A.Y. 2023-24)

Syllabus:

Unit	Contents	Hrs.
1	**Introduction to Engineering Drawing** Drawing tools, drawing standards, line conventions, lettering, systems and rules of dimensioning	2
2	**Orthographic Projections** Principles of Orthographic Projections, types of orthographic projections–First angle and third angle projections, Obtaining orthographic projections of given pictorial views by using first angle projection method along with sectional views. Basic drawing commands to draw 2D views using CAD software	4
3	**Development of lateral surfaces (DLS) of solids** Applications of development of lateral surface, methods of development, development and antidevelopment of lateral surface of solids (Prism, Pyramid, and Cone)	4
4	**IsometricProjections** Principles of Isometric projection – Isometric and natural Scale, Isometric views of simple and compound solids, drawing isometric views from given orthographic views. Basic drawing commands to draw 3D views using CAD software	4

Suggested learning recourses:

Textbooks:

- N.D.Bhatt, "Elementary Engineering Drawing", Charotar Publishing House, Anand (India)
- M.L.Dabhade, "Engineering Graphics" I, Vision Publications, Pune
- Dhananjay Jolhe, "Engineering Drawing", Tata McGraw Hill publishing company Ltd., New Delhi.

Reference Books:

- Warren Luzzader, "Fundamentals of Engineering Drawing", Prentice Hall of India, New Delhi.
- Shah, M.B. & Rana B.C.), "Engineering Drawing and Computer Graphics", Pearson
- Education Agrawal B. & Agrawal C. M., "Engineering Graphics", TMH Publication

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Course: Engineering Drawing and graphics Lab

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Engineering Drawing and Graphics	1	0	4	1	3	CIE: 100			CIE: 100	

Course Outcomes:

Students who successfully complete this course will have demonstrated an ability to:

1. Develop the ability to visualize and communicate three dimensional shapes and their sections by representing three-dimensional objects into two-dimensional views using concept of orthographic projection.
2. Draw the development of lateral surfaces of assembly and cut sections of different geometrical solids for engineering applications.
3. Apply the visualization practices to draw isometric projection from a given orthographic views.
4. Draw 2D and 3D drawings using computer aided drafting tool

Syllabus:

Unit	Contents	Hrs.
1	**Orthographic view** Two examples on orthographic views one with principal views and another with sectional views.	**4**
2	**Development of lateral surface of solids** One example on development of solid and another on antidevelopment of solid.	**4**
3	**Isometric views:** Two example on Isometric views.	**4**
4	**Orthographic Views (using CAD software):** Draw 2D views of any 04 examples using CAD software.	**4**
5	**Isometric views (using CAD software)** Draw 3D views of any 04 examples using CAD software.	**4**

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Course: Systems in Mechanical Engineering

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Systems in Mechanical Engineering	2	0	2	1	3	30	10	60	50	50

Course Outcomes:

Students who successfully complete this course will have demonstrated an ability to:

1. Understand the basic concepts and application of thermodynamics
2. Apply laws of Thermodynamics to various energy conversions devices
3. Understand power transmission elements and identify their suitability for various industrial power transmitting applications.
4. Select manufacturing processes suitable to produce components.

Syllabus:

Unit	Contents	Hrs.
1	**Introduction to Thermodynamics** Basic Concepts: Thermodynamic system, Equilibrium etc. Thermodynamic work and Heat, I and II Laws of thermodynamics and their applications in Engineering, Heat Engine, Refrigerator and Heat pump, Carnot Principle.	**6**
2	**Energy Conversion Devices:** Boilers, working principle of Steam turbine, Gas turbine, Hydraulic turbines. I.C. engines (2 Stroke and 4 stroke), Reciprocating Compressor, Reciprocating and Centrifugal pump (Elementary treatment only).	**7**
3	**Machine elements** Power transmission shafts, axles, keys (types and constructional features), Bearings: Purpose, Classification, Sliding contact bearing: Solid journal bearing, Bush bearing, Rolling contact bearing: Ball bearing, Roller bearings Power Transmission Devices (basic elements and constructional features): Belt drive: Flat and V belt drive, Open and Cross belt drive, Chain drive, Gear drives: Spur gear, Helical Gear, Spiral Gear, Bevel Gear, Worm and Worm Wheel, Rack and Pinion, Couplings: Rigid Coupling: Muff coupling, Flange Coupling, Flexible Coupling: Universal Coupling	**6**
4	**Introduction to Manufacturing** Machine tools: Lathe machine, Drilling Machine, Milling machine (Basic elements, Working Principle and operations) Manufacturing processes: Casting: Pattern making, Moulding, Forging, and metal joining processes: Welding, Soldering, Brazing	**7**

Suggested learning resources:

Textbooks:

1. P. K Nag, "Engineering Thermodynamics", Tata McGraw-Hill Publishing Co. Ltd, 2005
2. Hajra Choudhary, "Elements of Workshop Technology", Media Promoters and Publishers Pvt. Ltd, 2010
3. Rajput, R.K., (2007), "Basic Mechanical Engineering", Laxmi Publications Pvt. Ltd

Reference Books:

1. Yunus A. Cengel & Boles, "Thermodynamics ",Tata McGraw-Hill Publisher Co. Ltd., 2001
2. Arora and Domkunwar, "Thermal Engineering", Dhanpat Rai and Sons., 2009
3. Basic Engineering Thermodynamics, 'Rayner Joel", Pearson Education, 2008
4. V. B Bhandari, Design of machine elements, Tata McGraw-Hill Publisher Co. Ltd., 2010 Tata McGraw Hill publishER Co. Ltd., 2017

Manufacturing processes for Engineering materials, S. Kalpakjian, Pearson Publication, 2010

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Course: Systems in Mechanical Engineering Lab

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Systems in Mechanical Engineering	2	0	2	1	3	30	10	60	50	50

Course Outcomes:

Students who successfully complete this course will have demonstrated an ability to:

1. Develop the understanding of thermodynamics laws and apply to various energy devices
2. Utilize the knowledge obtained in theory to identify mechanical elements and devices.
3. Identify and select suitable manufacturing operation for component manufacturing.

Syllabus:

Sr. no.	Contents	Hrs.
	Demonstration/Study of the following systems to be completed by every student (Any SIX). 1) Energy conversion devices (any TWO) 2) Internal Combustion (IC) engine (4 Stroke / 2 Stroke / Petrol / Diesel) 3) Machine elements (key, shaft, bearing etc.) 4) Power transmission devices (gear, belt, chain, coupling etc.) 5) Working of machine tools and parts (any TWO) 6) Conventional and non-conventional energy sources and power plants (any THREE) 7) Working of Computer Numerical Controlled (CNC) machine 8) Understanding of Industrial Robotics and its applications Automation of manufacturing systems	**6**

Term Work:

The student's journal should contain write-ups on theory/specifications of the device/sketch/layout/assignment/sample short questions/latest knowhow etc. for every lab work. Assessment of student must be based on understanding of theory, attentiveness during demonstration and journal submission. Each candidate shall be required to complete and submit the lab journal

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Course: Engineering Thermodynamics

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Engineering Thermodynamics	3	1	0	0	4	30	10	60	--	--

Course Outcomes:

Students who successfully complete this course will have demonstrated an ability to:

1. Apply basic laws of thermodynamics in analysis and design of thermodynamic cycles including vapor and gas power cycles, refrigeration cycles, and heat-pump.
2. Use thermodynamic relations in evaluation of thermodynamic properties.
3. Apply the fundamentals of conservation of mass and energy, and properties of ideal gas mixtures in design and analysis.
4. Evaluate performance of air standard cycles.

Syllabus:

Unit	Contents	Hrs.
1	**Basic concepts and properties:** Introduction, thermodynamic system, control volume, macroscopic and microscopic approaches, properties and state of a system, point and path functions, thermodynamic equilibrium, processes and cycles, quasi-static process, properties such as specific volume, pressure, temperature, zeroth law of thermodynamics, temperature scales	6
2	**Ideal gases and vapors:** Difference between gases and vapors, ideal gases, gas laws, equation of state, gas constant, universal gas constant, work and heat, definition of work, thermodynamic work, work in compressible system, work-a path function, work done during various processes, p-v diagram, definition of heat, heat transfer a path function, comparison of heat and work, Phase change process of a pure substance: specific heats, sensible heat and latent heat, triple point, critical point, superheat and total heat of steam.	6
3	**First law of thermodynamics:** Energy of systems, classification of energy, law of conservation of energy, first law applied to closed system undergoing a cycle, Joule experiment, energy-a property of system, internal energy: a function of temperature, enthalpy, specific heat at constant volume and constant pressure, change in internal energy and heat transfer during various non-flow processes. First law applied to flow processes: steady-state steady flow process, mass balance and energy balance in steady flow process, steady flow energy equation and its application to nozzles and diffusers, throttling valve, turbines and compressors, pumps, heat exchangers etc. Work done and heat transfer during steady flow processes.	6

4	**Second law of thermodynamics:** Limitations of first law, heat engines, refrigerators and heat pumps, Kelvin-plank and Clausius statements, their equivalence, reversible and irreversible processes, factors that render processes irreversible, Carnot cycle, two propositions regarding the efficiency of Carnot cycles, the thermodynamic temperature scale, reversed Carnot cycle, COP of heat pump and refrigeration. Thermodynamic processes – constant volume, isothermal, adiabatic, polytrophic processes, throttling and free expansion- p-v and T-s diagrams-work done, heat exchanged, and change in internal energy.	**6**
5	**Entropy:** Inequality of Clausius, entropy: a property of system, entropy change for ideal gases, entropy change of a system during irreversible process, lost work, principle of increase of entropy. Availability and irreversibility: available energy referred to cycle, decrease in available energy with heat transfer through a finite temperature difference. Tds equations, Availability in a steady flow system, irreversibility and effectiveness.	**6**
6	**Power cycles:** **Gas power cycles:** Otto cycle, Diesel cycle, semi-Diesel, Sterling cycles, and their efficiency and mean effective pressure calculations. **Vapors power cycles:** Properties of steam, specific volume and entropy of steam, dryness fraction of steam, throttling of steam, determination of dryness fraction, steam tables and their use, T-s and H-s diagram, Rankine and modified Rankine cycle, work done and efficiency, specific steam consumption, comparison of Rankine and Carnot cycle, representation on P-v, T-s and h-s diagram.	**6**

Suggested learning resources:

Textbooks:

- Thermodynamics: An Engineering Approach, 3rd Edition, Yunus Çengel and Michael, Boles, Tata McGraw Hill.
- Basic and Applied Thermodynamics, 2nd Edition, Nag P. K., Tata McGraw-Hill.

Reference Books:

- Fundamentals of Thermodynamics, 5th Edition, Richard E. Songtag, Claus Borgnakke and Gordon J. Van Wylen, John Wiley and Sons, Inc.
- Thermodynamics, 4th Edition, J.P. Holman, McGraw-Hill.
- Engineering Thermodynamics, 2nd Edition, Jones J.B. and Hawkins G.A., John Wyley and Sons.
- Fundamentals of Engineering Thermodynamics, Moran M.S. and Shapiro H.N., John Wyley and Sons, 1988.
- Thermodynamics, 5th Edition, K. Wark, McGraw-Hill.

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Course: Solid Mechanics

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Solid Mechanics	2	0	0	1	2	30	20	50	--	--

Course outcomes:

Students who successfully complete this course will have demonstrated an ability to:

1. Apply basic laws of thermodynamics in analysis and design of thermodynamic cycles including vapor and gas power cycles, refrigeration cycles, and heat-pump.
2. Use thermodynamic relations in evaluation of thermodynamic properties.
3. Apply the fundamentals of conservation of mass and energy, and properties of ideal gas mixtures in design and analysis.
4. Evaluate performance of air standard cycles.

Syllabus:

Unit	Contents	Hrs.
1	**Simple stress and strain:** Simple stress and strain- introduction to types of loads (static, dynamic and impact loading), various type of stresses with applications, Hook's law, Poisson's ratio, modulus of elasticity, modulus of rigidity, bulk modulus, interrelationship between elastic constants, stress-strain diagram for ductile and brittle materials, factor of safety, stresses and strains in determinate and indeterminate beams, homogenous and composite bars under concentrated loads and self-weight, thermal stresses in plane and composite members.	**5**
2	**Shear force and bending moment diagram:** Shear force and bending moment diagram (SFD & BMD)- introduction to SFD, BMD with application SFD & BMD for statically determinate beam due to concentrated load, uniformly distributed load, uniformly varying load, couple and combined loading, relationship between rate of loading, shear force and bending moment, concept of zero shear force, maximum bending moment, point of contra flexure.	**5**
3	**Stresses, slope and deflection on beams:** Bending stresses on a beam- introduction to bending stresses on a beam with application, theory of simple bending, assumptions in pure bending, derivation of flexural formula, moment of inertia of common cross section (circular, hollow circular, rectangular – I and T), bending stress distribution along the same cross section. Shear stresses on beam- introduction to transverse shear stresses on a beam with application, shear stress distribution diagram along the circular, hollow circular, rectangular I and T cross section.	**8**

	Slope and deflection on a beam- introduction to slope and deflection on a beam with application slope, deflection and radius of curvature, Macaulay's method.	
4	**Torsion of circular shafts, Buckling of columns and strain energy:** Introduction to torsion on a shaft with application, basic torsion formulae and assumption in torsion theory, torque transmission on strength and rigidity basis. Buckling of columns- Introduction to buckling of columns with its applications, different column conditions, critical and safe load, and determination by Euler's theory, limitations of Euler's theory. Strain energy and impact loading- concept of strain energy, derivation, and use of expressions for deformation of axially loaded members under gradual, sudden and impact loads.	**6**
5	**Principal stresses and Theories of failure:** Principal stresses- introduction to principal stresses with applications, transformation of plane stress, principal stresses and planes (analytical methods and Mohr's circle), stresses due to combined normal and shear stresses. Theories of elastic failure- introduction to theories of failure with application, Maximum Principal stress theory, Maximum shear stress theory, Maximum distortion energy theory, Maximum principal stain theory, Maximum strain energy theory. Thin cylinders and spheres- Introduction, thin cylindrical vessel subjected to internal pressure, stresses in a thin cylindrical vessel subjected to internal pressure, effect on internal pressure on dimensions of a thin cylindrical shell, thin spherical shell, effect on internal pressure on dimensions of a thin spherical shell.	**6**

Suggested learning resources:

Textbooks:

- R K Bansal, "Strength of materials", Laxmi Publication
- S. Ramamurtham, "Strength of materials", Dhanpatrai Publication
- S S Ratan, "Strength of materials", Tata McGraw Hill Publication Co. Ltd.
- S K Sarkar, "Strength of materials", McGraw Hill New Delhi
- Singer and Pytel, "Strength of materials", Harper and row Publication
- R C Hibbeler,"Mechanics of materials", Prentice Hall Publication

Reference Books:

- Egor P Popov, "Introduction to mechanics of solids", Prentice Hall Publication
- G H Ryder, "Strength of materials", McMillan Publication
- Beer and Johnston, "Strength of materials", CBS Publication
- James M. Gere, "Mechanics of materials", CL Engineering
- Timoshenko and Young, "Strength of materials", CBS Publication

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Course: Machine Drawing and Geometric Modeling

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Machine drawing and Geometric Modeling	1	0	2	1	2	30	20	50	--	--

Course outcomes:

Students will be able to:

1. Comprehend various types of drawings, including production drawings, assembly drawings, and part drawings and apply standardization principles for creation of drawings.
2. Evaluate the application of fits, limits, geometric tolerances, and surface finish, and apply them using appropriate nomenclature, symbols, and rules.
3. Evaluate positional and orientation tolerances, understand material modifiers, and apply surface profiles and runout controls effectively in production drawings, ensuring quality and precision in manufacturing processes.

Syllabus:

Unit	Content	Hrs.
1	**Introduction to Machine Drawing:** Types of Drawings, Standardization, Production Drawing, Assembly and part drawings, Blueprint reading, Study, and preparation of bill of materials. Design considerations – Limits, fits, and standardization; Friction and lubrication. **Self-Study:** Dimensioning Techniques, Sections and other conventions, Machine elements and their conventional representation such as keys, Joint between links, springs, gears, cams, shafts, rack and pinions, belt and chains drives, sprockets, pulleys, flywheels, bearings, couplings, clutches, and breaks, threaded parts and locking arrangements, bolted, riveted, welded and adhesive joints, piping layouts, pipe fittings, valves, joints, stuffing box & glands, expansion joints etc.	2
2	**Limits, Fits and Tolerances:** ISO system of tolerance, Tolerance charts, Hole - base and shaft -base system of tolerance, Types of fits, symbols and applications, values related to various manufacturing processes, Application of fits. **Part I: Self-Study:** Application of fits, selection of fits and determination of limits, tolerance values related to various manufacturing processes	4
3	**Geometric Tolerances:** Introduction, Nomenclature, Rules, Symbols, datums and applications of Geometric Tolerances, Max & Min Material principles,	4

	Positional, Orientation tolerance (axis, midplane and surface), Material modifiers (MMC, LMC, RFS), Surface profiles, Surface form tolerance, Runout controls **Part II: Self-Study:** Symbols for geometrical characteristics and their application, method of indicating geometrical tolerances on drawings, application of geometrical tolerances, material modifiers	
4	**Surface Roughness & Production Drawing:** Surface Textures, Roughness values and Roughness Grades, Machining symbols Conventional Representation on part drawings. **Self-Study:** Roughness values and roughness grades, indication of surface roughness details on drawings	**2**

Note: *Content mentioned for self-study is integral part of the syllabus and it will be considered for evaluation of the course.*

Suggested learning resources:

Textbooks:

- Machine Drawing, K. L. Narayana, P. Kanniah, & K.V. Reddy, SciTech Publications
- Production Drawing, K. L. Narayana, P. Kanniah, & K.V. Reddy, New Age International Pvt Ltd

Reference Books:

- IS Code: SP 46 – 1988, Standard Drawing Practices for Engineering Institutes
- Machine Drawing, PS Gill, Katsons
- Machine Drawing, O.P Jahkar, Amit Mathur, Khanna Publishing House
- Machine Drawing, ND Bhat, Charotar Publishing House
- Manual of Engineering Drawing, Colin H Simmons, and Neil Phelps and Dennis Maguire, Elsevier Newnes
- Machine Design, Sadhu Singh, Khanna Book Publishing, 2021.
- Fundamentals of Machine Component Design, Juvinal, R.C., John Wiley, 1994.
- R. L. Norton, "Mechanical Design – An Integrated Approach," Prentice Hall, 2009.
- Sadhu Singh, "Machine Design Data Book", Khanna Book Publishing, 2022.
- Computer Aided Engineering Drawing, S. Trymbaka Murthy, I.K. International Publishing House Pvt. Ltd, Pune
- Engineering Drawing and Computer Graphics, Shah, Pearson

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Course: Machine Drawing and Geometric Modeling Lab

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Machine Drawing and Geometric Modeling lab	0	0	2	1	1	CIE:100			CIE:100	

Course outcomes:

Students will be able to:

1. Comprehend the various machine elements such as keys, gears, shafts, and joints and apply the knowledge of various ISO and BIS standards conventions and guidelines, symbols, tolerances, limits and fits during drafting and part modelling of machine elements.
2. Create 3D geometric model of parts, their orthographic and production drawings using CAD software, considering manufacturing processes and incorporating technical details and symbols.
3. Collaborate effectively to create complex assembly drawings, demonstrating their ability to apply standards and conventions while working in a team.

Syllabus:

Unit	Content	Practical
1	**Lab learning: Studies and demonstration of standard components** Machine elements such as keys, Joint between links, springs, gears, cams, shafts, rack and pinions, belt and chains drives, sprockets, pulleys, flywheels, bearings, couplings, clutches and breaks. Threaded parts and Locking Arrangements. Bolted, Riveted, Welded and Adhesive Joints. Conventional representation of piping layouts, pipe fittings, valves, joints. Stuffing box & glands, Expansion joints etc. **Lab work: Component and assembly study** Observe all machine elements in a machine. Describe their relative position, sequence of assembly, relation with other mating components, classify fits, surface finish, mention feature details, requirement of lubrication etc. ***Self-Study:*** *Observation and studies of different assemblies and their parts such as vehicles, IC engines, machine tools, manufacturing and any mechanical equipment.*	**1**
2	**Lab learning: Standards and conventions:** Dimensioning Techniques, Sections and other conventions. **Lab learning: Orthographic CAD:** Orthographic representation of machine drawing, Draw, Modify, and Edit features/commands in drafting software. **Lab work: Orthographic drawing:**	**3**

	Orthographic drawing of machine elements using 2D drafting software. Complete 3 views along with required sectional views, select machine element with more features along with few internal features which requires use of technical notes, and symbols on machine drawing. • Orthographic drawing No.1 • Orthographic drawing No.2 ***Self-Study:*** *Use of any AutoCAD software for drafting and 3D part modelling.*	
3	**Lab learning: Solid Modelling using CAD:** Part Modeling & Assembly Modeling, editing of solids, Sheet metal modeling, Surface modelling, 3-D operations such as shading and rendering etc. Introduction to CAD customization. **Lab work: Production drawing:** Production drawing of a machine part using part modelling (3D) CAD software. Complete 3 views along with sectional views, select machine element with more features along with few internal features which requires use of technical notes, and symbols, limits, and surface finish on machine drawing. • Production drawing No.1 assuming that the part is manufactured using machining/forging/casting and surface treatment. • Production drawing No.2 assuming the part is made using sheet metal operations and welding/riveting. ***Self-Study:*** *Use of any AutoCAD software for drafting and 3D part modelling.*	**3**
4	**Lab learning: Assembly and part drawings** Blueprint reading, Study, and preparation of bill of materials. Use of Limits, fits, tolerances, surface finish and production requirements on part drawing. **Lab work: Assembly and details using Manual and CAD tools:** Select an Assembly and detail drawing example having at least 6-12 different components. Complete 3 views along with sectional views of assembly and parts. Include required details for production drawing such as limits, fits and tolerances (Size, form, orientation etc.), all symbols, methods and conventions. Also include isometric and exploded views for assembly. • Complete the assembly and detail drawing on an A1 drawing sheet using manual tools. • Complete the assembly and detail drawing using Part/solid (3D) modelling software. ***Self-Study:*** *Use of any AutoCAD software for drafting and 3D part modelling.*	**3**

5	**Lab learning: Collaborative teamwork:** Use of online tools and features in CAD software for concurrent engineering. **Lab work: Assembly and detail drawing using CAD as group assignment in collaborative online CAD environment:** Select an Assembly and detail drawing example having at least 10-15 different components. Select assembly with at least 4 times the number of students. The minimum size of a group should not be less than 2 or more than 4. Complete the assembly and detail drawing using Part/solid (3D) modelling software. Complete 3 views along with sectional views of assembly and parts. Include required details for production drawing such as limits, fits and tolerances (Size, form, orientation etc.), all symbols, methods and conventions. Also include isometric and exploded views for assembly. ***Self-Study:*** *Use of any AutoCAD software for drafting and 3D part modelling.*	**2**

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Course: Manufacturing Technology

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							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Manufacturing Technology	2	0	2	1	3	30	20	50	CIE:100	

Course outcomes:

Students who successfully complete this course will have demonstrated an ability to:

1. Analyse various manufacturing & finishing processes and select the process for a given job.
2. Estimate the indexing movements related to various types of indexing used in milling related process.
3. Apply knowledge of manufacturing processes to solve the related problems.
4. Identify and explain the function of the basic components of machine tools and its accessories.

Syllabus:

Unit	Contents	Hrs.
1	**Hot and cold working of metals:** Principles of rolling, forging, drop, press, upset, roll forging, extrusion, drawing, spinning, and effect of hot working. Cold working processes**,** Cold rolling, swaging, forging, extrusion- forward, backward and impact roll forming, tube drawing, wire drawing, spinning, shot penning, high-energy rate forming, sheet metal working, types of presses, drives, different operations and types of dies, Forging design**.**	**8**
2	**Joining processes:** Arc welding- Theory, SMAW, GTAW, GMAW, FCAW, Submerged arc welding, Stud welding Resistance welding- Theory, spot and seam projection welding processes Gas welding Friction welding, Ultrasonic welding, Thermit welding, EBW and LASER welding Use of adhesive for joining, classification of adhesives, types of adhesive and their application, surface preparation and various joints welding defects and quality.	**6**
3	**Foundry- Pattern making, moulding and casting:** Sand casting, types of pattern material, pattern making allowances, core print moulding, sand properties and testing, hand and machine moulding, core boxes, core making, melting and pouring, melting furnaces- Cupola, electric arc and induction furnaces. Cleaning, finishing and heat treatment of casting, defects in casting, shell moulding and investment casting. Permanent mould dies casting- Die-casting, low-pressure permanent mould casting, hot and cold chamber processing, centrifugal casting, semi centrifugal casting and continuous casting.	**8**
4	**Machining processes-Turning, drilling, reaming and milling:** Turning and boring, lathe construction, accessories and operations. Fundamentals of drilling processes, drill geometry, types of drilling machines, operations performed on drilling machines, type of drill. Reaming processes and reamer types. Fundamental	**8**

	aspects, cutter types and geometry, Operations performed on milling machine, dividing head method of indexing. Fundamentals of CNC Machining- Lathe & milling.	
5	**Grinding and Finishing Processes:** Grinding wheels, wheel marking, wheel selection, wheel mounting, and types of grinding machines. Honing, lapping, super finishing, buffing and burnishing processes.	**5**

Suggested learning resources:

Textbooks:

- Chapman W.A.- "Workshop Technology, Vol. II, III, & I", Edward Arnold Pub.Ltd. London
- Hajra Chaudhary S.K.- Elements of Workshop Technology, Vol. I& II, Media Prom & Pub, Mumbai.

Reference Books:

- HMT Handbook- Production Technology
- Roy A. & Linberg- "Processes and materials of manufacturing", Prentice Hall of India, Delhi.
- Campbell J.S.- Principles of manufacturing Materials and Processes, McGraw-Hill, New York.
- Begeman - "Manufacturing processes", Asia Publishing house Bombay.

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Course: Manufacturing Technology Lab

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Manufacturing Technology	2	0	2	1	3	--			50	50

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Get the knowledge of working of machine tools, mechanisms and accessories used in various manufacturing processes including CNC Machines.
2. Perform the job of turning, chamfering, taper turning and threading operation using conventional and CNC lathe by using CNC Programming.
3. Perform Welding using gas/arc/ resistance welding process.

Syllabus:

Unit	Content	Hrs.
1	**Term work:** Each candidate shall be required to complete and submit the following term work: **Jobs:** Plain and Taper turning – one job (Conventional & CNC Lathe), Thread cutting – one Job, Welding (gas or arc or resistance) – one job	2
2	**Journal:** Assignments on machine tools will be in the form of a journal based on demonstrations on machine tools. This should include sketches and relevant descriptions as given below: • Machines (Any Two) • Lathe • Universal milling machine • Radial drilling machine • Cylindrical grinder. • Mechanisms (Any Two) • Spindle arbor (assembly) drive of milling machine • Half nut mechanism • Thread cutting mechanisms. • Accessories • Universal dividing head • Milling cutter	2

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Course: Humanities & Social Sciences Course (Ability Enhancement Course)
S.Y. B.Tech. (Semester III) – Indian Language: Sanskrit

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Sanskrit	2	0	0	0	2	30	20	50	--	--

Course outcomes:

On satisfying the requirements of this course, students will have the knowledge and skills to:

1. Familiarize themselves with the basic grammatical categories of Sanskrit.
2. Form simple sentences in Sanskrit.
3. Understand and extract the meaning of the prescribed Sanskrit scientific texts.
4. Co-relates the significance of scientific literature with modern knowledge.

Syllabus:

Unit	Contents	Hrs.
1	Introduction to the Sanskrit phonology, Sandhi- Guṇa, Vṛddhi, Yaṇ, Savarṇadīrgha, Introduction to persons, numbers and the present tense. Introduction to Kāraka and Vibhaktis- 1. Prathamā - Dvitīyā 2. Tṛtīyā - Caturthī	**7**
2	Introduction to the past tense and the imperative and potential moods Introduction to Kāraka and Vibhaktis- 1. Pañcamī 2. Śaṣṭhī 3. Saptamī Introduction to Samāsa	**7**
3	Janapadaniveśa - Kauṭilīya Arthaśāstra + Rasaratnasamuccaya	**7**
4	Chapter 1 of the Līlāvatī (up to square roots)	**7**

Suggested learning resources:

- V. S. Apte, The student's Sanskrit to English dictionary, 2015. Motilal Banarasidass.
- A. Macdonell, A Sanskrit English dictionary, 1893, Oxford press.
- V. S. Apte, The student's English to Sanskrit dictionary, 2014. Motilal Banarasidass.
- Samskṛt- Śabdadhātu- Rūpāvali, Navneet publications.
- R. D. Desai, Sanskrit pravesha, 2017, Continental prakashan.
- Madhav Deshpande, Samskṛtsubodhinī, 2007, University of Michigan.

- Web Sanskrit Dictionary based on ``The Practical Sanskrit-English Dictionary" by Vaman Shivaram Apte. - http://www.aa.tufs.ac.jp/~tjun/sktdic/
- Shankar Lal Hari Shankar, RasaRatnaSamucchaya of Vagbhatacharya, 2019, Khemraj Shrikrushnadas Prakashan.
- Colebrook, English translation of the Līlāvatī, (with notes by Banerjee), 1893, Thacker spink and co.
- Līlāvatī, Khemraj Shrikrushnadas, 1908, Shri Venkateshvar steam press Mumbai.
- R. Shamasastry, Kautilya's Arthashastra, 1915, Bangalore: Government Press.
- R. Shamasastry, editor: Ashok Kumar Shukla - with Sanskrit Text, Kautilya's Arthashastra, 1915, Bangalore: Government Press.
- Read Kautilya's Arthashastra for free on: https://www.wisdomlib.org/hinduism/book/kautilya-arthashastrasanskrit/ d/doc905574.html

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Course: Humanities & Social Sciences Course (Ability Enhancement Course)
S.Y. B.Tech. (Semester III) – Indian Language: Pali

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Pali	2	0	0	0	2	30	20	50	--	--

Course outcomes:

On satisfying the requirements of this course, students will have the knowledge and skills to:
1. Students will become acquainted with some literary specimens of Pali literature in prose and poetry.
2. Through this literature they will learn ancient Indian moral, humanitarian and scientific values.
3. They will develop an interest in the Pali language and literature.
4. They will learn to appreciate the Indian literary heritage.

Syllabus:

Unit	Content	Hrs.
1	Introduction to Pali: What is Pali? Its origin and homeland; Pali Literature: Early Phase, Commentarial Phase and Post commentarial Phase	**7**
2	Introduction to Grammar: Alphabets, Pronunciation, Phonetic variation; Noun, Verb and Sentence formation	**7**
3	Selected Prose: Nakkhattajātaka, Vīmaṃsakasutta, Kālāmasutta, Vitakkasaṇṭhānasutta	**7**
4	Selected Poetry: Selected portion from Dhammapada, Puṇṇikātherī, Kumbhajātaka with pronunciation and recitation	**7**

Suggested learning resources:

- B. Mahadevan, Bhat Vinayak and NagendraPavan R.N., 'Introduction to Indian Knowledge Systems: Concepts and Applications'
- Dharmapal 'Indian Science and Technology'
- Kapil Kapoor, Singh Avdhesh Kumar, 'Indian Knowledge Systems'
- Chattopadhyaya, Debiprasad, History of science and technology in ancient India: the beginnings, Firma KLM Pvt. Ltd. 1986.
- Irfan Habib (ed.), People's History of India – Vol 20: Technology in Medieval India, c. 650–1750, Aligarh Historians Society and Tulika Books, 2016.
- Jan Gonda, A History of Indian Literature, Otto Harrassowitz, Wiesbaden, 1975.

- L. Gopal and V. C. Shrivastava, History of Agriculture in India (Upto 1200 A. D.), Concept Publishing, New Delhi, 2008.
- PushkarSohoni, Introduction to the History of Architecture in India, IISER, Pune, 2020.
- SurendranathDasgupta, A History of Indian Philosophy, Cambridge University press, 1922.
- RadhavallabhTripathi, Vāda in theory and practice: studies in debates, dialogues and discussions in Indian intellectual discourses, IIAS, Shimla, 2016.
- ThanuPadmanabhan (ed.), Astronomy in India: A Historical Perspective, Indian National Science Academy, Springer, New Delhi. 2014.

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Course: Value Education Course

S.Y. B.Tech. (Semester III/IV) Constitution of India & Universal Human Values

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Constitution of India & Universal Human Values	1	0	0	0	1	CIE: 100			--	

Course Outcomes:

Students will be able to

1. Understand the basis of Law, the concept 'Constitution' and the interpretation of the Preamble.
2. Define the basis of governance of the nation and the fundamental rights. Illustrate the functioning of the Union and the State Executive.
3. Outlines the aspects that allow the use of rights to fulfill one's duties as a responsible citizen.
4. Analyze the moral and ethical character needed for a professional engineer.

Syllabus:

Unit	Contents	Hrs.
1	Introduction to The Constitution of India, understanding its objects. Preamble to the constitution of India. Understanding the concept 'Rule of Law', Human Rights and Fundamental Rights.	**3**
2	Fundamental rights under Part-III, Exercise of the Rights, limitations, and important cases. Fundamental duties & their significance. Relevance of Directive principles of State Policy.	**3**
3	Legislative, Executive & Judiciary (Union and State Level) Prerogative Writs. Electoral procedure in India	**3**
4	Constitutional Provisions for Scheduled Castes, Scheduled Tribes, & Backward classes. Constitutional Provisions for Women & Children; Emergency Provisions. Amendment procedure and few important Constitutional Amendments	**3**
5	Relationship between Law and Ethics, Professional Ethics for Engineers Universal Human Values	**2**

Suggested Readings:

- Introduction to the Constitution of India by Durga Das Basu (Students Edn.) Prentice – Hall EEE, 19th/20th Edn.
- Suresh, J. & Raghavan, B.S. (2016). Human Values and Professional Ethics. S. Chand & Company Pvt. Ltd. New Delhi.
- Engineering Ethics by Charles E.Haries, Michael. S.Pritchard and Michael J.Robins Thompson Asia,
- An Introduction to Constitution of India by M.V. Pylee, Vikas Publishing. Gogate, S. B. (2011). Human Values & Professional Ethics. Vikas Publishing House Pvt. Ltd. New Delhi.

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Course: Mathematics

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Mathematics	3	0	0	1	3	30	20	50	--	--

Course outcomes:
Students who successfully complete this course will have demonstrated an ability to:

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Syllabus:

Unit	Contents	Hrs.
1	**Matrix Algebra:** Properties of Matrices and Determinants, Solutions of Systems of linear equations using Gauss Elimination method, Eigen Values and Eigen Vectors. *Self-study: Properties of Matrices and Determinants*	**6**
2	**Calculus:** Functions of several variables (Domain and Range), Partial Derivatives, The Chain Rule, Double Integral, Triple Integral, Cartesian and polar coordinates. Applications to Area, Volume, Moments, and Center of Mass. *Self-study:* Applications of Double and Triple Integral.	**8**
3	**Vector Calculus:** Vector differentiation, gradient, divergence and curl, line integrals, surface integrals, statements, and illustrations of theorems of Green, Stokes and Gauss, applications. *Self-study:* Area, Volume, Moments, and Center of	**10**
4	**Ordinary Differential Equations:** First order Ordinary Differential Equations - Variable Separable, Homogeneous, Linear; Higher order linear equations with constant coefficients, non-homogeneous higher order linear differential equations with constant coefficients: method of variation of parameters; Applications to Initial value problems: Simple Electrical Circuits. *Self-study:* First order Ordinary Differential Equations - Variable Separable, Homogeneous ODEs (Ordinary Differential Equations)	**8**
5	**Partial Differential Equations:** Fourier Series; Partial differential equations. Initial and Boundary value problems by separation of variables method, boundary value problems: Vibration of string: one dimensional wave equation. *Self-study:* Types of PDEs (Partial Differential Equations)	**8**

	OR	
6	**Probability:** Mean, median, mode, standard deviation, combinatorial probability, joint and conditional probability. Probability distributions, Binomial distribution, Poisson distribution, Normal distribution.	**8**

Suggested learning resources:

Textbooks:

- Advanced Engineering Mathematics (10^{th} edition) by Erwin Kreyszig, Wiley Eastern Ltd.
- Thomas' Calculus (14^{th} edition) by Maurice D. Weir, Joel Hass, Frank R. Giordano, Pearson Education.

Reference Books:

- Calculus for Scientists and Engineers by K.D Joshi, CRC Press.
- A course in Calculus and Real Analysis (1^{st} edition) by Sudhir Ghorpade and Balmohan Limaye, Springer-Verlag, New York.
- Applied Mathematics Vol.1 (Reprint July 2014) by P.N. Wartikar and J.N. Wartikar, Pune Vidhyarthi Griha Prakashan Pune.

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Course: Humanities & Social Sciences Course

S.Y. B.Tech. (Semester III/IV) – Principles of Entrepreneurship

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Principles of Entrepreneurship	2	0	0	1	2	30	20	50	--	--

Course Outcomes:

On completion of syllabus students will understand the basic concepts of entrepreneurship and business opportunities to familiarize themselves with knowledge about business and project reports for starting a new venture on team based.

1. To enable the students to understand the concept of Entrepreneurship and to learn the professional behavior expected of an entrepreneur.
2. To identify significant changes and trends which create business opportunities and to analyze the environment for potential business opportunities.
3. To provide conceptual exposure on converting idea to a successful entrepreneurial firm.

Syllabus:

Unit	Contents	Hrs.
1	Entrepreneurship: Meaning of entrepreneurship – Types of Entrepreneurships – Traits of entrepreneurship – Factors promoting entrepreneurship- Barriers to entrepreneurship- the entrepreneurial culture- Stages in entrepreneurial process – Women entrepreneurship and economic development- SHG.	**3**
2	Developing Successful Business Ideas: Recognizing opportunities – trend analysis – generating ideas – Brainstorming, Focus Groups, Surveys, Customer advisory boards, Day in the life research – Encouraging focal point for ideas and creativity at a firm level-Protecting ideas from being lost or stolen – Patents and IPR.	**4**
3	Opportunity Identification and Evaluation Opportunity identification and product/service selection – Generation and screening the project ideas – Market analysis, technical analysis, Cost benefit analysis and network analysis- Project formulation – Assessment of project feasibility- Dealing with basic and initial problems of setting up of Enterprises.	**3**
4	Business Planning Process Meaning of business plan- Business plan process- Advantages of business planning preparing a model project report for starting a new venture (Team-based project work)	**2**
5	Funding Sources of Finance- Venture capital- Venture capital process- Business angles Commercial banks- Government Grants and Schemes.	**2**

Suggested Readings:

Text Books:

- Reddy, Entrepreneurship: Text & Cases - Cengage, New Delhi.
- Kuratko/rao, Entrepreneurship: a south asian perpective.- Cengage, New Delhi.
- Leach/Melicher, Entrepreneurial Finance – Cengage., New Delhi.
- K.Sundar – Entrepreneurship Development – Vijay Nicole Imprints private Limited
- Khanka S.S., Entrepreneurial Development, S.Chand & Co. Ltd., New Delhi, 2001.
- Sangeeta Sharma, Entrepreneurship Development, PHI Learning Pvt. Ltd., 2016.
- P. Khanna, "Industrial Engineering and Management", Dhanpatrai publications Ltd, New Delhi.

Reference Books:

- Barringer, B., Entrepreneurship: Successfully Launching New Ventures, 3rd Edition, Pearson, 2011.
- Bessant, J., and Tidd, J., Innovation and Entrepreneurship, 2nd Edition, John Wiley &Sons, 2011.
- Desai, V., Small Scale Industries and Entrepreneurship, Himalaya Publishing House, 2011.
- Donald, F.K., Entrepreneurship- Theory, Process and Practice, 9th Edition, Cengage Learning, 2014.

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Course: Fluid Mechanics

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Fluid Mechanics	3	0	2	1	4	30	20	50	50	50

Course outcomes:

Students who successfully complete this course will have an ability to:

1. Understand and apply the basic concepts of Fluid Mechanics for solving problems involving fluid properties: Static and kinematic.
2. Derive and apply the governing equations of Fluid Dynamics.
3. Apply energy equations for various Fluid systems and measuring devices.
4. Apply and understand various dimensionless numbers for problems in fluid mechanics.

Syllabus:

Unit	Contents	Hrs.
1	**Basics with fluid statics:** Definition of fluid, fluid properties such as viscosity, vapor pressure, compressibility, surface tension, capillarity, Mach number etc., pressure at a point in the static mass of fluid, variation of pressure, Pascal's law, pressure measurement by simple and differential manometers using manometric expression. Introduction to Hydrostatic forces and Centre of pressure, Buoyancy, Centre of buoyancy, stability of floating bodies, metacenter and metacentric height and its application in shipping.	**6**
2	**Fluid Kinematics:** Velocity of fluid particle, types of fluid flow, description of flow, acceleration of fluid particle, rotational & irrotational flow, path line, streamline and streak line, Laplace's equation in velocity potential and Poisson's equation in stream function, flow net, Vorticity and Circulation.	**4**
3	**Governing equations in Fluid Dynamics** Continuity equation (Cartesian, polar and cylindrical coordinates). Derivation of Momentum equations using differential approach, Reynolds transport theorem, Integration of Euler's equation to obtain Bernoulli's equation, Bernoulli's theorem, Application of Bernoulli's theorem such as Venturi meter, Orifice meter, pitot tube (static, dynamic and stagnation pressure) and orifices etc. Introduction to Navier Stokes Equation.	**6**
4	**Laminar flow:** Hagen-Poiseuille equation, flow through parallel plates, Couette flow. **Introduction to boundary layer:** Thickness, over a plate, Equations of boundary layer, Laminar and turbulent boundary layer, introduction to flow separation of layer, and methods	**6**

	for control. Introduction to External flow: Drag, lift, Drag on cylinder, Development of lift in Cylinder	
5	**Turbulent flow**: Introduction to RANS (Models). Development in pipes, Velocity distribution in pipes, hydrodynamic smooth and rough pipe. Introduction to compressible flow.	**6**
6	**Flow through pipes:** Reynolds's experiment, frictional loss in pipe flow, major and minor losses, HGL and TEL, flow through series and parallel pipes, Equivalent Pipe, Loss of head due to friction in a pipe with side tapping's, siphon, Power Transmission, Pipe networks. Dimensional homogeneity, Rayleigh's method, Buckingham's theorem. Similitude and Model analysis: similarity laws and dimensionless numbers.	**8**

Suggested learning resources:

Textbooks:

- Hydraulics and Fluid Mechanics including Hydraulic Machines, Dr. P. N. Modi and Dr. S. M. Seth, Standard Book House S. Ramamurtham, "Strength of materials", Dhanpatrai Publication.
- Textbook of Fluid Mechanics and Hydraulic Machine, Dr. R. K.Bansal, Laxmi Publications, New Delhi S K Sarkar, "Strength of materials", McGraw Hill New Delhi.
- Fluid Mechanics – Fundamentals and application. YunusCengel and John Cimbala.
- Introduction to Fluid Mechanics and Fluid Machines. S. K.Som, GautamBiswas and Suman Charaborty. Mc-Graw Hill Publication.

Reference Books:

- Introduction to Fluid Mechanics, Fox R W, Pritchard P J, A T Mc Donald. John Wiley and Sons Publication G H Ryder, "Strength of materials", McMillan Publication
- Fluid Mechanics, Frank M. White. McGraw Hill Publications
- Engineering Fluid Mechanics, Prof K L Kumar, Chand Publication
- Fluid Mechanics, P. K. Kundu, I. M. Kohen and David Dowling Fifth Edition Elsevier Publication.

Course: FLUID MECHANICS LAB

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Fluid Mechanics	3	0	2	1	4	30	20	50	50	50

Course outcomes:

Students will be able to

1. Measure the pressure using manometers
2. carry out the velocity/discharge measurement using various devices
3. determine the coefficient of discharge using Bernoulli's equation
4. determine the friction factor for flow
5. Determination of Reynolds number and flow visualization.

Lab work Term-work:
The candidates must carry out the experiments and the analysis of the fluid flow phenomenon through at least 7 experiments from (sr. no. 1 to 11) and Sr. no 12.

- Measurement of viscosity using Red Wood viscometer/Falling sphere viscometer.
- Study and demonstration of pressure measurement using manometers.
- Determination of the metacentric height of a floating body and its stability.
- Verification of Bernoulli's Principle and Total energy.
- Calibration Venturi meter for flow measurement
- Calibration Orifice meter for flow measurement
- Demonstration of Pitot tube for velocity measurement
- Demonstration and flow visualization of laminar and turbulent flow using Reynolds apparatus.
- Determination of the frictional losses and friction factor in pipes.
- Determination of pressure variation around a circular body/surface when it is submerged in a flow.
- Small application-oriented assignment based on concepts in fluid mechanics.
- Flow through pipe using CFD software

Course: Design of Machine Elements

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Design of Machine Elements	2	1	0	1	3	30	20	50	--	--

Course Outcomes:

1. Apply fundamentals of machine design to identify the type of design to formulate the design problem statement and apply the design procedure.
2. Evaluate the different types of modes of failures/stresses induced in a component due to different types of static loading conditions and design the elements/simple joints like cotter or knuckle joint against the most critical mode of failure.
3. Apply the shaft design codes to design various shafts, design of keys and couplings, springs like, helical compression, helical torsion and leaf spring.
4. Design various types of bolted joints and power screws and welded joints subjected to static loads and bending moments.

Syllabus:

Unit	Contents	Hrs.
1	**Fundamental aspects of design:** The meaning of design, engineering design, phases of design, design considerations, stress and strain considerations, factor of safety, standardization, preferred series.	**6**
2	**Design against static load:** Modes of failure, Critical mode of failure, stresses due to bending and torsional load, eccentric loading, Design for biaxial loading through theories of failure, design of cotter and knuckle joints.	**6**
3	**Design of shafts, keys, and couplings:** Shaft, Types of Shafts, Shaft subjected to bending and torsion, Shaft design on strength basis and rigidity deflection basis, A.S.M.E code for shaft design, types of keys and their design, design of rigid and flexible couplings.	**6**
4	**Design of threaded Joints and Power screws:** Threaded Joints, I.S.O Metric screw threads profile, Coarse and fine threads, designation of metric threads, Bolts of uniform strength, Design of bolted and threaded joints, eccentrically loaded bolted joints, Design of power screws.	**6**
5	**Design of welded joints:** Types of welded joints, stresses in welded joints, strength of welded joints, eccentrically loaded welded joints, and welded joints subjected to bending moment.	**6**
6	**Design of Mechanical Springs**	**6**

	Mechanical Spring, Types of springs, Terminology of helical spring, Design of mechanical springs, helical torsion spring, design of multi leaf spring, nipping and shot peening of spring.	

Suggested learning resources:

Textbooks:

- Shigley I.E. and Mischke C.R., "Mechanical Engineering Design", McGraw Hill Education (India) Ltd.
- Bhandari V.B., "Design of Machine Elements", McGraw Hill Education (India) Ltd.
- Khurmi and Gupta, "A textbook of Machine Design" S Chand Publication.

Reference Books:

- Spotts M. F., "Design of Machine Elements", Prentice Hall International.
- Black P.H. and Eugene Adams, "Machine Design", McGraw Hill Book Co. ltd.
- P.S.G. College of Technology, "Design Data, Coimbatore.
- Hall A.S., Holowenko A.R. and Laughlin H.,"Theory and Practice of Machine Design", Schaumis outline series, McGraw Hill Publication.

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Course: Kinematics of Machines

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Kinematics of Machines	3	0	2	1	4	30	20	50	50	50

Course outcomes:

Students who successfully complete this course will have demonstrated an ability to:

1. Understand the concepts of motion transmission.
2. Determine the displacement, velocity, acceleration of points in given mechanisms analytically and graphically.
3. Calculate the torque and power transmitted by different types of gears.
4. Determine and illustrate the motion, acceleration of different types of cams and followers and illustrate the various types of governors.

Syllabus:

Unit	Contents	Hrs.
1	**Fundamentals of kinematics:** Kinematic link, Kinematic pair, Types of constrained motions, Types of Kinematic pairs, Kinematic chain, Types of joints, Mechanism, Machine, Degree of freedom (Mobility), Kutzbach criterion, Grubler's criterion, Grashoff's law for four bar kinematic chain. Inversions of Four bar chain, Slider crank chain and Double slider crank chain, Hooke's joint, Introduction to Compliant mechanism.	**8**
2	**Velocity and acceleration analysis:** Graphical methods - Relative velocity and acceleration methods, Corioli's component of acceleration, instantaneous centre of Rotation method,	**10**
3	**Kinetics of slider crank mechanism:** Static and dynamic force analysis of slider crank mechanism, dynamically equivalent system, correction couple, Klein's construction, graphical and analytical method for determination of torque on crankshaft for IC engine.	**8**
4	**Kinematics of Gears** Classification of gears, Types of gears, Spur gears - terminology, fundamental law of toothed gearing, involute and cycloidal profile, conjugate action, contact ratio, minimum number of teeth, interference and under cutting. Helical gears: Nomenclatures, center distance, force analysis.	**8**
5	**Kinematics of cams and followers and governors**	**8**

	Types of cams and followers, types of follower motion, velocity and acceleration diagrams, profile of cam cams for various follower motions. Governor of different types, Sleeve displacement and speed relation of the governor.	

Suggested learning resources:

Textbooks:

- John Hannah and Stephens, R. C., "Mechanics of Machines: Advanced Theory and Examples", 1970, Hodder; Student international edition ISBN 0713132329 Edward Arnold London
- Ballaney, P., "Theory if Machines and Mechanisms", 2005, ISBN 9788174091222 Khanna Publications
- S S Ratan, "Theory of Machines", Tata McGraw Hill Publication Co. Ltd.
- Bansal, R. K., "Theory of machines", Laxmi Publications Pvt. Ltd, New Delhi

Reference Books:

- Bevan Thomas, "The Theory of Machines", 3rd edition, CBS publishing
- Uicker Jr, J. J., Penock G. R. and Shigley, J. E., "Theory oif Machines and Mechanisms' 2003, Tata McGraw Hill
- Ramamurthy, V., "Mechanisms of Machines", 3rd edition, ISBN 978-1842654569, Narosa Publishing House

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Course: Kinematics of Machines Lab

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Kinematics of Machines	3	0	2	1	4	30	20	50	50	50

Course Objectives:

At the end of the course, students will demonstrate the ability to:

1. Students will demonstrate ability towards graphically estimating velocity and acceleration.
2. Students will exhibit skills towards application of principles of static and dynamics force analysis.
3. Students will demonstrate knowledge of various mechanisms to design and analyse mechanisms essential in mechanical engineering.

Syllabus:

Unit	Contents	Hrs.
1	**List of Experiments:** 1. Determination of moment of inertia of rigid bodies by bifilar/trifilar suspension methods. 2. Compound pendulum. 3. Experimental verification of displacement relation for different shaft angles for single Hooke's joint. 4. To generate gear tooth profile and to study the effect of under cutting and rack shift using model. 5. To determine the characteristics curve of any two types of centrifugal governor and to find its coefficient of in-sensitiveness and stability.	2 each
2	**List of Assignments:** 1. Analytical determination of inertia forces in engine mechanisms. 2. Problem on Hooke's joint.	
3	**List of Drawing Sheets:** 1. Graphical solution to problems on velocity acceleration in mechanism by relative velocity and acceleration method including problem with Corioli's component of acceleration. 2. Velocity by instantaneous centre method. 3. Klein's construction and inertia force analysis for slider cranks mechanisms. 4. To draw cam profile for various types of followers' motion.	
4	Kinematics study of mechanism using CAD software	

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Course: Humanities & Social Sciences Course

S.Y. B.Tech. (Semester III/IV) – Principles of Economics

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Kinematics of Machines	2	0	0	1	2	30	20	50	--	--

Course Outcomes:

1. Demonstrate understanding of economic theories and policies.
2. Identify economic problems and solve them by applying acquired knowledge, facts and techniques in the available framework.
3. Categorize, classify and compare economic situations and draw inferences and conclusions.
4. Adapt to changing economic atmosphere and propose alternative solutions to the problems.

Syllabus:

Unit	Content	Hrs.
1	Introduction to Economics Definitions, basic concepts of economics: Cost, efficiency and scarcity, Opportunity Cost, Types of economics: Microeconomics, Macroeconomics and Managerial Economics, Difference between microeconomics and macroeconomics, Application of Managerial economics	8
2	Microeconomics Analysis Demand Analysis, Supply Analysis, Theories of Utility and Consumers Choice, Cost analysis, Competition and Market Structures. Application of microeconomics theories	8
3	Macro-Economic Analysis Aggregate Demand and Supply, Economic Growth and Business Cycles, inflation, Fiscal Policy, National income, theory of Consumption, savings and investments, Commercial and Central banking. Use of macroeconomic theories.	8
4	International Economics Balance of Trade and Balance of Payments, Barriers to Trade, Benefits of Trade/Comparative Advantage, Foreign Currency Markets/Exchange Rates, Monetary, Fiscal and Exchange rate policies, Economic Development. Application of exchange rate policies	8

Reference Books

- Macroeconomics: N. Gregory Mankiw, 2018
- Managerial Economics: Economic Tools for Today's Decision Makers: by Paul Keat (Author), Philip Young (Author) 2013
- Principles Of Macro Economics: Misra and Puri.2009, Himalaya publication, New Delhi.

- Modern Microeconomics, A. koutsoyiannis , Macmillan , London
- Microeconomics Robert S. Pindyck and daniel L. rubinfeld:,pearson education. New Delhi
- Micro economics: K. N. Verma

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(Formerly College of Engineering Pune)
School of Mechanical and Materials Engineering
Wellesley Road, Shivajinagar, Pune - 411005

Course: Value Education Course
S.Y. B.Tech. (Semester III/IV) - Environmental Studies

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Environmental Studies	1	0	0	1	1	CIE: 100			--	

Course outcomes:

1. Aware about different sustainable techniques for conservation and management of natural resources and importance of studying sustainable development goals. Develop a critical understanding of the environmental issues of concern and to understand the sectoral effects on the local, regional, and global environmental issues.
2. Aware about sources of different kinds of pollution and its types, sensitize themselves to adverse health impacts of pollution and knowing the techniques of pollution prevention and management.
3. Aware about factors impacting biodiversity loss and ecosystem degradation in India and the world & major conservation strategies taken in India, importance of biodiversity and their role in conserving biodiversity. Aware about Climate change with reference to impacts, adaptation & mitigation strategies.
4. Learn about the Environmental management system, Environmental legislation, policies, international treaties etc. and our country's stand on and responses to the major international agreements. Major international institutions and programs and the role played by them in the protection and preservation of the environment.

Syllabus:

Unit	Contents	Hrs.
1	**Humans and the Environment:** The man-environment interaction: Humans as hunter-gatherers; Mastery of fire; Origin of agriculture; Emergence of city-states; Great ancient civilizations and the environment; Middle Ages and Renaissance; Industrial revolution and its impact on the environment; Population growth and natural resource exploitation; Global environmental change. The emergence of environmentalism: Anthropocentric and eco-centric perspectives (Major thinkers); The Club of Rome- Limits to Growth; UN Conference on Human Environment 1972; World Commission on Environment and Development and the concept of sustainable development; Rio Summit and subsequent international efforts.	**1**
2	**Natural Resources and Sustainable Development:**	**2**

	Overview of natural resources: Definition of resource; Classification of natural resources- biotic and abiotic, renewable and non-renewable. Biotic resources: Major type of biotic resources- forests, grasslands, wetlands, wildlife and aquatic (fresh water and marine); Microbes as a resource; Status and challenges. Water resources: Types of water resources- fresh water and marine resources; Availability and use of water resources; Environmental impact of over-exploitation, issues and challenges; Water scarcity and stress; Conflicts over water. Soil and mineral resources: Important minerals; Mineral exploitation; Environmental problems due to extraction of minerals and use; Soil as a resource and its degradation. Energy resources: Sources of energy and their classification, renewable and non-renewable sources of energy; Conventional energy sources- coal, oil, natural gas, nuclear energy; non-conventional energy sources- solar, wind, tidal, hydro, wave, ocean thermal, geothermal, biomass, hydrogen and fuel cells; Implications of energy use on the environment. Introduction to sustainable development: Sustainable Development Goals (SDGs)- targets and indicators, challenges and strategies for SDGs.	
3	**Environmental Issues: Local, Regional and Global:** Environmental issues and scales: Concepts of micro-, meso-, synoptic and planetary scales; Temporal and spatial extents of local, regional, and global phenomena. Pollution: Impact of sectoral processes on Environment, Types of Pollution- air, noise, water, soil, municipal solid waste, hazardous waste; Transboundary air pollution; Acid rain; Smog. Land use and Land cover change: land degradation, deforestation, desertification, urbanization. Biodiversity loss: past and current trends, impact. Global change: Ozone layer depletion; Climate change.	**2**
4	**Conservation of Biodiversity and Ecosystems:** Biodiversity and its distribution: Biodiversity as a natural resource; Levels and types of biodiversity; Biodiversity in India and the world; Biodiversity hotspots; Species and ecosystem threat categories. Ecosystems and ecosystem services: Major ecosystem types in India and their basic characteristics forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services- classification and their significance. Threats to biodiversity and ecosystems: Land use and land cover change; Commercial exploitation of species; Invasive species; Fire, disasters and climate change.	**2**
5	**Environmental Pollution and Health:** Understanding pollution: Production processes and generation of wastes; Assimilative capacity of the environment; Definition of pollution; Point sources and non-point sources of pollution. Air pollution: Sources of air pollution; Primary and secondary pollutants; Criteria pollutants- carbon monoxide, lead, nitrogen oxides, ground-level ozone, particulate matter and Sulphur dioxide; Other important air pollutants- Volatile Organic compounds (VOCs), Peroxyacetyl Nitrate (PAN), Polycyclic aromatic hydrocarbons (PAHs) and Persistent organic pollutants (POPs); Indoor air pollution; Adverse health impacts of air pollutants; National Ambient Air Quality Standards. Water pollution: Sources of water pollution; River, lake and marine pollution, groundwater pollution; water quality Water quality parameters and standards; adverse health impacts of water pollution on human and aquatic life. Soil pollution and solid waste: Soil pollutants and their sources; Solid and hazardous waste; Impact on human health. Noise pollution: Definition of noise; Unit of measurement of noise	**2**

	pollution; Sources of noise pollution; Noise standards; adverse impacts of noise on human health. Thermal and radioactive pollution: Sources and impacts on human health and ecosystems.	
6	**Climate Change: Impacts, Adaptation and Mitigation:** Understanding climate change: Natural variations in climate; Structure of atmosphere; Anthropogenic climate change from greenhouse gas emissions– past, present and future; Projections of global climate change with special reference to temperature, rainfall, climate variability and extreme events; Importance of 1.5 °C and 2.0 °C limits to global warming; Climate change projections for the Indian sub-continent. Impacts, vulnerability and adaptation to climate change: Observed impacts of climate change on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Impacts on animal species, agriculture, health, urban infrastructure; the concept of vulnerability and its assessment; Adaptation vs. resilience; Climate-resilient development; Indigenous knowledge for adaptation to climate change. Mitigation of climate change: Synergies between adaptation and mitigation measures; Green House Gas (GHG) reduction vs. sink enhancement; Concept of carbon intensity, energy intensity and carbon neutrality; National and international policy instruments for mitigation, decarbonizing pathways and net zero targets for the future; Energy efficiency measures; Renewable energy sources; Carbon capture and storage, National climate action plan and Intended Nationally Determined Contributions (INDCs); Climate justice.	**2**
7	**Environmental Management:** Introduction to environmental laws and regulation: Constitutional provisions- Article 48A, Article 51A (g) and other derived environmental rights; Introduction to environmental legislations on the forest, wildlife and pollution control. Environmental management system: ISO 14001, Life cycle analysis; Cost-benefit analysis, Environmental audit and impact assessment; Environmental risk assessment, Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability; Ecolabeling /Eco mark scheme	**2**
8	**Environmental Treaties and Legislation:** Major International organizations and initiatives: United Nations Environment Programme (UNEP), International Union for Conservation of Nature (IUCN), World Commission on Environment and Development (WCED), United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Panel on Climate Change (IPCC), and Man and the Biosphere (MAB) programme.	**2**
9	**Case Studies and Field Work:** Discussion on one national and one international case study related to the environment and sustainable development. Field visits to identify local/regional environmental issues, make observations including data collection and prepare a brief report. Documentation of campus biodiversity, Campus environmental management activities such as solid waste disposal, water management and sewage treatment	**1**

**** This syllabus is as prescribed by the UGC and modified as per NEP Structure**

Suggested Readings:

- Hughes, J. Donald (2009) An Environmental History of the World- Humankind's Changing Role in the Community of Life, 2nd Edition. Routledge.
- Gilbert M. Masters and W. P. (2008). An Introduction to Environmental Engineering and Science, Ela Publisher (Pearson)
- Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press.
- Krishnamurthy, K.V. (2003) Textbook of Biodiversity, Science Publishers, Plymouth, UK
- Jackson, A. R., & Jackson, J. M. (2000). Environmental Science: The Natural Environment and Human Impact. Pearson Education.
- Pittock, Barrie (2009) Climate Change: Science, Impacts and Solutions. 2nd Edition. Routledge.

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Course: Numerical Methods and Programming Language

Course Code	Course Name	Teaching Scheme (Weightage in Hr.)					Evaluation Scheme (Weightage in %)				
							Theory			Laboratory	
		L	T	P	S	Cr	MSE	TA	ESE	ISE	ESE
<tbd>	Computational Methods and Programming Language	0	0	2	1	1	--			50	50

Course outcomes:

Students who successfully complete this course will have demonstrated an ability to:

1. Use numerical methods in modern scientific computing.
2. Determine numerical solutions of nonlinear equations in a single variable.
3. Use numerical interpolation and obtain numerical solution to engineering problems using programming.
4. Estimate solution to problems using numerical integration and differentiation.

Syllabus:

Unit	Contents	Hrs.
1	**Numerical methods I:** Introduction to numerical methods: Difference between analytical & numerical approach Error Approximations: Types of Errors: Absolute, Relative, Algorithmic, Truncation, Round off Error, Error Propagation, Concept of convergence-relevance to numerical methods, Roots of equations: Bracketing and Open Methods Simultaneous Equations: Gauss-Elimination, with partial pivoting, Gauss-Seidal, Gauss- Jordan, Gauss-Jacobi, Thomas algorithm for Tri-diagonal Matrix	6
2	**Numerical methods II:** Numerical Integration: Trapezoidal rule, Simpson's 1/3rd Rule, Simpson's 3/8th Rule, Gauss Quadrature 2 point and 3-point method. Double Integration using Trapezoidal rule, Simpson's 1/3rd Rule, Ordinary Differential Equations [ODE]: Taylor series method, Euler Method, Runge-Kutta fourth order, Simultaneous equations using RungeKutta2nd order method Partial Differential Equations [PDE]: Finite Difference methods Introduction to finite difference method, Simple Laplace method, PDEs-Parabolic explicit solution, Elliptic- explicit solution	6
3	**Curve fitting and Regression analysis:** Interpolation: Approximation by Forward, Backward, Central and Divided Difference Formulae, Interpolation by Newton's Formulae, Lagrange's, Spline Interpolation, Hermite and Stirling Formulae, Curve fitting: Least square technique- Straight line, Power equation, Exponential equation and Quadratic equation, Regression using Machine Learning algorithms: Linear Regression, Logistic Regression, Polynomial Regression, Support Vector Regression, Regression trees: Decision tree, random forest, Ridge Regression, Lasso Regression, Clustering/ K-Means, K-Nearest Neighbor (KNN), Neural Networks	6

Suggested learning resources:

Textbooks:

- Steven C. Chapra, Raymond P. Canale, Numerical Methods for Engineers, 4th edition, TataMcGraw Hill Co-Ltd
- Steven C. Chapra, Applied Numerical Methods with MATLAB for Engineers andScientist, 2nd edition, Tata McGraw Hill Co-Ltd
- S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India Delhi
- Rajaraman, "Computer Oriented Numerical Methods", Prentice Hall of India Delhi
- T Veerarajan, T Rama Chandran, "Theory and Problems in Numerical Method" TataMcGraw Hill Co-Ltd

Reference Books:

- William H. Press, Saul A. Tenkolsky, William T, Vellering, Brain P. Flannery "NumericalRecipes in C", Cambridge University Press
- Alex Smola and S.V.N. Vishwanathan, Introduction to Machine Learning,CambridgeUniversity Press
- Rudolph Russell, Machine Learning: Step-by-Step Guide to Implement MachineLearningAlgorithms with Python, an open source book.
- Aurélien Géron, Hands-On Machine Learning with Scikit-Learn and TensorFlow Concepts, Tools, and Techniques to Build Intelligent Systems, O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472.