



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
 (Established by Govt. of A.P., ACT No.30 of 2008)
 ANANTHAPURAMU – 515 002 (A.P) INDIA

MECHANICAL ENGINEERING

II B.TECH.

Semester-III							
S.No.	Course Code	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	20A54303	Complex variables, Transforms and Application of PDE	BS	3	0	0	3
2.	20A01302T	Fluid Mechanics & Hydraulic Machines	PC	3	0	0	3
3.	20A03301T	Manufacturing Processes	PC	3	0	0	3
4.	20A03302	Thermodynamics	PC	3	0	0	3
5.	20A01305T	Mechanics of Materials	ES	3	0	0	3
6.	20A01302P	Fluid Mechanics & Hydraulic Machines Lab	PC	0	0	3	1.5
7.	20A03301P	Manufacturing Processes Lab	PC	0	0	3	1.5
8.	20A01305P	Mechanics of Materials Lab	ES	0	0	3	1.5
9.	20A05305	Skill oriented course – I Application Development with Python	SC	1	0	2	2
10.	20A99201	Mandatory noncredit course – II Environmental Science	MC	3	0	0	0
Total							21.5

Semester-IV							
S.No.	Course Code	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	20A54402	Numerical Methods & Probability Theory	BS	3	0	0	3
2.	20A03401T	Applied Thermodynamics	PC	3	0	0	3
3.	20A03402	Kinematics of Machinery	PC	3	0	0	3
4.	20A03403T	Manufacturing Technology	PC	3	0	0	3
5.	20A52301 20A52302 20A52303	Humanities Elective- I Managerial Economics & Financial Analysis Organizational Behavior Business Environment	HS	3	0	0	3
6.	20A03401P	Applied Thermodynamics Lab	PC	0	0	3	1.5
7.	20A03403P	Manufacturing Technology Lab	PC	0	0	3	1.5
8.	20A03404	Computer Aided Machine Drawing	PC	0	0	3	1.5
9.	20A52401	Skill oriented course – II Soft skills	SC	1	0	2	2
10.	20A99401	Mandatory noncredit course – III Design Thinking for Innovation	MC	2	1	0	0
11.	20A99301	NSS/NCC/NSO Activities	-	0	0	2	0
Total							21.5
Community Service Internship/Project (Mandatory) for 6 weeks duration during summer vacation							



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Note:

1. Eligible and interested students can register either for Honors or for a Minor in IV Semester as per the guidelines issued by the University
2. Students shall register for NCC/NSS/NSO activities and will be required to participate in an activity for two hours in a week during fourth semester.
3. Lateral entry students shall undergo a bridge course in Mathematics during third semester



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MECHANICAL ENGINEERING

Course Code	Complex variables, Transforms & Partial Differential Equations	L	T	P	C
20A54303		3	0	0	3
Pre-requisite	Functions, Differentiations and Integration	Semester		III	
Course Objectives:					
This course aims at providing the student to acquire the knowledge on the calculus of functions of complex variables. The aim is to analyze the solutions of partial differential equations.					
Course Outcomes (CO): Student will be able to					
<ul style="list-style-type: none"> • Understand the analyticity of complex functions and conformal mappings. • Apply cauchy's integral formula and cauchy's integral theorem to evaluate improper integrals along contours. • Understand the usage of laplace transforms. • Evaluate the fourier series expansion of periodic functions. • Formulate/solve/classify the solutions of partial differential equations and also find the solution of one-dimensional wave equation and heat equation. 					
UNIT - I	Complex Variable – Differentiation:	9 Hrs			
Introduction to functions of complex variable-concept of Limit & continuity- Differentiation, Cauchy-Riemann equations, analytic functions (exponential, trigonometric, logarithm), harmonic functions, finding harmonic conjugate-construction of analytic function by Milne Thomson method-Conformal mappings-standard transformations ($e^z, \frac{1}{z}, kz$) Mobius transformations (bilinear) and their properties.					
UNIT - II	Complex Variable – Integration:	9 Hrs			
Line integral-Contour integration, Cauchy's integral theorem, Cauchy Integral formula, Liouville's theorem (without proof) and Maximum-Modulus theorem (without proof);power series expansions: Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals (around unit circle, semi circle with $f(z)$ not having poles on real axis).					
UNIT - III	Laplace Transforms	9 Hrs			
Definition-Laplace transform of standard functions-existence of Laplace Transform – Inverse transform – First shifting Theorem, Transforms of derivatives and integrals – Unit step function – Second shifting theorem – Dirac's delta function – Convolution theorem – Laplace transform of Periodic function. Differentiation and integration of transform – solving Initial value problems to ordinary differential equations with constant coefficients using Laplace transforms.					
UNIT - IV	Fourier series	8 Hrs			
Determination of Fourier coefficients (Euler's) – Dirichlet conditions for the existence of Fourier series – functions having discontinuity-Fourier series of Even and odd functions – Fourier series in an arbitrary interval – Half-range Fourier sine and cosine expansions- typical wave forms - Parseval's formula- Complex form of Fourier series.					
UNIT - V	Partial Differential Equations & Applications	9 Hrs			
Solution of second order PDEs by Method of separation of variables – Solutions of one dimensional wave equation, one dimensional heat equation under initial and boundary conditions. Steady state two dimensional heat equations (Laplace equations).					
Textbooks:					
<ol style="list-style-type: none"> 1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers. 2. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India 					
Reference Books:					
<ol style="list-style-type: none"> 1. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers. 2. Advanced Engineering Mathematics, by Alan Jeffrey, Elsevier. 					
Online Learning Resources:					



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1. nptel.ac.in/courses/111107056
2. onlinelibrary.wiley.com
3. <https://onlinecourses.nptel.ac.in/noc18ma12>.



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MECHANICAL ENGINEERING

Course Code	Fluid Mechanics and Hydraulic Machines (Common to Civil & Mechanical)		L	T	P	C
20A01302T			3	0	0	3
Pre-requisite	Physics, Chemistry	Semester	III			
Course Objectives:						
<ul style="list-style-type: none"> To impart ability to solve engineering problems in fluid mechanics To explain basics of statics, kinematics and dynamics of fluids and various measuring techniques of hydrostatic forces on objects. To enable the students measure quantities of fluid flowing in pipes, tanks and channels To Introduce concepts of uniform and non-uniform flows through open channel. To impart knowledge on design of turbines and pumps. 						
Course Outcomes (CO):						
<ul style="list-style-type: none"> Familiarize basic terms used in fluid mechanics Understand the principles of fluid statics, kinematics and dynamics Understand flow characteristics and classify the flows and estimate various losses in flow through channels Analyze characteristics for uniform and non-uniform flows in open channels. Design different types of turbines, centrifugal and multistage pumps. 						
UNIT - I	Introduction to Fluid Statics					
Distinction between a fluid and a solid - characteristics of fluids - Fluid Pressure: Pressure at a point, Pascal's law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U Tube Differential Manometer. pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.						
UNIT - II	Fluid kinematics and Dynamics					
Classification of fluid flow - Stream line, path line, streak line and stream tube; stream function, velocity potential function. One, two and three - dimensional continuity equations in Cartesian coordinates. Fluid Dynamics: Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation: Venturimeter, orifice meter and Pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow – Free and Forced; Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number						
UNIT - III	Analysis Of Pipe Flow					
Energy losses in pipelines; Darcy – Weisbach equation; Minor losses in pipelines; Hydraulic Grade Line and Total Energy Line; Concept of equivalent length – Pipes in Parallel and Series. Laminar Flow- Laminar flow through: circular pipes, annulus and parallel plates. Stoke's law, Measurement of viscosity. Reynolds experiment, Transition from laminar to turbulent flow. Resistance to flow of fluid in smooth and rough pipes-Moody's diagram – Introduction to boundary layer theory.						
UNIT - IV	Flow in Open Channels					
Open Channel Flow-Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section. Uniform Flow-Continuity Equation, Energy Equation and Momentum Equation, Characteristics of uniform flow, Chezy's formula, Manning's formula. Computation of Uniform flow. Specific energy, critical flow, discharge curve, Specific force, Specific depth, and Critical depth. Measurement of Discharge and Velocity – Broad Crested Weir. Gradually Varied Flow Dynamic Equation of Gradually Varied Flow. Hydraulic Jump and classification - Elements and characteristics- Energy dissipation.						



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UNIT - V	Hydraulic Machines
<p>Impact of Jets- Hydrodynamic force of jets on stationary and moving flat, inclined and curved vanes - velocity triangles at inlet and outlet - Work done and efficiency - Hydraulic Turbines: Classification of turbines; pelton wheel and its design. Francis turbine and its design - efficiency - Draft tube: theory - characteristic curves of hydraulic turbines - Cavitation - Working principles of a centrifugal pump, work done by impeller; heads, losses and efficiencies; minimum starting speed; Priming; specific speed; limitation of suction lift, net positive suction head (NPSH); Performance and characteristic curves; Cavitation effects; Multistage centrifugal pumps; troubles and remedies – Introduction to Reciprocating Pump.</p>	
Textbooks:	
<ol style="list-style-type: none"> 1. P. M. Modi and S. M. Seth, “Hydraulics and Fluid Mechanics”, Standard Book House 2. K. Subrahmanya, “Theory and Applications of Fluid Mechanics”, Tata McGraw Hill 	
Reference Books:	
<ol style="list-style-type: none"> 1. R. K. Bansal, A text of “Fluid Mechanics and Hydraulic Machines”, Laxmi Publications (P) Ltd., New Delhi. 2. K. Subramanya, Open channel Flow, Tata McGraw Hill. 3. N. Narayana Pillai, Principles of “Fluid Mechanics and Fluid Machines”, Universities Press Pvt Ltd, Hyderabad. 3rd Edition 2009. 4. C. S. P. Ojha, R. Berndtsson and P. N. Chadramouli, “Fluid Mechanics and Machinery”, Oxford University Press, 2010. 5. Banga & Sharma, “Hydraulic Machines”, Khanna Publishers. 	
Online Learning Resources:	
<ol style="list-style-type: none"> 1. https://www.coursera.org/courses?query=fluid%20mechanics 2. https://www.udemy.com/topic/fluid-mechanics/ 3. https://onlinecourses.nptel.ac.in/noc21_ce31/preview 4. https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-01-unified-engineering-i-ii-iii-iv-fall-2005-spring-2006/fluid-mechanics/ 5. http://lms.msionline.org/mod/folder/view.php?id=138 	



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MECHANICAL ENGINEERING

Course Code	Manufacturing Processes		L	T	P	C
20A03301T			3	0	0	3
Pre-requisite	NIL	Semester	III			
Course Objectives:						
<ul style="list-style-type: none"> • To introduce the students to working principle of different metal casting processes and gating system. • To impart knowledge on plastic deformation, cold and hot working process, working of a rolling mill and types, extrusion processes. • To teach principles of forging, tools and dies, working of forging processes. • To develop fundamental understanding on classification of the welding processes, working of different types of welding processes and welding defects. • To impart knowledge on manufacturing methods of plastics, ceramics and powder metallurgy. • To introduce the basic concepts of Unconventional Machining Processes. 						
Course Outcomes (CO):						
At the end of the course, the student will be able to						
<ul style="list-style-type: none"> • Demonstrate different metal casting processes and gating systems. (L2) • Classify working of various welding processes. (L2) • Evaluate the forces and power requirements in rolling process. (L5) • Apply the principles of various forging operations. (L3) • Outline the manufacturing methods of plastics, ceramics and powder metallurgy. (L1) • Identify different unconventional processes and their applications. (L3) 						
UNIT - I	Casting Processes				8 Hrs	
Introduction: Importance and selection of manufacturing processes. Introduction to casting process, process steps; pattern and design of gating system; Solidification of casting: Concept, solidification of pure metal and alloy; Special casting processes: Shell casting, investment casting, die casting, centrifugal casting, casting defects and remedies.						
UNIT - II	Metal Forming & Forging				8 Hrs	
Introduction, nature of plastic deformation, hot and cold working of metals, mechanics of metal forming; Rolling: Principle, types of rolling mill and products, roll passes, forces in rolling and power requirements; Extrusion: Basic extrusion process and its characteristics, hot extrusion and cold extrusion, wire drawing, tube drawing. Principles of forging, tools and dies. Types: Smith forging, drop forging, forging hammers, rotary forging and forging defects. Sheet metal forming: Mechanics of sheet metal working, blanking, piercing, bending, stamping.						
UNIT - III	Metal Joining Processes				8 Hrs	
Classification of welding processes, types of welds and welded joints and V-I characteristics, arc welding, weld bead geometry, submerged arc welding, gas tungsten arc welding, gas metal arc welding. applications, advantages and disadvantages of the above processes, Plasma Arc welding, Laser Beam Welding, Electron Beam Welding and Friction Stir Welding. Heat affected zones in welding; soldering and brazing: Types and their applications, Welding defects: causes and remedies.						
UNIT - IV	Plastic Processing, Ceramics and Powder Metallurgy				8 Hrs	
Plastics: Types, properties and their applications, processing of plastics, extrusion of plastics, transfer molding and compression molding, injection molding, thermoforming, rotational molding, and blow molding Ceramics: Classification of ceramic materials, properties and their application, ceramic powder preparation; Processing of ceramic parts: Pressing, casting, sintering; Secondary processing of ceramics: Coatings, finishing. Powder Metallurgy: Principle, manufacture of powders, steps involved.						



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UNIT - V	Unconventional Machining Processes	10 Hrs
principle and processes parameters of Electrical discharge machining (EDM), electro-chemical machining (ECM), Laser beam machining (LBM), plasma arc machining (PAM), electron beam machining, Abrasive jet machining (AJM), water jet machining (WJM), and ultrasonic machining(UM)		
Textbooks:		
<ol style="list-style-type: none"> 1. Rao P.N., Manufacturing Technology – Volume I, 5/e, McGraw-Hill Education, 2018. 2. Kalpakjain S and Schmid S.R., Manufacturing Engineering and Technology, 7/e, Pearson, 2018. 		
Reference Books:		
<ol style="list-style-type: none"> 1. Introduction to Physical Metallurgy by Sidney H.Avner 2. Millek P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes and Systems, 4/e, John Wiley and Sons Inc, 2010. 3. Sharma P.C., A Text book of Production Technology, 8/e, S Chand Publishing, 2014. 		
Online Learning Resources:		
<ol style="list-style-type: none"> 1. https://www.digimat.in/nptel/courses/video/112107145/L01.html 2. https://www.digimat.in/nptel/courses/video/112105126/L01.html 		



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MECHANICAL ENGINEERING

Course Code	Thermodynamics		L	T	P	C
20A03302			3	0	0	3
Pre-requisite	NIL	Semester	III			
Course Objectives:						
<ul style="list-style-type: none"> To introduce the concepts of heat, work, energy and governing rules for conversion of one form to other. To explain relationships between properties of matter and basic laws of thermodynamics. To teach the concept of entropy for identifying the disorder and feasibility of a thermodynamic process. To introduce the concept of available energy for maximum work conversion. To impart knowledge on steam properties. To provide fundamental concepts of air standard cycles used in IC engines and gas turbines. 						
Course Outcomes (CO):						
After completing the course, the student will be able to:						
<ul style="list-style-type: none"> Understand the importance of thermodynamic properties related to conversion of heat energy into work. (L1) Apply the laws of thermodynamics to boilers, heat pumps, refrigerators, heat engines, compressors and nozzles. (L3) Utilize steam properties to design steam based components. (L4) Analyze thermodynamic relations and air standard cycles. (L5) 						
UNIT - I	First law of Thermodynamics					10 Hrs
Introduction: Basic Concepts: Macroscopic and microscopic viewpoints, definitions of thermodynamic terms, quasi – static process, point and path function, forms of energy, ideal gas and real gas, Zeroth law of thermodynamics and Temperature measurement. Joule’s experiment - first law of thermodynamics, corollaries-perpetual motion machines of first kind, first law applied to non-flow and flow process- limitations of first law of thermodynamics.						
UNIT - II	Second Law of Thermodynamics					8 Hrs
Kelvin - Planck statement and Clausius statement and their equivalence, corollaries - perpetual motion machines of second kind - reversibility and irreversibility, cause of irreversibility - Carnot cycle, heat engine, heat pump and refrigerator, Carnot theorem, Carnot efficiency.						
UNIT - III	Entropy, Availability and Irreversibility					8 Hrs
Clausius inequality - Concept of Entropy- entropy equation for different processes and systems. Definition of exergy and anergy, expressions for availability and irreversibility. Availability in steady flow, non-flow processes and irreversibility. Maxwell relations, TdS equations difference in heat capacities, ratio of heat capacities.						
UNIT - IV	Properties of Steam and use of Steam Tables					8 Hrs
Pure Substances, P-V-T surfaces, T-s and h-s diagram, Mollier chart, dryness fraction, property tables, analysis of steam undergoing various thermodynamic processes using Mollier chart– steam calorimetry. Energy equation, Joule Thompson coefficient Clausius - Clapeyron equation.						
UNIT - V	Air Standard Cycles					8 Hrs
Otto, Diesel and dual cycles, P-V and T -S diagrams - description and efficiencies, mean effective pressures. Brayton Cycle - Comparison of Otto, Diesel and dual cycles, Comparison of Brayton and Otto Cycles.						



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Textbooks:

1. P.K.Nag, Engineering Thermodynamics, 5/e, Tata McGraw Hill, 2013.
2. Yunus A. Cengel, Michael A. Boles, Thermodynamics, 7/e, Tata McGraw Hill, 2011.

Reference Books:

1. J.B.Jones and G.A.Hawkins, Introduction to Thermodynamics, 2/e, John Wiley & Sons, 2012.
2. Moran, Michael J. and Howard N. Shapiro, Fundamentals of Engineering Thermodynamics, 3/e, Wiley, 2015
3. R.K. Rajput, S.Chand& Co., Thermal Engineering, 6/e, Laxmi publications, 2010

Online Learning Resources:

1. <https://nptel.ac.in/courses/112/105/112105266/>
2. <https://nptel.ac.in/courses/112/104/112104113/>



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MECHANICAL ENGINEERING

Course Code	Mechanics of Materials		L	T	P	C
20A01305T			3	0	0	3
Pre-requisite	NIL	Semester	III			
Course Objectives:						
<ul style="list-style-type: none"> • Understand the basics of stresses and strains • Draw the shear force and bending moment drawings of various beams. • Understand the Behaviour of members and Torsional forces • Understand the Behaviour of cylinders • Understand the stresses developing in curved beams. 						
Course Outcomes (CO):						
<ul style="list-style-type: none"> • Evaluate stresses and strains • To draw the SF and BM diagrams for various beams under different loading conditions • Determine the resistance and deformation in machine members subjected to torsional loads and springs. • Analyze and design thin, thick cylinders. • Analysis of stresses in curved bars. 						
UNIT - I	Analysis of stress and strain					
Types of external loads - self weight - internal stresses - normal and shear stresses - strain - Hooke's law - Poisson's ratio - relationship between elastic constants - stress strain diagrams working stress - elongation of bars of constant and varying sections - Stress on inclined planes for axial and biaxial stress fields - principal stresses - Mohr's circle of stress - principal strains - strain rosette – principal stress/strain problem as an eigenvalue problem.						
UNIT - II	Bending moment and shear force					
Different types of beams - shear force and bending moment diagrams for simply supported, overhanging and cantilever beams - relationship connecting intensity of loading, shearing force and bending moment - shear force and bending moment diagrams for statically determinate plane frames.						
UNIT - III	Torsion and Springs					
Torsion formulation stresses and deformation in circular and hollow shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.						
UNIT - IV	Thin Cylinders, Spheres and Thick Cylinders					
Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lamé's theory – Application of theories of failure.						
UNIT - V	Bending of curved bars & Unsymmetrical Bending					
Stresses in bars of small initial curvature, Winkler-Bach theory, Stresses in bars of large initial curvature, Deflection of Crane hooks, Chain links, circular rings, stresses in circular rings. Introduction to unsymmetrical bending, Stresses and deflection in unsymmetrical bending, Shear center for angle, Channel and I-sections.						
Textbooks:						
<ol style="list-style-type: none"> 1. Mechanics of Material – J. M. Gere and S. P. Timoshenko – CBS publisher 2. Popov, E.P., Mechanics of Materials, Prentice Hall India, New Delhi, 2002. 						
Reference Books :						
<ol style="list-style-type: none"> 1. Advanced Mechanics of Materials–A. P. Boresi and O. M. Sidebottom–John Wiley & Sons 2. Strength of Materials – R. K. Rajput – S. Chand & Company 						



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3. Beer, F.P., Johnston, E.R. and DeWolf, J.T., Mechanics of Materials, 3rd ed., Tata McGraw-Hill
4. Strength of Material – Dr. Sadhu Singh – Khanna Publishers
5. Strength of Material, Vol. I and II – S. P. Timoshenko – EWP Press

Online Learning Resources:

1. <https://nptel.ac.in/courses/112/107/112107146/>
2. <https://ocw.mit.edu/courses/materials-science-and-engineering/3-11-mechanics-of-materials-fall-1999/>
3. <https://www.coursera.org/courses?query=mechanics%20of%20materials>
4. <https://www.udemy.com/course/strengthofmaterials/>



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MECHANICAL ENGINEERING

Course Code	FLUID MECHANICS AND HYDRAULIC MACHINES LAB (Common to Civil & Mechanical)		L	T	P	C
20A01302P			0	0	3	1.5
Pre-requisite	NIL	Semester	III			
Course Objectives:						
By performing this laboratory, the student will be able to know the fluid flow measurements by considering different types flow measurement devices and working principles of various pumps and motors.						
Course Outcomes (CO):						
By performing the various tests in this laboratory the student will be able to know the principles of discharge measuring devices and head loss due to sudden contraction and expansion in pipes and working principles of various pumps and motors.						
List of Experiments:						
<ol style="list-style-type: none"> 1. Verification of Bernoulli's equation. 2. Calibration of Venturi meter. 3. Calibration of Orifice meter 4. Determination of Coefficient of discharge for a small orifice by constant head method. 5. Determination of Coefficient of discharge for a small orifice by variable head method. 6. Determination of Coefficient of discharge for an external mouth piece by Constant head method. 7. Determination of Coefficient of discharge for an external mouth piece by variable head method. 8. Calibration of contracted Rectangular Notch. 9. Calibration of contracted Triangular Notch. Determination of friction factor 10. Determination of loss of head in a sudden contraction. 11. Determination of loss of head in a sudden Expansion. 12. Performance test on Impulse turbines 13. Performance test on reaction turbines (Francis and Kaplan Turbines) 14. Impact of jet 15. Performance test on centrifugal pumps, determination of operating point and efficiency 						
References:						
<ol style="list-style-type: none"> 1. Fluid Mechanics & Hydraulic Machines A Lab Manual by Ts Desmukh (Author), Laxmi Publications (P) Ltd 2. Fluid Mechanics & Machinery Laboratory Manual by N Kumara Swamy (Author), Charotar Books Distributors 3. Lab. Manual of Fluid Mechanics & Machines by Gupta, Chandra (Author), cbspd (Publisher) 						
Online Learning Resources/Virtual Labs:						
1. http://eerc03-iiith.vlabs.ac.in/						



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MECHANICAL ENGINEERING

Course Code	Manufacturing Processes Lab		L	T	P	C
20A03301P			0	0	3	1.5
Pre-requisite	NIL	Semester	III			
Course Objectives:						
<ul style="list-style-type: none"> Acquire practical knowledge on Metal Casting, Welding, Press Working and unconventional machining Processes 						
Course Outcomes (CO):						
At the end of the lab, the student will be able to <ul style="list-style-type: none"> Fabricate different types of components using various manufacturing techniques. (L6) Adapt unconventional manufacturing methods. (L6) 						
List of Experiments:						
<ol style="list-style-type: none"> METAL CASTING <ol style="list-style-type: none"> Gating Design and pouring time and solidification time calculations. Sand Properties Testing – Exercise for Strength and Permeability. Molding, Melting and Casting for ferrous/ non ferrous materials. WELDING <ol style="list-style-type: none"> TIG Welding. MIG Welding. Friction stir welding. Any other Special Welding Processes. MECHANICAL PRESS WORKING <ol style="list-style-type: none"> Press Tool: Blanking and Piercing operation with Simple, Compound and Combination dies. Closed die forging, Deep Drawing and Extrusion operations. UN CONVENTIONAL MANUFACTUNRING PROCESSES <ol style="list-style-type: none"> Electro Discharge Machining (EDM) / Wire cut EDM Plasma arc cutting / Abrasive jet machining (AJM) Additive manufacturing with reverse engineering 						



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MECHANICAL ENGINEERING

Course Code	Mechanics of Materials Lab		L	T	P	C
20A01305P			0	0	3	1.5
Pre-requisite	NIL	Semester	III			
Course Objectives:						
<ul style="list-style-type: none"> By performing this laboratory, the student will be able to know the structural behavior of various materials 						
Course Outcomes (CO):						
<ul style="list-style-type: none"> By performing the various tests in this laboratory the student will be able to know the structural behavior of various structural elements when subjected to external loads 						
List of Experiments:						
<ol style="list-style-type: none"> Tension test. Bending test on (Steel/Wood) Cantilever beam. Bending test on simply supported beam. Torsion test. <u>Vickers Hardness Test</u> <u>Rockwell Hardness Test</u> <u>Brinell Hardness Test</u> Compression test on Open coiled springs Tension test on Closely coiled springs Compression test on wood/ concrete Izod Impact test on metals Charpy Impact test on metals Shear test on metals <u>Direct Shear Test on Timber Specimen</u> Use of electrical resistance strain gauges. Continuous beam – deflection test. <p>Note : Any 12 of the above equipments</p>						
References:						
1. Strength of Materials Lab Manual by Anand Jayakumar A , Notion Press						
Online Learning Resources/Virtual Labs:						
1. http://sm-nitk.vlabs.ac.in/#						



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MECHANICAL ENGINEERING

Course Code	Application Development with Python		L	T	P	C
20A05305			1	0	2	2
Pre-requisite	NIL	Semester	III			
Course Objectives:						
<ol style="list-style-type: none"> To learn the basic concepts of software engineering and life cycle models To explore the importance of Databases in application Development Acquire programming skills in core Python To understand the importance of Object-oriented Programming 						
Course Outcomes (CO):						
Students should be able to						
<ol style="list-style-type: none"> Identify the issues in software requirements specification and enable to write SRS documents for software development problems Explore the use of Object oriented concepts to solve Real-life problems Design database for any real-world problem Solve mathematical problems using Python programming language 						
Module 1. Basic concepts in software engineering and software project management						
Basic concepts: abstraction versus decomposition, the evolution of software engineering techniques, Software development life cycle						
Software project management: project planning and project scheduling						
Task:						
1. <u>Identifying the Requirements from Problem Statements</u>						
Module 2. Basic Concepts of Databases						
Database systems applications, Purpose of Database Systems, view of Data, Database Languages, Relational Databases, <u>Data Definition Language(DDL) Statements: (Create table, Alter table, Drop table), Data Manipulation Language(DML) Statements</u>						
Task:						
1. Implement <u>Data Definition Language(DDL) Statements: (Create table, Alter table, Drop table)</u>						
2. Implement <u>Data Manipulation Language(DML) Statements</u>						
Module 3. Python Programming:						
Introduction to Python: Features of Python, Data types, Operators, Input and output, Control Statements, Looping statements						
Python Data Structures: Lists, Dictionaries, Tuples.						
Strings: Creating strings and basic operations on strings, string testing methods.						
Functions: Defining a function- Calling a function- Types of functions-Function Arguments- Anonymous functions- Global and local variables						
OOPS Concepts; Classes and objects- Attributes- Inheritance- Overloading- Overriding- Data hiding						
Modules and Packages: Standard modules-Importing own module as well as external modules Understanding Packages Powerful Lamda function in python Programming using functions, modules and external packages						
Working with Data in Python: Printing on screen- Reading data from keyboard- Opening and closing file- Reading and writing files- Functions-Loading Data with Pandas-Numpy						
Tasks:						
1. OPERATORS						



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- a. Read a list of numbers and write a program to check whether a particular element is present or not using membership operators.
- b. Read your name and age and write a program to display the year in which you will turn 100 years old.
- c. Read radius and height of a cone and write a program to find the volume of a cone.
- d. Write a program to compute distance between two points taking input from the user (Hint: use Pythagorean theorem)

2. CONTROL STRUCTURES

- a. Read your email id and write a program to display the no of vowels, consonants, digits and white spaces in it using if...elif...else statement.
- b. Write a program to create and display a dictionary by storing the antonyms of words. Find the antonym of a particular word given by the user from the dictionary using while loop.
- c. Write a Program to find the sum of a Series $1/1! + 2/2! + 3/3! + 4/4! + \dots + n/n!$. (Input :n = 5, Output : 2.70833)
- d. In number theory, an abundant number or excessive number is a number for which the sum of its proper divisors is greater than the number itself. Write a program to find out, if the given number is abundant. (Input: 12, Sum of divisors of 12 = 1 + 2 + 3 + 4 + 6 = 16, sum of divisors 16 > original number 12)

3: LIST

- a. Read a list of numbers and print the numbers divisible by x but not by y (Assume x = 4 and y = 5).
- b. Read a list of numbers and print the sum of odd integers and even integers from the list.(Ex: [23, 10, 15, 14, 63], odd numbers sum = 101, even numbers sum = 24)
- c. Read a list of numbers and print numbers present in odd index position. (Ex: [10, 25, 30, 47, 56, 84, 96], The numbers in odd index position: 25 47 84).
- d. Read a list of numbers and remove the duplicate numbers from it. (Ex: Enter a list with duplicate elements: 10 20 40 10 50 30 20 10 80, The unique list is: [10, 20, 30, 40, 50, 80])

4: TUPLE

- a. Given a list of tuples. Write a program to find tuples which have all elements divisible by K from a list of tuples. test_list = [(6, 24, 12), (60, 12, 6), (12, 18, 21)], K = 6, Output : [(6, 24, 12), (60, 12, 6)]
- b. Given a list of tuples. Write a program to filter all uppercase characters tuples from given list of tuples. (Input: test_list = [(“GFG”, “IS”, “BEST”), (“GFg”, “AVERAGE”), (“GfG”,), (“Gfg”, “CS”)], Output : [(,“GFG”, „IS“, „BEST“)]).
- c. Given a tuple and a list as input, write a program to count the occurrences of all items of the list in the tuple. (Input : tuple = ('a', 'a', 'c', 'b', 'd'), list = ['a', 'b'], Output : 3)

5: SET

- a. Write a program to generate and print a dictionary that contains a number (between 1 and n) in the form (x, x*x).
- b. Write a program to perform union, intersection and difference using Set A and Set B.
- c. Write a program to count number of vowels using sets in given string (Input : “Hello World”, Output: No. of vowels : 3)
- d. Write a program to form concatenated string by taking uncommon characters from two strings using set concept (Input : S1 = "aacdb", S2 = "gafd", Output : "cbgf").

6: DICTIONARY

- a. Write a program to do the following operations:
 - i. Create a empty dictionary with dict() method
 - ii. Add elements one at a time
 - iii. Update existing key's value
 - iv. Access an element using a key and also get() method
 - v. Deleting a key value using del() method
- b. Write a program to create a dictionary and apply the following methods:
 - i. pop() method



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- ii. popitem() method
- iii. clear() method
- c. Given a dictionary, write a program to find the sum of all items in the dictionary.
- d. Write a program to merge two dictionaries using update() method.

7: STRINGS

- a. Given a string, write a program to check if the string is symmetrical and palindrome or not. A string is said to be symmetrical if both the halves of the string are the same and a string is said to be a palindrome string if one half of the string is the reverse of the other half or if a string appears same when read forward or backward.
- b. Write a program to read a string and count the number of vowel letters and print all letters except 'e' and 's'.
- c. Write a program to read a line of text and remove the initial word from given text. (Hint: Use split() method, Input : India is my country. Output : is my country)
- d. Write a program to read a string and count how many times each letter appears. (Histogram).

8: USER DEFINED FUNCTIONS

- a. A generator is a function that produces a sequence of results instead of a single value. Write a generator function for Fibonacci numbers up to n.
- b. Write a function merge_dict(dict1, dict2) to merge two Python dictionaries.
- c. Write a fact() function to compute the factorial of a given positive number.
- d. Given a list of n elements, write a linear_search() function to search a given element x in a list.

9: BUILT-IN FUNCTIONS

- a. Write a program to demonstrate the working of built-in statistical functions mean(), mode(), median() by importing statistics library.
- b. Write a program to demonstrate the working of built-in trigonometric functions sin(), cos(), tan(), hypot(), degrees(), radians() by importing math module.
- c. Write a program to demonstrate the working of built-in Logarithmic and Power functions exp(), log(), log2(), log10(), pow() by importing math module.
- d. Write a program to demonstrate the working of built-in numeric functions ceil(), floor(), fabs(), factorial(), gcd() by importing math module.

10. CLASS AND OBJECTS

- a. Write a program to create a BankAccount class. Your class should support the following methods for
 - i) Deposit
 - ii) Withdraw
 - iii) GetBalanace
 - iv) PinChange
- b. Create a SavingsAccount class that behaves just like a BankAccount, but also has an interest rate and a method that increases the balance by the appropriate amount of interest (Hint:use Inheritance).
- c. Write a program to create an employee class and store the employee name, id, age, and salary using the constructor. Display the employee details by invoking employee_info() method and also using dictionary (__dict__).
- d. Access modifiers in Python are used to modify the default scope of variables. Write a program to demonstrate the 3 types of access modifiers: public, private and protected.

11. FILE HANDLING

- a. . Write a program to read a filename from the user, open the file (say firstFile.txt) and then perform the following operations:
 - i. Count the sentences in the file.
 - ii. Count the words in the file.
 - iii. Count the characters in the file.
- b. . Create a new file (Hello.txt) and copy the text to other file called target.txt. The target.txt file should store only lower case alphabets and display the number of lines copied.
- c. Write a Python program to store N student's records containing name, roll number and branch. Print



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the given branch student's details only.

References:

1. Rajib Mall, "Fundamentals of Software Engineering", 5th Edition, PHI, 2018.
2. Ramez Elmasri, Shamkant, B. Navathe, "Database Systems", Pearson Education, 6th Edition, 2013.
3. Reema Thareja, "Python Programming - Using Problem Solving Approach", Oxford Press, 1st Edition, 2017.
4. Larry Lutz, "Python for Beginners: Step-By-Step Guide to Learning Python Programming", CreateSpace Independent Publishing Platform, First edition, 2018

Online Learning Resources/Virtual Labs:

1. <http://vlabs.iitkgp.ernet.in/se/>
2. <http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/index.php>
3. <https://python-iitk.vlabs.ac.in>



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MECHANICAL ENGINEERING

Course Code	ENVIRONMENTAL SCIENCE (Common to All Branches of Engineering)		L	T	P	C
20A99201			3	0	0	0
Pre-requisite	NIL	Semester	III Sem			
Course Objectives:						
<ul style="list-style-type: none"> • To make the students to get awareness on environment • To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life • To save earth from the inventions by the engineers. 						
Course Outcomes (CO):						
<p>At the end of the course, the student will be able to</p> <ul style="list-style-type: none"> • Grasp multidisciplinary nature of environmental studies and various renewable and nonrenewable resources. • Understand flow and bio-geo- chemical cycles and ecological pyramids. • Understand various causes of pollution and solid waste management and related preventive measures. • About the rainwater harvesting, watershed management, ozone layer depletion and waste land reclamation. • Casus of population explosion, value education and welfare programmes. 						
UNIT - I						8 Hrs
Multidisciplinary Nature Of Environmental Studies: – Definition, Scope and Importance – Need for Public Awareness.						
Natural Resources : Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:						
UNIT - II						12 Hrs
Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:						
<ol style="list-style-type: none"> a. Forest ecosystem. b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) 						
Biodiversity And Its Conservation : Introduction 0 Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.						
UNIT - III						8 Hrs



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Environmental Pollution: Definition, Cause, effects and control measures of :

- a. Air Pollution.
- b. Water pollution
- c. Soil pollution
- d. Marine pollution
- e. Noise pollution
- f. Thermal pollution
- g. Nuclear hazards

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

UNIT - IV

10 Hrs

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

UNIT - V

8 Hrs

Human Population And The Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

Field Work: Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc..

Textbooks:

1. Text book of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission, Universities Press.
2. Palaniswamy, “Environmental Studies”, Pearson education
3. S.Azeem Unnisa, “Environmental Studies” Academic Publishing Company
4. K.Raghavan Nambiar, “Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus”, Scitech Publications (India), Pvt. Ltd.

Reference Books:

1. Deeksha Dave and E.Sai Baba Reddy, “Textbook of Environmental Science”, Cengage Publications.
2. M.Anji Reddy, “Text book of Environmental Sciences and Technology”, BS Publication.
3. J.P.Sharma, Comprehensive Environmental studies, Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, “Environmental Sciences and Engineering”, Prentice hall of India Private limited
5. G.R.Chatwal, “A Text Book of Environmental Studies” Himalaya Publishing House
6. Gilbert M. Masters and Wendell P. Ela, “Introduction to Environmental Engineering and Science, Prentice hall of India Private limited.



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MECHANICAL ENGINEERING

Course Code	Numerical Methods & Probability theory (Common to EEE, MECH)		L	T	P	C
20A54402			3	0	0	3
Pre-requisite	Basic Equations and Basic Probability	Semester	IV			
Course Objectives:						
This course aims at providing the student with the knowledge on various numerical methods for solving equations, interpolating the polynomials, evaluation of integral equations and solution of differential equations. The theory of Probability and random variables.						
Course Outcomes (CO): Student will be able to						
<ul style="list-style-type: none"> • Apply numerical methods to solve algebraic and transcendental equations • Derive interpolating polynomials using interpolation formulae • Solve differential and integral equations numerically • Apply probability theory to find the chances of happening of events. • Understand various probability distributions and calculate their statistical constants. 						
UNIT - I	Solution of Algebraic & Transcendental Equations:		8 Hrs			
Introduction-Bisection method-Iterative method-Regula falsi method-Newton Raphson method System of Algebraic equations: Gauss Jordan method-Gauss Siedal method.						
UNIT - II	Interpolation		8 Hrs			
Finite differences-Newton's forward and backward interpolation formulae – Lagrange's formulae. Gauss forward and backward formula, Stirling's formula, Bessel's formula.						
UNIT - III	Numerical Integration & Solution of Initial value problems to Ordinary differential equations		9 Hrs			
Numerical Integration: Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Modified Euler's Method-Runge-Kutta Methods.						
UNIT - IV	Probability theory:		9 Hrs			
Probability, probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem, random variables (discrete and continuous), probability density functions, properties, mathematical expectation.						
UNIT - V	Random variables & Distributions:		9 Hrs			
Probability distribution - Binomial, Poisson approximation to the binomial distribution and normal distribution-their properties-Uniform distribution-exponential distribution						
Textbooks:						
1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers. 2. Probability and Statistics for Engineers and Scientists, Ronald E. Walpole,PNIE. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India.						
Reference Books:						
1. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers. 2. Advanced Engineering Mathematics, by Alan Jeffrey, Elsevier.						
Online Learning Resources:						
1. https://onlinecourses.nptel.ac.in/noc17_ma14/preview 2. nptel.ac.in/courses/117101056/17 3. http://nptel.ac.in/courses/111105090						



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MECHANICAL ENGINEERING

Course Code	Applied Thermodynamics		L	T	P	C
20A03401T			3	0	0	3
Pre-requisite	NIL	Semester	IV			
Course Objectives:						
<ul style="list-style-type: none"> To introduce students to the Working Principles of IC engines. To teach combustion process in SI and CI engines. To impart knowledge on different types of compressors. To familiarize concepts of thermodynamic cycles used in steam power plants and gas turbines To impart knowledge on the working of nozzles, turbines, refrigeration and air conditioning. 						
Course Outcomes (CO):						
<ul style="list-style-type: none"> After completing this course, the students can Understand the working of IC engines with combustion process. (L1) Select compressors for different applications. (L2) Use T-s diagram in vapour power and gas power cycles. (L3) Evaluate the relative performance of different steam turbines (L6) Select appropriate refrigerant for different applications. (L6) 						
UNIT - I	IC Engines					10 Hrs
Working and classification of IC engines, comparison of two stroke and four stroke engines, comparison of SI and CI Engines.						
Testing and Performance of IC Engines: Methods of testing IC Engines, performance analysis of IC Engines.						
Combustion in IC Engines: SI engine: stages of combustion, normal combustion, abnormal combustion, variables effecting ignition lag, Flame propagation and knocking. CI engine: stages of combustion, normal combustion, abnormal combustion, variables effecting delay period and knocking.						
UNIT - II	Air compressors					8 Hrs
Reciprocating Compressor: Single stage reciprocating compressors, work required, effect of clearance in compressors, volumetric efficiency, multi stage compressor, effect of inter cooling in multi stage compressors, compressor performance.						
Rotary Compressor: Working principle of a rolling piston type compressor (fixed vane type), multi vane type compressors, characteristics of rotary vane type compressor, working principle of centrifugal and axial flow compressors.						
UNIT - III	Vapour & Gas Power Cycles					8 Hrs
Vapour power cycle, simple Rankine cycle, mean temp of heat addition, thermodynamic variables effecting efficiency, Rankine cycle – reheating and regeneration.						
Simple gas turbine plant, Brayton cycle, closed cycle and open cycle for gas turbines, condition for optimum pressure ratio, actual cycle. Methods to improve performance: regeneration, intercooling and reheating.						
UNIT - IV	Nozzles & Steam Turbines					8 Hrs
Type of nozzles - gas and steam nozzles. Compressible flow through nozzle- condition for maximum discharge - Nozzle efficiency - Super saturation.						
Steam Turbines - impulse turbine and reaction turbine – compounding of impulse turbines - velocity diagrams in impulse and reaction turbines, blade efficiency, degree of reaction.						
UNIT - V	Refrigeration & Air-Conditioning					8 Hrs
Refrigeration: Bell-Coleman cycle - vapour compression cycle, sub cooling and super heating-vapour absorption cycle, properties of common refrigerants.						
Principles of Psychrometry and Air Conditioning: Psychrometric properties, psychrometric processes, summer and winter air conditioning systems.						
Textbooks:						
<ol style="list-style-type: none"> Thermal Engineering, Mahesh V Rathore, Tata McGraw Hill 2017 M.L.Mathur and F.S.Mehta, Thermal Engineering, Jain brothers,2014 						



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Reference Books:

1. Ganesan V, Internal Combustion Engines, Tata McGraw Hill, 2017.
2. Yahya, S. M., Turbines, Compressors and Fans, 4/e, Tata McGraw Hill, 2010.
3. Nag P.K, Engineering Thermodynamics, 4/e, Tata McGraw-Hill, 2008.
4. Onkar Singh, Thermal Turbomachines, 3/e, Wiley India, 2014.
5. Refrigeration and Air Conditioning, C.P.Arora

Online Learning Resources:

1. <https://nptel.ac.in/courses/112/103/112103307/>
2. <https://nptel.ac.in/courses/112/103/112103275/>



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MECHANICAL ENGINEERING

Course Code	KINETICS OF MACHINERY		L	T	P	C
20A03402			3	0	0	3
Pre-requisite	NIL	Semester	IV			
Course Objectives:						
The Objectives of this course are to: <ul style="list-style-type: none"> To provide a foundation for the study of Dynamics of Machinery and machine design. Comprehend the fundamentals of kinematics and to understand the concept of machines, mechanisms and related terminologies. Analyze a mechanism for displacement, velocity and acceleration at any point in a moving link. To develop skills for designing and analyzing linkages and mechanisms. Formulate the concept of synthesis and analysis of different mechanisms. To understand the Principles and working of various straight line motion mechanisms. To analyze Steering gear mechanisms and working of Hooke's joint. To understand the theory of gears, gear trains and cams. 						
Course Outcomes (CO):						
<ul style="list-style-type: none"> Build up critical thinking and problem-solving capacity of various mechanical engineering problems related to kinematics of machines (L4) Understand the basic principles of mechanisms in mechanical engineering (L1) Assess various concepts of mechanisms like straight line motion mechanisms, Steering gear mechanisms and working principles of power elements (Gears, gear trains, Cams) and design related problems effectively (L6) Examine the velocity and acceleration diagram for a given mechanism (L3) Utilize analytical, mathematical and graphical aspects of kinematics of Machines for effective design (L3) Construct the cam profile for a given motion (L3) Analyze various gear trains (L4) 						
UNIT - I	MECHANISMS AND MACHINES					8 Hrs
Elements or Links – Classification – Rigid Link, flexible and fluid link. Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained. Mechanisms and machines – classification of mechanisms and machines – kinematic chain – inversion of mechanisms – inversions of quadric cycle chain, single and double slider crank chain. Mobility of mechanisms.						
UNIT - II	Steering & Straight-Line Motion Mechanisms					8 Hrs
Straight Line Motion Mechanisms- Exact and approximate, copied and generated types – Peaucellier, Hart, Scott Russel, Grasshopper, Watt, Tchebicheff and Robert Mechanisms. Pantograph. Steering Mechanisms: Conditions for correct steering – Davis Steering gear, Ackermanns steering gear. Hooke's Joint (Universal coupling) -Single and double Hooke's joint — applications – Simple problems.						
UNIT - III	KINEMATICS					10 Hrs
Velocity and Acceleration Diagrams- Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration – Graphical method – Application of relative velocity method – Slider crank mechanism, four bar mechanism. Acceleration diagrams for simple mechanisms, determination of Coriolis component of acceleration, Klein's construction: Analysis of slider crank mechanism for displacement, velocity and acceleration of slider using analytical method. Instantaneous Centre Method: Instantaneous centre of rotation, centrode and axode – relative motion between two bodies – Three centers in-line theorem – Locating instantaneous centers for simple mechanisms and determination of angular velocity of points and links.						
UNIT - IV	Gears & GEAR TRAINS					10 Hrs
GEARS: Higher pairs, toothed gears – types – law of gearing, condition for constant velocity Ratio for transmission of motion, Forms of tooth- cycloidal and involute profiles. Velocity of sliding – phenomena of interference – Methods to avoid interference - Condition for minimum number of teeth, expressions for arc of contact and path of contact. Introduction to Helical, Bevel and Worm gears.						



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GEAR TRAINS: Introduction –Types of gears – Simple, Compound, Reverted and Epicyclic gear trains, Train value – Methods of finding train value or velocity ratio – Tabular column method for Epicyclic gear trains. Torque in epicyclic gear trains. Differential gear of an automobile – Simple problems.		
UNIT - V	CAMS & Followers	8 Hrs
CAMS: Definitions of cam and follower – uses – Types of followers and cams – Terminology. Types of follower motion - Uniform velocity, Simple harmonic motion, Cycloidal, uniform acceleration and retardation, Maximum velocity and maximum acceleration during outward and return strokes. Drawing of cam profiles.		
ANALYSIS OF MOTION OF FOLLOWERS: Tangent cam with roller follower – circular arc (Convex) cam with flat faced and roller follower		
Textbooks:		
<ol style="list-style-type: none"> 1. Theory of Machines and Mechanisms-S.S.Rattan, Tata McGraw Hill Publishers. 2. Theory of Machines R.S Khurmi& J.K Gupta, S Chand Publishers. 		
Reference Books:		
<ol style="list-style-type: none"> 1. Theory of Machines by Thomas Bevan/ CBS 2. Theory of Machines / R.K Bansal 3. Theory of Machines Sadhu Singh PearsonsEdn 4. Mechanism and Machine Theory / JS Rao and RV Dukkipati / New Age 5. The theory of Machines /Shiegley/ Oxford. 6. Theory of machines – PL. Balaney/khanna publishers 		
Online Learning Resources:		
<ol style="list-style-type: none"> 1. https://www.digimat.in/nptel/courses/video/112104121/L01.html 2. https://nptel.ac.in/courses/112/105/112105268/ 		



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MECHANICAL ENGINEERING

Course Code	Manufacturing Technology		L	T	P	C
20A03403T			3	0	0	3
Pre-requisite	NIL	Semester	IV			
Course Objectives:						
<ul style="list-style-type: none"> • To introduce the parameters in the metal cutting operation. • To relate tool wear and tool life and the variables that control them. • To calculate machining times for different machining processes. • To impart knowledge on various metal cutting processes. (Lathe, drilling, boring shaping, slotting, milling and grinding). • To teach the principles of jigs and fixtures and types of clamping and work holding devices. 						
Course Outcomes (CO):						
At the end of the course, the student will be able to						
<ul style="list-style-type: none"> • Choose cutting processes and variables. (L3) • Relate tool wear and tool life. (L1) • Calculate the machining parameters for different machining processes. (L5) • Identify methods to generate different types of surfaces. (L3) • Explain work-holding requirements. (L2) • Design jigs and fixtures. (L6) 						
UNIT - I	Material Removal Processes					8 Hrs
Metal Cutting: Single and multi-point cutting tools, orthogonal and oblique cutting, Merchant circle diagram, chip formation, tool wear and tool life, surface finish and integrity, machinability, cutting tools and materials, cutting fluids.						
UNIT - II	Lathe and Drilling Machines					12 Hrs
Lathe and Lathe Operations: Principles of working, specifications, types of lathes, operations, work and tool holders. Taper turning, thread turning attachments for lathes. Machining time calculations. Turret and capstan lathes - Principle of working -						
Drilling Machines: Principles of working, specifications, types, and operations performed - tool holding devices - nomenclature of twist drill, Machining time calculations						
UNIT - III	Boring, Reaming and Taping					8 Hrs
Boring Machines- Principles of working, specifications, types, and operations performed - tool holding devices - nomenclature of boring tools, Machining time calculations						
Reaming and Reamers: Principles of working, specifications, types, and operations performed – tool holding devices - nomenclature of reamers. Machining time calculations						
Taping and Taps: Principles of working, specifications, types, and operations performed - tool holding devices - nomenclature of taps.						
UNIT - IV	Milling, Shaping and Abrasive Machining					10 Hrs
Milling operations and Milling machines - Principles of working, specifications, classifications of milling machines, machining operations, types and geometry of milling cutters, methods of indexing, and accessories to milling machines, machining time calculations.						
Shaping, Slotting and planing machines - Principles of working - principal parts, specification, classification, operations performed, machining time calculations						
Abrasive Machining: Grinding and grinding machines: Grinding process, types of grinding machines, grinding process parameters, honing, lapping, other finishing processes.						
UNIT - V	Jigs and Fixtures					8 Hrs
Principles of design of Jigs and fixtures and uses, 3-2-1 principle of location and clamping, classification of Jigs & Fixtures, types of clamping and work holding devices, typical examples of jigs and fixtures.						
Textbooks:						



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1. P.N. Rao, Manufacturing Technology: Metal Cutting and Machine Tools, (Volume 2), 3/e, Tata McGraw-Hill Education, 2013
2. R.K. Jain and S.C. Gupta, Production Technology, 17/e, Khanna Publishers, 2012.

Reference Books:

1. Kalpakzian S and Schmid SR, Manufacturing Engineering and Technology, 7/e, Pearson, 2018.
2. Milton C.Shaw , Metal Cutting Principles, 2/e, Oxford, 2012
3. Hindustan Machine Tools, Production Technology, TMH, 2001
4. V.K.Jain, Advanced Machining Process,12/e, Allied Publications, 2010
5. AB. Chattopadhyay, Machining and Machine Tools, 2/e, Wiley, 2017
6. Halmi A Yousuf & Hassan, , Machine Technology: Machine Tools and Operations, CRC Press Taylor and Francis Group, 2008

Online Learning Resources:

1. <https://www.digimat.in/nptel/courses/video/112107239/L01.html>
2. <https://nptel.ac.in/courses/112/104/112104304/>



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MECHANICAL ENGINEERING

Course Code	MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS (Common to All branches of Engineering)		L	T	P	C
20A52301			3	0	0	3
Pre-requisite	NIL	Semester	III			
Course Objectives:						
<ul style="list-style-type: none"> • To inculcate the basic knowledge of micro economics and financial accounting • To make the students learn how demand is estimated for different products, input-output relationship for optimizing production and cost • To Know the Various types of market structure and pricing methods and strategy • To give an overview on investment appraisal methods to promote the students to learn how to plan long-term investment decisions. • To provide fundamental skills on accounting and to explain the process of preparing financial statements 						
Course Outcomes (CO):						
<ul style="list-style-type: none"> • Define the concepts related to Managerial Economics, financial accounting and management. • Understand the fundamentals of Economics viz., Demand, Production, cost, revenue and markets • Apply the Concept of Production cost and revenues for effective Business decision • Analyze how to invest their capital and maximize returns • Evaluate the capital budgeting techniques • Develop the accounting statements and evaluate the financial performance of business entity. 						
UNIT - I	Managerial Economics					
Introduction – Nature, meaning, significance, functions, and advantages. Demand-Concept, Function, Law of Demand - Demand Elasticity- Types – Measurement. Demand Forecasting- Factors governing Forecasting, Methods. Managerial Economics and Financial Accounting and Management.						
UNIT - II	Production and Cost Analysis					
Introduction – Nature, meaning, significance, functions and advantages. Production Function– Least-cost combination– Short run and Long run Production Function- Isoquants and Isocosts, MRTS - Cobb-Douglas Production Function - Laws of Returns - Internal and External Economies of scale. Cost & Break-Even Analysis - Cost concepts and Cost behavior- Break-Even Analysis (BEA) - Determination of Break-Even Point (Simple Problems)-Managerial significance and limitations of Break-Even Analysis.						
UNIT - III	Business Organizations and Markets					
Introduction – Nature, meaning, significance, functions and advantages. Forms of Business Organizations- Sole Proprietary - Partnership - Joint Stock Companies - Public Sector Enterprises. Types of Markets - Perfect and Imperfect Competition - Features of Perfect Competition Monopoly- Monopolistic Competition–Oligopoly-Price-Output Determination - Pricing Methods and Strategies						
UNIT - IV	Capital Budgeting					
Introduction – Nature, meaning, significance, functions and advantages. Types of Working Capital, Components, Sources of Short-term and Long-term Capital, Estimating Working capital requirements. Capital Budgeting– Features, Proposals, Methods and Evaluation. Projects – Pay Back Method, Accounting Rate of Return (ARR) Net Present Value (NPV) Internal Rate Return (IRR) Method (sample problems)						
UNIT - V	Financial Accounting and Analysis					



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Introduction – Nature, meaning, significance, functions and advantages. Concepts and Conventions- Double-Entry Book Keeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments). *Financial Analysis* - Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability.

Textbooks:

1. Varshney&Maheswari: Managerial Economics, Sultan Chand, 2013.
2. Aryasri: Business Economics and Financial Analysis, 4/e, MGH, 2019

Reference Books:

1. Ahuja HI Managerial economics Schand,3/e,2013
2. S.A. Siddiqui and A.S. Siddiqui: Managerial Economics and Financial Analysis, New Age International, 2013.
3. Joseph G. Nellis and David Parker: Principles of Business Economics, Pearson, 2/e, New Delhi.
4. Domnick Salvatore: Managerial Economics in a Global Economy, Cengage, 2013.

Online Learning Resources:

<https://www.slideshare.net/123ps/managerial-economics-ppt>
<https://www.slideshare.net/rossanz/production-and-cost-45827016>
<https://www.slideshare.net/darkyla/business-organizations-19917607>
<https://www.slideshare.net/balarajbl/market-and-classification-of-market>
<https://www.slideshare.net/ruchi101/capital-budgeting-ppt-59565396>
<https://www.slideshare.net/ashu1983/financial-accounting>



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MECHANICAL ENGINEERING

Course Code	ORGANISATIONAL BEHAVIOUR (Common to All branches of Engineering)		L	T	P	C
20A52302			3	0	0	3
Pre-requisite	NIL	Semester	III			
Course Objectives:						
<ul style="list-style-type: none"> • To enable student's comprehension of organizational behavior • To offer knowledge to students on self-motivation, leadership and management • To facilitate them to become powerful leaders • To Impart knowledge about group dynamics • To make them understand the importance of change and development 						
Course Outcomes (CO):						
<ul style="list-style-type: none"> • Define the Organizational Behaviour, its nature and scope. • Understand the nature and concept of Organizational behaviour • Apply theories of motivation to analyse the performance problems • Analyse the different theories of leadership • Evaluate group dynamics • Develop as powerful leader 						
UNIT - I	Introduction to Organizational Behavior					
Meaning, definition, nature, scope and functions - Organizing Process – Making organizing effective -Understanding Individual Behaviour –Attitude -Perception - Learning – Personality.						
UNIT - II	Motivation and Leading					
Theories of Motivation- Maslow's Hierarchy of Needs - Herzberg's Two Factor Theory - Vroom's theory of expectancy – Mc Clelland's theory of needs–Mc Gregor's theory X and theory Y– Adam's equity theory – Locke's goal setting theory– Alderfer's ERG theory .						
UNIT - III	Organizational Culture					
Introduction – Meaning, scope, definition, Nature - Organizational Climate - Leadership - Traits Theory–Managerial Grid - Transactional Vs Transformational Leadership - Qualities of good Leader - Conflict Management -Evaluating Leader- Women and Corporate leadership.						
UNIT - IV	Group Dynamics					
Introduction – Meaning, scope, definition, Nature- Types of groups - Determinants of group behavior - Group process – Group Development - Group norms - Group cohesiveness - Small Groups - Group decision making - Team building - Conflict in the organization– Conflict resolution						
UNIT - V	Organizational Change and Development					
Introduction –Nature, Meaning, scope, definition and functions- Organizational Culture - Changing the Culture – Change Management – Work Stress Management - Organizational management – Managerial implications of organization's change and development						
Textbooks:						
1. Luthans, Fred, Organisational Behaviour, McGraw-Hill, 12 Th edition 2011 2. P Subba Ran, Organisational Behaviour, Himalya Publishing House 2017						
Reference Books:						
<ul style="list-style-type: none"> ▪ McShane, Organizational Behaviour, TMH 2009 ▪ Nelson, Organisational Behaviour, Thomson, 2009. ▪ Robbins, P. Stephen, Timothy A. Judge, Organisational Behaviour, Pearson 2009. ▪ Aswathappa, Organisational Behaviour, Himalaya, 2009 						
Online Learning Resources:						
httphttps://www.slideshare.net/Knight1040/organizational-culture-9608857s://www.slideshare.net/AbhayRajpoot3/motivation-165556714 https://www.slideshare.net/harshrastogi1/group-dynamics-159412405 https://www.slideshare.net/vanyasingla1/organizational-change-development-26565951						



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MECHANICAL ENGINEERING

Course Code	Business Environment (Common to All branches of Engineering)		L	T	P	C
20A52303			3	0	0	3
Pre-requisite	NIL	Semester	III			
Course Objectives:						
<ul style="list-style-type: none"> • To make the student to understand about the business environment • To enable them in knowing the importance of fiscal and monetary policy • To facilitate them in understanding the export policy of the country • To Impart knowledge about the functioning and role of WTO • To Encourage the student in knowing the structure of stock markets 						
Course Outcomes (CO):						
<ul style="list-style-type: none"> • Define Business Environment and its Importance. • Understand various types of business environment. • Apply the knowledge of Money markets in future investment • Analyse India's Trade Policy • Evaluate fiscal and monetary policy • Develop a personal synthesis and approach for identifying business opportunities 						
UNIT - I	Overview of Business Environment					
Introduction – meaning Nature, Scope, significance, functions and advantages. Types-Internal & External, Micro and Macro. Competitive structure of industries -Environmental analysis-advantages & limitations of environmental analysis& Characteristics of business.						
UNIT - II	Fiscal & Monetary Policy					
Introduction – Nature, meaning, significance, functions and advantages. Public Revenues - Public Expenditure - Evaluation of recent fiscal policy of GOI. Highlights of Budget- Monetary Policy - Demand and Supply of Money –RBI -Objectives of monetary and credit policy - Recent trends- Role of Finance Commission.						
UNIT - III	India's Trade Policy					
Introduction – Nature, meaning, significance, functions and advantages. Magnitude and direction of Indian International Trade - Bilateral and Multilateral Trade Agreements - EXIM policy and role of EXIM bank -Balance of Payments– Structure & Major components - Causes for Disequilibrium in Balance of Payments - Correction measures.						
UNIT - IV	World Trade Organization					
Introduction – Nature, significance, functions and advantages. Organization and Structure - Role and functions of WTO in promoting world trade - GATT -Agreements in the Uruguay Round –TRIPS, TRIMS - Disputes Settlement Mechanism - Dumping and Anti-dumping Measures.						
UNIT - V	Money Markets and Capital Markets					
Introduction – Nature, meaning, significance, functions and advantages. Features and components of Indian financial systems - Objectives, features and structure of money markets and capital markets - Reforms and recent development – SEBI – Stock Exchanges - Investor protection and role of SEBI, Introduction to international finance.						
Textbooks:						
1. Francis Cherunilam (2009), International Business: Text and Cases, Prentice Hall of India. 2. K. Aswathappa, Essentials of Business Environment: Texts and Cases & Exercises 13th Revised Edition.HPH2016						
Reference Books:						



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- 1.K. V. Sivayya, V. B. M Das (2009), Indian Industrial Economy, Sultan Chand Publishers, New Delhi, India.
2. Sundaram, Black (2009), International Business Environment Text and Cases, Prentice Hall of India, New Delhi, India.
3. Chari. S. N (2009), International Business, Wiley India.
- 4.E. Bhattacharya (2009), International Business, Excel Publications, New Delhi.

Online Learning Resources:

<https://www.slideshare.net/ShompaDhali/business-environment-53111245>
<https://www.slideshare.net/rbalsells/fiscal-policy-ppt>
<https://www.slideshare.net/aguness/monetary-policy-presentationppt>
<https://www.slideshare.net/DaudRizwan/monetary-policy-of-india-69561982>
<https://www.slideshare.net/ShikhaGupta31/indias-trade-policyppt>
<https://www.slideshare.net/viking2690/wto-ppt-60260883>
<https://www.slideshare.net/prateeknepal3/ppt-mo>



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MECHANICAL ENGINEERING

Course Code	Applied Thermodynamics Lab		L	T	P	C
20A03401P			0	0	3	1.5
Pre-requisite	NIL	Semester	IV			
Course Objectives:						
<ul style="list-style-type: none"> • Understand the functioning and performance of I.C. Engines • To find heat losses in various engines 						
Course Outcomes (CO):						
<p>Upon the successful completion of course, students will be able to</p> <ul style="list-style-type: none"> • Explain different working cycles of engine • Describe various types of combustion chambers in IC engines • Illustrate the working of refrigeration and air conditioning systems • Evaluate heat balance sheet of IC engine. • 						
LIST OF EXPERIMENTS						
<p>Demonstration of diesel and petrol engines by cut models</p> <ol style="list-style-type: none"> 1. Valve timing diagram of 4-stroke diesel engine 2. Port timing diagram of 2-stroke petrol engine 3. Performance of 2-stroke single cylinder petrol engine 4. Morse test on multi cylinder petrol engine 5. Performance of 4-stroke single cylinder diesel engine 6. Assembly and disassembly of diesel and petrol engines 7. Exhaust gas analysis 8. Performance of two stage reciprocating air compressor 9. Determination of nozzle characteristics 10. Performance of Refrigeration system 11. Performance of Air conditioning system 12. Performance of heat pump 						



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MECHANICAL ENGINEERING

Course Code	Manufacturing Technology Lab		L	T	P	C
20A03403P			0	0	3	1.5
Pre-requisite	NIL	Semester	IV			
Course Objectives:						
<ul style="list-style-type: none"> • Familiarize the construction and working of various machine tools. • Teach selection of parameters for different machining processes. 						
Course Outcomes (CO):						
After completion of this course the student may be able to <ul style="list-style-type: none"> • Implement the concept of machining with various machine tools.(L5) • Get hands on experience on various machine tools and machining operations. (L5) 						
List of Experiments:						
<ol style="list-style-type: none"> 1. Demonstration of operations on general purpose machines: Lathe, drilling, milling, shaper, slotting, cylindrical and surface grinding machines. 2. Step turning and knurling on lathe machine 3. Taper turning and knurling on lathe machine 4. Thread cutting (left hand or right hand) on lathe machine. 5. Drilling and Boring operations. 6. Reaming and tapping operations. 7. Milling (Gear cutting) by using simple and Compound indexing. 8. key way/Groove cutting on milling machine 9. Shaping and planing operations 10. Slotting operations 11. Cylindrical and surface grinding operations 12. Grinding of single point cutting tool 						



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MECHANICAL ENGINEERING

Course Code	Computer Aided Machine Drawing		L	T	P	C
20A03404			0	0	3	1.5
Pre-requisite	NIL	Semester	IV			
Course Objectives:						
<ul style="list-style-type: none"> • Introduce conventional representations of material and machine components. • Train to use software for 2D and 3D modeling. • Familiarize with thread profiles, riveted, welded and key joints. • Teach solid modeling of machine parts and their sections. • Explain creation of 2D and 3D assembly drawings. • Familiarize with limits, fits and tolerances in mating components 						
Course Outcomes (CO):						
<p>After completion of this lab student will be able to</p> <ul style="list-style-type: none"> • Demonstrate the conventional representations of materials and machine components. • Model riveted, welded and key joints using CAD system. • Create solid models and sectional views of machine components. • Generate solid models of machine parts and assemble them. • Translate 3D assemblies into 2D drawings. • Create manufacturing drawing with dimensional and geometric tolerances. 						
<p>The following contents are to be done by any 2D software package</p> <p>Conventional representation of materials and components: Detachable joints: Drawing of thread profiles, hexagonal and square-headed bolts and nuts, bolted joint with washer and locknut, stud joint, screw joint and foundation bolts. Riveted joints: Drawing of rivet, lap joint, butt joint with single strap, single riveted, double riveted double strap joints. Welded joints: Lap joint and T joint with fillet, butt joint with conventions. Keys: Taper key, sunk taper key, round key, saddle key, feather key, woodruff key. Couplings: rigid – Muff, flange; flexible – bushed pin-type flange coupling, universal coupling, Oldhams' coupling.</p> <p>The following contents to be done by any 3D software package</p> <p>Sectional views Creating solid models of complex machine parts and create sectional views. Assembly drawings: (Any four of the following using solid model software) Lathe tool post, tool head of shaping machine, tail stock, machine vice, gate valve, carburettor, piston, connecting rod, eccentric, screw jack, plumber block, axle bearing, pipe vice, clamping device, Geneva cam, universal coupling,</p> <p>Manufacturing drawing: Representation of limits, fits and tolerances for mating parts. Use any four parts of above assembly drawings and prepare manufacturing drawing with dimensional and geometric tolerances.</p>						
Textbooks:						
<ol style="list-style-type: none"> 1. K.L.Narayana, P.Kannaiah and K.Venkat Reddy, Production Drawing, New Age International Publishers, 3/e, 2014 2. Software tools/packages- Auto CAD, Solid works or equivalent. 						



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Reference Books:

3. Cecil Jensen, Jay Helsel and Donald D.Voisinet, Computer Aided Engineering Drawing, Tata Mcgraw-Hill, NY, 2000.
4. James Barclay, Brain Griffiths, Engineering Drawing for Manufacture, Kogan Page Science, 2003.
5. N.D.Bhatt, Machine Drawing, Charotar, 50/e, 2014.

Online Learning Resources:

<https://eedocs.files.wordpress.com/2014/02/machinedrawing.pdf>



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MECHANICAL ENGINEERING

Course Code	Soft Skills		L	T	P	C
20A52401			1	0	2	2
Pre-requisite	NIL	Semester	IV			
Course Objectives:						
<ul style="list-style-type: none"> • To encourage all round development of the students by focusing on soft skills • To make the students aware of critical thinking and problem-solving skills • To develop leadership skills and organizational skills through group activities • To function effectively with heterogeneous teams 						
Course Outcomes (CO):						
By the end of the program students should be able to						
<ul style="list-style-type: none"> • Memorize various elements of effective communicative skills • Interpret people at the emotional level through emotional intelligence • apply critical thinking skills in problem solving • analyse the needs of an organization for team building • Judge the situation and take necessary decisions as a leader • Develop social and work-life skills as well as personal and emotional well-being 						
UNIT – I	Soft Skills & Communication Skills				10 Hrs	
Introduction, meaning, significance of soft skills – definition, significance, types of communication skills - Intrapersonal & Inter-personal skills - Verbal and Non-verbal Communication						
Activities:						
Intrapersonal Skills- Narration about self- strengths and weaknesses- clarity of thought – self- expression – articulating with felicity (The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes and literary sources)						
Interpersonal Skills- Group Discussion – Debate – Team Tasks - Book and film Reviews by groups - Group leader presenting views (non- controversial and secular) on contemporary issues or on a given topic.						
Verbal Communication- Oral Presentations- Extempore- brief addresses and speeches- convincing- negotiating- agreeing and disagreeing with professional grace.						
Non-verbal communication – Public speaking – Mock interviews – presentations with an objective to identify non- verbal clues and remedy the lapses on observation						
UNIT – II	Critical Thinking				10 Hrs	
Active Listening – Observation – Curiosity – Introspection – Analytical Thinking – Open-mindedness – Creative Thinking						
Activities:						
Gathering information and statistics on a topic - sequencing – assorting – reasoning – critiquing issues – placing the problem – finding the root cause - seeking viable solution – judging with rationale – evaluating the views of others - Case Study, Story Analysis						
UNIT – III	Problem Solving & Decision Making				10 Hrs	
Meaning & features of Problem Solving – Managing Conflict – Conflict resolution – Methods of decision making – Effective decision making in teams – Methods & Styles						
Activities:						
Placing a problem which involves conflict of interests, choice and views – formulating the problem – exploring solutions by proper reasoning – Discussion on important professional, career and organizational decisions and initiate debate on the appropriateness of the decision. Case Study & Group Discussion						
UNIT – IV	Emotional Intelligence & Stress Management				10 Hrs	



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Managing Emotions – Thinking before Reacting – Empathy for Others – Self-awareness – Self-Regulation – Stress factors – Controlling Stress – Tips

Activities:

Providing situations for the participants to express emotions such as happiness, enthusiasm, gratitude, sympathy, and confidence, compassion in the form of written or oral presentations.

Providing opportunities for the participants to narrate certain crisis and stress –ridden situations caused by failure, anger, jealousy, resentment and frustration in the form of written and oral presentation, Organizing Debates

UNIT – V

Leadership Skills

10 Hrs

Team-Building – Decision-Making – Accountability – Planning – Public Speaking – Motivation – Risk-Taking - Team Building - Time Management

Activities:

Forming group with a consensus among the participants- choosing a leader- encouraging the group members to express views on leadership- democratic attitude- sense of sacrifice – sense of adjustment – vision – accommodating nature- eliciting views on successes and failures of leadership using the past knowledge and experience of the participants, Public Speaking, Activities on Time Management, Motivation, Decision Making, Group discussion etc.

NOTE:-

1. The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes, epics, scriptures, autobiographies and literary sources which bear true relevance to the prescribed skill.

2. Case studies may be given wherever feasible for example for Decision Making- The decision of King Lear or for good Leadership – Mahendar Singh Dhoni etc.

Textbooks:

1. Personality Development and Soft Skills (English, Paperback, Mitra Barun K.) Publisher: Oxford University Press; Pap/Cdr edition (July 22, 2012)
2. Personality Development and Soft Skills: Preparing for Tomorrow, Dr Shikha Kapoor Publisher : I K International Publishing House; 0 edition (February 28, 2018)

Reference Books:

1. Soft skills: personality development for life success by Prashant Sharma, BPB publications 2018.
2. Soft Skills By Alex K. Published by S.Chand
3. Soft Skills: An Integrated Approach to Maximise Personality Gajendra Singh Chauhan, Sangeetha Sharma Published by Wiley.
4. Communication Skills and Soft Skills (Hardcover, A. Sharma) Publisher: Yking books
5. SOFT SKILLS for a BIG IMPACT (English, Paperback, Renu Shorey) Publisher: Notion Press
6. Life Skills Paperback English Dr. Rajiv Kumar Jain, Dr. Usha Jain Publisher: Vayu Education of India

Online Learning Resources:

1. https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCyvXh0E_y-bOO1_q
2. https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KIJ
3. <https://youtu.be/-Y-R9hDI7IU>
4. <https://youtu.be/gkLsn4ddmTs>
5. <https://youtu.be/2bf9K2rRWwo>
6. <https://youtu.be/FchfE3c2jzc>



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MECHANICAL ENGINEERING

Course Code	Design Thinking for Innovation (Common to All branches of Engineering)		L	T	P	C
20A99401			2	1	0	0
Pre-requisite	NIL	Semester	IV			
Course Objectives:						
The objective of this course is to familiarize students with design thinking process as a tool for breakthrough innovation. It aims to equip students with design thinking skills and ignite the minds to create innovative ideas, develop solutions for real-time problems.						
Course Outcomes (CO):						
<ul style="list-style-type: none"> ● Define the concepts related to design thinking. ● Explain the fundamentals of Design Thinking and innovation ● Apply the design thinking techniques for solving problems in various sectors. ● Analyse to work in a multidisciplinary environment ● Evaluate the value of creativity ● Formulate specific problem statements of real time issues 						
UNIT - I	Introduction to Design Thinking					10 Hrs
Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.						
UNIT - II	Design Thinking Process					10 Hrs
Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brain storming, product development						
Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.						
UNIT - III	Innovation					8 Hrs
Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity.						
Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.						
UNIT - IV	Product Design					8 Hrs
Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies.						
Activity: Importance of modelling, how to set specifications, Explaining their own product design.						
UNIT - V	Design Thinking in Business Processes					10 Hrs
Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes.						
Activity: How to market our own product, About maintenance, Reliability and plan for startup.						
Textbooks:						
1. Change by design, Tim Brown, Harper Bollins (2009) 2. Design Thinking for Strategic Innovation, Idris Mootee, 2013, John Wiley & Sons.						
Reference Books:						



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1. Design Thinking in the Classroom by David Lee, Ulysses press
2. Design the Future, by Shrrutin N Shetty, Norton Press
3. Universal principles of design- William lidwell, kritinaholden, Jill butter.
4. The era of open innovation – chesbrough.H

Online Learning Resources:

<https://nptel.ac.in/courses/110/106/110106124/>
<https://nptel.ac.in/courses/109/104/109104109/>
https://swayam.gov.in/nd1_noc19_mg60/preview



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COMMUNITY SERVICE PROJECT

.....**Experiential learning through community engagement**

Introduction

- Community Service Project is an experiential learning strategy that integrates meaningful community service with instruction, participation, learning and community development
- Community Service Project involves students in community development and service activities and applies the experience to personal and academic development.
- Community Service Project is meant to link the community with the college for mutual benefit. The community will be benefited with the focused contribution of the college students for the village/ local development. The college finds an opportunity to develop social sensibility and responsibility among students and also emerge as a socially responsible institution.

Objective

Community Service Project should be an integral part of the curriculum, as an alternative to the 2 months of Summer Internships / Apprenticeships / On the Job Training, whenever there is an exigency when students cannot pursue their summer internships. The specific objectives are;

- To sensitize the students to the living conditions of the people who are around them,
- To help students to realize the stark realities of the society.
- To bring about an attitudinal change in the students and help them to develop societal consciousness, sensibility, responsibility and accountability
- To make students aware of their inner strength and help them to find new /out of box solutions to the social problems.
- To make students socially responsible citizens who are sensitive to the needs of the disadvantaged sections.
- To help students to initiate developmental activities in the community in coordination with public and government authorities.
- To develop a holistic life perspective among the students by making them study culture, traditions, habits, lifestyles, resource utilization, wastages and its management, social problems, public administration system and the roles and responsibilities of different persons across different social systems.

Implementation of Community Service Project

- Every student should put in a 6 weeks for the Community Service Project during the summer vacation.
- Each class/section should be assigned with a mentor.
- Specific Departments could concentrate on their major areas of concern. For example, Dept. of Computer Science can take up activities related to Computer Literacy to different sections of people like - youth, women, house-wives, etc
- A log book has to be maintained by each of the student, where the activities undertaken/involved to be recorded.
- The logbook has to be countersigned by the concerned mentor/faculty incharge.
- Evaluation to be done based on the active participation of the student and grade could be awarded by the mentor/faculty member.



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- The final evaluation to be reflected in the grade memo of the student.
- The Community Service Project should be different from the regular programmes of NSS/NCC/Green Corps/Red Ribbon Club, etc.
- Minor project report should be submitted by each student. An internal Viva shall also be conducted by a committee constituted by the principal of the college.
- Award of marks shall be made as per the guidelines of Internship/apprentice/ on the job training

Procedure

- A group of students or even a single student could be assigned for a particular habitation or village or municipal ward, as far as possible, in the near vicinity of their place of stay, so as to enable them to commute from their residence and return back by evening or so.
- The Community Service Project is a twofold one –
 - First, the student/s could conduct a survey of the habitation, if necessary, in terms of their own domain or subject area. Or it can even be a general survey, incorporating all the different areas. A common survey format could be designed. This should not be viewed as a duplication of work by the Village or Ward volunteers, rather, it could be another primary source of data.
 - Secondly, the student/s could take up a social activity, concerning their domain or subject area. The different areas, could be like –
 - Agriculture
 - Health
 - Marketing and Cooperation
 - Animal Husbandry
 - Horticulture
 - Fisheries
 - Sericulture
 - Revenue and Survey
 - Natural Disaster Management
 - Irrigation
 - Law & Order
 - Excise and Prohibition
 - Mines and Geology
 - Energy
 - Internet
 - Free Electricity
 - Drinking Water

EXPECTED OUTCOMES

BENEFITS OF COMMUNITY SERVICE PROJECT TO STUDENTS

Learning Outcomes

- Positive impact on students' academic learning
- Improves students' ability to apply what they have learned in “the real world”



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- Positive impact on academic outcomes such as demonstrated complexity of understanding, problem analysis, problem-solving, critical thinking, and cognitive development
- Improved ability to understand complexity and ambiguity

Personal Outcomes

- Greater sense of personal efficacy, personal identity, spiritual growth, and moral development
- Greater interpersonal development, particularly the ability to work well with others, and build leadership and communication skills

Social Outcomes

- Reduced stereotypes and greater inter-cultural understanding
- Improved social responsibility and citizenship skills
- Greater involvement in community service after graduation

Career Development

- Connections with professionals and community members for learning and career opportunities
- Greater academic learning, leadership skills, and personal efficacy can lead to greater opportunity

Relationship with the Institution

- Stronger relationships with faculty
- Greater satisfaction with college
- Improved graduation rates

BENEFITS OF COMMUNITY SERVICE PROJECT TO FACULTY MEMBERS

- Satisfaction with the quality of student learning
- New avenues for research and publication via new relationships between faculty and community
- Providing networking opportunities with engaged faculty in other disciplines or institutions
- A stronger commitment to one's research

BENEFITS OF COMMUNITY SERVICE PROJECT TO COLLEGES AND UNIVERSITIES

- Improved institutional commitment
- Improved student retention
- Enhanced community relations

BENEFITS OF COMMUNITY SERVICE PROJECT TO COMMUNITY

- Satisfaction with student participation
- Valuable human resources needed to achieve community goals
- New energy, enthusiasm and perspectives applied to community work
- Enhanced community-university relations.

SUGGESTIVE LIST OF PROGRAMMES UNDER COMMUNITY SERVICE PROJECT

The following the recommended list of projects for Engineering students. The lists are not exhaustive and open for additions, deletions and modifications. Colleges are expected to focus on specific local issues for this kind of projects. The students are expected to carry out these projects with involvement, commitment, responsibility and accountability. The mentors of a group of students should take the



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responsibility of motivating, facilitating, and guiding the students. They have to interact with local leadership and people and appraise the objectives and benefits of this kind of projects. The project reports shall be placed in the college website for reference. Systematic, Factual, methodical and honest reporting shall be ensured.

For Engineering Students

1. Water facilities and drinking water availability
2. Health and hygiene
3. Stress levels and coping mechanisms
4. Health intervention programmes
5. Horticulture
6. Herbal plants
7. Botanical survey
8. Zoological survey
9. Marine products
10. Aqua culture
11. Inland fisheries
12. Animals and species
13. Nutrition
14. Traditional health care methods
15. Food habits
16. Air pollution
17. Water pollution
18. Plantation
19. Soil protection
20. Renewable energy
21. Plant diseases
22. Yoga awareness and practice
23. Health care awareness programmes and their impact
24. Use of chemicals on fruits and vegetables
25. Organic farming
26. Crop rotation
27. Flourey culture
28. Access to safe drinking water
29. Geographical survey
30. Geological survey
31. Sericulture
32. Study of species
33. Food adulteration
34. Incidence of Diabetes and other chronic diseases
35. Human genetics
36. Blood groups and blood levels
37. Internet Usage in Villages
38. Android Phone usage by different people
39. Utilisation of free electricity to farmers and related issues
40. Gender ration in schooling lvel- observation.



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Complimenting the community service project the students may be involved to take up some awareness campaigns on social issues/special groups. The suggested list of programmes are;

Programmes for School Children

1. Reading Skill Programme (Reading Competition)
2. Preparation of Study Materials for the next class.
3. Personality / Leadership Development
4. Career Guidance for X class students
5. Screening Documentary and other educational films
6. Awareness Programme on Good Touch and Bad Touch (Sexual abuse)
7. Awareness Programme on Socially relevant themes.

Programmes for Women Empowerment

1. Government Guidelines and Policy Guidelines
2. Womens' Rights
3. Domestic Violence
4. Prevention and Control of Cancer
5. Promotion of Social Entrepreneurship

General Camps

1. General Medical camps
2. Eye Camps
3. Dental Camps
4. Importance of protected drinking water
5. ODF awareness camp
6. Swatch Bharath
7. AIDS awareness camp
8. Anti Plastic Awareness
9. Programmes on Environment
10. Health and Hygiene
11. Hand wash programmes
12. Commemoration and Celebration of important days

Programmes for Youth Empowerment

1. Leadership
2. Anti-alcoholism and Drug addiction
3. Anti-tobacco
4. Awareness on Competitive Examinations
5. Personality Development

Common Programmes

1. Awareness on RTI
2. Health intervention programmes
3. Yoga
4. Tree plantation
5. Programmes in consonance with the Govt. Departments like –
 - i. Agriculture
 - ii. Health
 - iii. Marketing and Cooperation



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- iv. Animal Husbandry
- v. Horticulture
- vi. Fisheries
- vii. Sericulture
- viii. Revenue and Survey
- ix. Natural Disaster Management
- x. Irrigation
- xi. Law & Order
- xii. Excise and Prohibition
- xiii. Mines and Geology
- xiv. Energy

Role of Students:

- Students may not have the expertise to conduct all the programmes on their own. The students then can play a facilitator role.
- For conducting special camps like Health related, they will be coordinating with the Governmental agencies.
- As and when required the College faculty themselves act as Resource Persons.
- Students can work in close association with Non-Governmental Organizations like Lions Club, Rotary Club, etc or with any NGO actively working in that habitation.
- And also with the Governmental Departments. If the programme is rolled out, the District Administration could be roped in for the successful deployment of the programme.
- An in-house training and induction programme could be arranged for the faculty and participating students, to expose them to the methodology of Service Learning.

Timeline for the Community Service Project Activity

Duration: 8 weeks

1. Preliminary Survey (One Week)

- A preliminary survey including the socio-economic conditions of the allotted habitation to be conducted.
- A survey form based on the type of habitation to be prepared before visiting the habitation with the help of social sciences faculty. (However, a template could be designed for different habitations, rural/urban.
- The Governmental agencies, like revenue administration, corporation and municipal authorities and village secretariats could be aligned for the survey.

2. Community Awareness Campaigns (One Week)

- Based on the survey and the specific requirements of the habitation, different awareness campaigns and programmes to be conducted, spread over two weeks of time. The list of activities suggested could be taken into consideration.

3. Community Immersion Programme (Three Weeks)

Along with the Community Awareness Programmes, the student batch can also work with any one of the below listed governmental agencies and work in tandem with them. This community involvement programme will involve the students in exposing themselves to the



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experiential learning about the community and its dynamics. Programmes could be in consonance with the Govt. Departments.

4. Community Exit Report (One Week)

- During the last week of the Community Service Project, a detailed report of the outcome of the 8 weeks work to be drafted and a copy shall be submitted to the local administration. This report will be a basis for the next batch of students visiting that particular habitation. The same report submitted to the teacher-mentor will be evaluated by the mentor and suitable marks are awarded for onward submission to the University.

Throughout the Community Service Project, a daily log-book need to be maintained by the students batch, which should be countersigned by the governmental agency representative and the teacher-mentor, who is required to periodically visit the students and guide them.