NRI INSTITUTE OF TECHNOLOGY

(An Autonomous Institution Permanently Affiliated to JNTUK, Kakinada)
(Accredited by NAAC with "A" Grade and ISO 9001:2015 Certified Institution)
POTHAVARAPPADU (V), (VIA) NUNNA, AGIRIPALLI (M), PIN – 521 212

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE FOR SECOND YEAR B.TECH PROGRAMME

II YEAR I SEMESTER

Sl. No	Course Code	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Maximum Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1	18A2100201	Complex Variables and Fourier Series	3	0	0	3	40	60	100	3
2	18A2103301	Material Science and Engineering	3	0	0	3	40	60	100	3
3	18A2103401	Basic Thermodynamics	3	0	0	3	40	60	100	3
4	18A2103402	Mechanics of Materials	3	0	0	3	40	60	100	3
5	18A2103403	Manufacturing Process	3	0	0	3	40	60	100	3
6	18A2102301	Essential of Electrical and Electronic Engineering	3	0	0	3	40	60	100	3
7	18A2103491	Material Testing and Metallurgy Lab	0	0	2	2	40	60	100	1
8	18A2103492	Manufacturing Process Lab	0	0	2	2	40	60	100	1
9	18A2102391	Essential of Electrical and Electronics Engineering Lab	0	0	2	2	40	60	100	1
Total			**18**	**0**	**06**	**24**	**360**	**540**	**900**	21

II YEAR II SEMESTER

Sl. No	Course Code	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Maximum Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1	18A2200201	Mathematics-IV	3	0	0	3	40	60	100	3
2	18A2203401	Design of Machine Members-I	3	0	0	3	40	60	100	3
	18A2203402	Fluid Mechanics and Hydraulic Machines	3	0	0	3	40	60	100	3
4	18A2203403	Kinematics of Machines	3	0	0	3	40	60	100	3
5	18A2203404	IC Engines and Gas Turbines	3	0	0	3	40	60	100	3
6	18A2203601 18A2203602	**Open Elective –I** i) Basics of Mechanical Engineering ii) Industrial Materials	3	0	0	3	40	60	100	3
7	18A2203301	Computer aided Machine Drawing (Internal)	2	0	3	5	40	60	100	1.5
8	18A2203491	Fluid Mechanics and Hydraulic Machines Lab	0	0	3	3	40	60	100	1
9	18A2203492	Thermal Engineering Lab	0	0	3	3	40	60	100	1
10	18A2200801	Professional Ethics and Human Values	3	0	0	3	40	60	100	0
Total			**23**	0	**9**	**33**	**400**	**600**	**10000**	21.5

L - LECTURE T – TUTORIAL P - PRACTICAL
CIA – Continuous Internal Assessment SEA – Semester End Assessment

18A2100201-ENGG.MATHEMAICS-III

Lecture – Tutorial:	2-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Sequences and series of numbers and of vectors, Derivative in one variable, Several variables, Integration in one variable, Integration with parameters, Sequences and series of functions, Uniform vs. point-wise convergence, Line integrals

Course Objectives:

1) To familiarize the techniques in complex variables.
2) To familiarize the techniques in Fourier series.
3) To familiarize the techniques in partial differential equations.
4) To equip the students to solve application problems in their disciplines.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	write an analytic function if either real part or imaginary part is known and by using Cauchy-Riemann equations or apply Milne-Thompson method(L3)
CO2	evaluate the integral of complex function over the region bounded by the closed curves by apply either Cauchy-Goursat theorem or Cauchy's integral formula or Cauchy's Residue theorem(L5)
CO3	write the infinite series expansion of complex function by apply Taylor's/Maclaurin's/Laurent's series(L3)
CO4	write a Fourier series expansion of a periodic function by using Euler's formulae (L3)
CO5	solve the Partial difference equations (L3)
CO6	solve one dimensional wave and heat equations by using partial differential equations (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2-Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2	2	-	-	-	-	-	-	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	-
CO6	3	3	2	2	-	-	-	-	-	-	-	-

UNIT I

Complex Variable – Differentiation & Integration

Complex function , Real and Imaginary parts of Complex function, Limit**,** Continuity and Derivative of complex function, Cauchy-Riemann equations, Analytic function, entire function, singular point, conjugate function**,** Harmonic functions, Milne-Thomson method**.**

Line integral of a complex function, Cauchy's theorem(only statement) ,Cauchy's Integral Formula.

UNIT II

Complex Variable- Series expansion, Residue Theorem & Evaluation of Real Integrals

Absolutely convergent and uniformly convergent of series of complex terms, Radius of convergence**,** Taylor's series, Maclaurin's series expansion, Laurent's series.

Zeros of an analytic function, Singularity, Isolated singularity, Removable singularity, Essential singularity, pole of order m, simple pole, Residues, Residue theorem, Calculation of residues, Residue at a pole of order m**,** Evaluation of real definite integrals: Integration around the unit circle**,** Integration around semi-circle.

UNIT III

Fourier Series

Introduction- Periodic functions – Fourier series of -periodic function - Dirichlet's conditions – Even and odd functions –Change of interval– Half-range sine and cosine series.

UNIT IV

Partial Differentials Equations & Applicatiions

Introduction,Formation of PDE, Solutiion of PDE, Linear equations of first order, Non-linear equations of first order.

Applications: Method of seperatiion of Variables, One dimensional Wave and Heat equations.

TEXT BOOKS:

1**)** B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43/e, 2010.

2) Erwin kreyszig, Advanced Engineering Mathematics, 9/e, John Wiley & Sons, 2006.

REFERENCE BOOKS:

1) J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7/e, Mc-Graw Hill, 2004.

2) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, 2008.

18A2103301- Material Science and Engineering

Lecture – Tutorial:	2-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Engineering Physics, Engineering Chemistry.

Course Objectives:

1) Acquire knowledge of basic structure and crystal arrangement of materials.
2) Understand the phase and importance of the phase diagram.
3) Acquire awareness of the ferrous and non-ferrous materials.
4) Gain the knowledge of heat treatment and various methods.
5) Know how the powder metallurgy processes and applications of composites.
6) Acquire knowledge of all the materials useful to the research and ultimately reaches the society

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Estimate the properties of the metals and alloys based on structures.
CO2	Classify, construct and analyze equilibrium diagrams.
CO3	Analyze and distinguish various ferrous, non-ferrous metals and alloys.
CO4	Identify the influence of mechanical working and heat treatment principles on materials.
CO5	Classify, analyze and suggest the suitable manufacturing method for composite materials and Powder metallurgy.
CO6	Able to suggest the suitable material for any applications demand by the society

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2-Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	-	-	-	-	-	-	-	-	2	-	-
CO2	-	3	3	-	-	-	3	-	-	-	-	-
CO3	-	3	3	2	-	-	-	-	-	-	-	-
CO4	-	3	3	3	-	2	-	-	-	-	-	-
CO5	-	-	-	3	-	2	2	-	-	-	-	-
CO6	-	3	3	3	-	-	-	-	-	-	-	-

UNIT I

Structure of Metals: Crystal Structures: Unit cells, Metallic crystal structures, Bonds in Solids – Metallic bond–solid solutions, Hume Rotherys rules. Imperfection in solids: Point, Line, interstitial and volume defects.

Constitution of Alloys: Necessity of Alloying, substitutional and interstitial solid solutions-Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid reactions. Iron-Iron-carbide diagram and microstructural aspects of ferrite, cementite, austenite, ledeburite, and cast iron.

UNIT II

Steels:
Plain carbon steels, use and limitations of plain carbon steels. classification of steels and alloys steels. Micro structure, properties and applications of stainless steels and tool steels.

Cast irons:
Micro structure, properties and applications of white cast iron, malleable cast iron, grey cast iron, nodular cast iron and alloy cast irons.

UNIT III

Heat Treatment of Steels: Annealing, tempering, normalizing and spheroidizing, isothermal transformation diagrams for Fe-Fe_3C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening.

Non-ferrous Metals and Alloys: Micro structure, properties and applications of copper and its alloys, aluminium and its alloys.

UNIT IV

Ceramics, Polymers and Composites: Structure, properties and applications of ceramics, polymers and composites.

Powder Metallurgy: Powder metallurgy process, preparation of powders, characteristics of metal powders, mixing, compacting, sintering, Applications of Powder Metallurgy.

TEXT BOOKS:

1**)** V.D.Kotgire, S.V.Kotgire, Material Science and Metallurgy, Everest Publishing House, 24thEdition,2008.

2)Sidney H. Avener, Introduction to Physical Metallurgy, Tata McGraw-Hill, 3rdEdition,2011.

3) William and callister, Materials Science and engineering, Wiley India private Ltd.,2011.

REFERENCE BOOKS:

1.U.C Jindal and Atish Mozumber, Material since and metallurgy, Pearson education-2012

2. Richard A.Flinn, Paul K.Trojan, Engineering Materials and Their Applications, Jaico Publishing House, 4thEdition,1999.

3.Raghavan.V, " Material Science and Metallurgy,FifthEdition, PHI Learning Pvt Limited,2013.

E-RESOURCES:

1) Prof.R.N.Ghosh, IIT Kharagpur, Solidification Binary Alloys, Iron-Carbon Phase Diagram,[English]WebAvailable:
https://www.youtube.com/results?search_query=prof.r.n+ghosh+lecturers

2) Prof.S.K.Gupta, IIT Delhi, Phase Diagrams, Crystal imperfections

[English] Web Available:https://www.youtube.com/watch?v=x3n9ht-eRfg

18A2103401-BASIC THERMODYNAMICS

Lecture – Tutorial:	2-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites: Engineering physics and engineering mathematics

Course Objectives:

1) To understand the basic concepts of energy conversions and fundamentals of thermodynamics and its application.
2) To acquire the knowledge of first law of thermodynamics and its analysis.
3) To learn the second law of thermodynamics and significance of entropy principles.
4) To learn the concepts of pure substance and vapour power cycles.
5) To learn the concepts of reactant, non-reactant gas mixtures and gas power cycles.
6) To understand the significance of various thermal cycles.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	The student should be able to understand the basic concepts of thermodynamics.
CO2	The student should be able to understand the first law of thermodynamics and its applications.
CO3	The student should be able to understand the second law of thermodynamics, use of Maxwells relations and thermodynamic functions and concept of entropy.
CO4	The student should be able to understand the formation of steam and calculate the quality of steam.
CO5	The student should be able to understand the working of vapour power cycels and calculate their performance.
CO6	The student should be able to understand the Concept of standard cycles and should be able to calculate the efficiency and performance parameters

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2-Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	1	-	-	-	1	1	-	-	-	-	1
CO2	1	1	1	1	-	1	-	-	-	-	-	1
CO3	2	1	1	1	-	1	-	-	-	-	-	1
CO4	2	1	1	1	-	1	1	-	-	-	-	1
CO5	1	1	1	1	-	1	1	-	-	-	-	1
CO6	2	2	2	1	-	1	1	-	-	-	-	1

UNIT I

Introduction: Basic Concepts : System, boundary, Surrounding, control volume, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Cycle – Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility – Energy in State and in Transition, Work and Heat, Point and Path function.

Zeroth Law of Thermodynamics: Concept of Temperature – Principles of Thermometry – Reference Points – Const. Volume gas Thermometer Scales of Temperature. Ideal gas scale-Deviations from perfect gas model-Vander waals equation of state- Compressibility charts-Variable specific heats-Gas Tables.

First law of Thermodynamics: Joule's Experiments, Corollaries and PMM-I First law applied to a Process – applied to a flow system – Steady Flow Energy Equation and its applications.

Throttling and free expansion processes, first law for non flow systems.

UNIT II

Second Law of Thermodynamics: Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance,Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature.

Entropy: Principle of Entropy Increase – Energy Equation, Availability and Irreversibility, Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations, Elementary Treatment of the Third Law of Thermodynamics.

UNIT III

Properties of Pure Substances: P-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction . Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry. Clausius – clapeyron Equation- Property Tables.

Vapour Power Cycles: Carnot Vapour Cycle, Working of simple Rankine Cycle. Description and representation on P–V and T-S diagram, Thermal Efficiency.

UNIT IV

Mixtures of perfect Gases : Mole Fraction, Mass friction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes – Mole fraction , Volume fraction and partial pressure, Equivalent Gas const. And Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour

Gas Power Cycles: Introduction, Analysis of Power Cycles- Carnot, Otto, Diesel, Dual, Brayton Cycle, Ericcson Cycle, Lenoir Cycle and Atkinson cycle.

TEXT BOOKS:

1. Engineering Thermodynamics , PK Nag 4th Edn , TMH.
2. Thermodynamics – An Engineering Approach with student resources DVD – Y.A.Cengel & M.A.Boles , 7th Edn - McGrawHill
3. Fundamentals of Thermodynamics by Claus Borgnakke Richard E. Sonntag, seventh edition, John Wiley & Sons, Inc.

REFERENCE BOOKS:

1. Engineering Thermodynamics – Jones & Dugan PHI
2. Thermodynamics – J.P.Holman , McGrawHill
3. Basic Engineering Thermodynamics – A.Venkatesh – Universities press.
4. An Introduction to Thermodynamics - Y.V.C.Rao – Universities press.
5. Thermodynamics – W.Z.Black & J.G.Hartley, 3rd Edn Pearson Publ.
6. Engineering Thermodynamics – D.P.Misra, Cengage Publ.
7. Engineering Thermodynamics – P.Chattopadhyay – Oxford Higher Edn Publ.

18A2103402- Mechanics of Materials

Lecture – Tutorial:	2-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Introduction to Mechanical Engineering Sciences
Engineering Mechanics

Course Objectives:

1) Gain a fundamental understanding of the concepts of stress and strain by analysing different solids and structures
2) Analyze and beams, to determine axial forces, torque, shear forces, and bending moments
3) Analyze the beams of different shapes for finding out the shear stress and bending stress distribution.
4) Develop the governing differential equation for the elastic curve, and apply different techniques for finding out the deflection at required points
5) Analyze determinate and indeterminate axial members, torsional members
6) Calculate the buckling load for columns with different end conditions.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Determine and illustrate principal stresses, principal strains, maximum shearing stress, and simple stresses acting on structural members.
CO2	Analyze bending stresses and shear stresses in structural members subjected to flexural loadings and draw the distribution diagrams.
CO3	Estimate the stresses and strains in circular torsion members
CO4	Determine the deflections and slopes produced in beams under loading conditions.
CO5	Analyze slender, long columns subjected to axial loads
CO6	Assess hoop and longitudinal stresses in thin and thick cylinders.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2-Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**3**	**3**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**
CO2	**3**	**3**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**
CO3	**3**	**3**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**
CO4	**3**	**3**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**
CO5	**3**	**3**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**
CO6	**3**	**3**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**

UNIT I

SIMPLE STRESSES: Concept of stress and strain, Hooke's law - Tension, Compression, and Shear, stress-strain diagram for mild steel – Factor of safety, Poisson's ratio, elastic constants and their relationship - Deformation of simple and compound bars. Thermal stresses – simple and Composite bars.

PRINCIPAL STRESSES: Principal planes, principal stress, maximum shearing stress on an inclined plane under Uniaxial, biaxial state of stress - Mohr's circle for plane stresses.

UNIT II

SHEAR FORCE AND BENDING MOMENT: Types of beams and loads – concept of shear force and bending moment, relation between SF, BM and rate of loading at a section of a beam, shear force and bending moment diagrams for cantilevers, simply supported and over hanging beams subjected to point loads, UDL, UVL and combination of these loads.

BENDING STRESSES: Theory of pure bending, bending equation derivation- determination of bending stress in beams across sections like rectangular, circular, I, T, angle and channel sections. Shear stress derivation, shear stress distribution across beams of various sections (rectangular, circular, I, T, angle and channel sections).

UNIT III

TORSION: Theory of pure torsion, transmission of power in solid and hollow circular shafts, shafts in series and parallel, combined bending and torsion.

DEFLECTION OF BEAMS: Differential equations of the deflection curve, Slope and deflection of cantilever, simply supported beams by double integration method - Macaulay's method - Moment area method. Application to simple cases including overhanging beams, Statically Indeterminate Beams and their solution methods.

UNIT IV

COLUMNS AND STRUTS: Buckling, Stability, Member subjected to different support conditions, Euler's theory, Rankine's theory.

CYLINDERS AND SHELLS: Longitudinal and circumferential stress and strains, Thin cylinder, thin spherical shells under internal pressure, changes in diameter and volume of cylinders –Riveted boiler shells, Thick cylinders - Lame's equation thick cylinders subjected to inside and outside pressures, compound cylinders.

TEXT BOOKS:

1**)** Solid Mechanics, by Popov

2) Strength of materials /GH Ryder/ Mc Millan publishers India Ltd.

3) Strength of Materials by S. Ramamrutham, R. Narayanan

REFERENCE BOOKS:

1. Strength of materials by R.K. Bansal
2. Strength of Materials by S.S. Rattan, Tata McGraw Hill Education Pvt., Ltd.,
3. Strength of materials by R.K. Rajput, S. Chand & Co, New Delhi
4. Strength of Materials -By Jindal, Umesh Publications.
5. Strength of Materials by S.Timoshenko
6. Strength of Materials by Andrew Pytel and Ferdinond L. Singer Longman.

E-RESOURCES:

1 . http://www.nptelvideos.in/2012/12/strength-of-materials.html

18A2103403- MANUFACTURING PROCESS

Lecture – Tutorial:	2-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Engineering Drawing
Engineering Workshop Technology

Course Objectives:

1) Acquire knowledge to understand about the primary manufacturing processes.
2) Understand the practical knowledge on casting, joining.
3) Acquire awareness on current manufacturing industry
4) Understand the practical knowledge on bulk forming, sheet metal forming
5) To introduce processing methods of plastics and unconventional machining processes.
6) Acquire knowledge of all the manufacturing processes useful to the research and ultimately reaches the society

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the Technology of the casting processes.
CO2	Differentiate various casting methods and their applications.
CO3	Differentiate various joining processes with applications
CO4	Understand various bulk metal forming and sheet metal processes
CO5	Understand Various Plastic operations.
CO6	Evaluate the manufacturing processes being utilized in the present industrial scenario.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2-Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	1	1	2	1	-	-	-	-	-	1	-
CO2	2	1	-	1	1	-	-	-	-	-	1	-
CO3	3	2	2	-		-		-	-	-	-	2
CO4	3	1	2	-		-	1	-	-	-	-	2
CO5	2	2	1	-	1	-	-	-	-	-	-	2
CO6	3	-	2	-	1	-	-	-	-	-	-	2

UNIT I

Introduction: Importance and selection of manufacturing processes.

Casting Processes: Introduction to casting process, process steps; pattern: types, materials and allowance; Moulding materials, equipment, Preparation, control and testing of moulding sands. Cores: Types of cores, core prints, principles and design of gating system; Solidification of casting: Concept, solidification of pure metal and alloy, short & long freezing range alloys.

Special casting processes: Shell casting, investment casting, die casting, centrifugal casting, casting defects and remedies.Methods of melting and types of furnaces-Cupola Furnace: Description, operation and zones, Electric Arc furnace.

UNIT II

Metal Joining Processes: Classification of welding processes, types of welded joints and their Characteristics, Gas welding, Different types of flames and uses, Oxy – Acetylene Gas cutting. Basic principles of Arc welding, weld bead geometry, Manual metal arc welding, submerged arc

welding, and Inert Gas welding- TIG & MIG welding.

Solid state welding processes- Friction welding, Friction stir welding, Forge welding, Explosive welding; Thermit welding, Plasma welding, Laser welding, electron beam welding, Soldering & Brazing. Heat affected zones in welding; pre & post heating, Weldability of metals, welding defects – causes and remedies.

UNIT III

Metal Forming and Plastic Processing

Metal Forming: 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**.**

Forging: 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.

Plastics: Types, properties and their applications, processing of plastics, injection molding, and blow molding.

UNIT IV

Unconventional Machining Processes: Electrical discharge machining (EDM), principle and processes parameters, electro-chemical machining (ECM) Laser beam machining (LBM), plasma arc machining (PAM) and electron beam machining Principles and process parameters of Abrasive jet machining (AJM), water jet machining, ultrasonic machining.

TEXT BOOKS:

[1] Manufacturing Technology by PN RaoVol.1,Edition-3,2009, TMH

[2] Principles of Metal Casting by Heine, Loper, Rosenthal.33rd Reprint,2008,TMH

[3] A course in Work shop technology Vol-I by B.S.Raghuwamshi, 2011, Dhanpatrai& sons.

[4] Mechanical Metallurgy by George. E. Dieter, SI Metric Edition 2000, McGraw Hills.

REFERENCE BOOKS:

[1] Welding and welding Technology by Richard L.Little,1973, McGraw Hill

[2] Workshop Technology Vol.1 by S.K.HazraChowdary. Khanna publishers

[3] S. Kalpakjain, S.R.Schmid, Manufacturing Engineering and Technology, Pearson Edu.,4thEdition, 2001.

[4] R.K. Jain , Production Technology /Khanna Publishers, 17thEdition, 2012.

[5] Lindberg, Process and materials of manufacturing, PE.

[6] Sarma P C, Production Technology, S Chand & Company Ltd, 3rdEdition, 2012.

E-RESOURCES:

[1] http://nptel.iitm.ac.in

[2] http://www.egr.msu.edu

[3] http://www.engr.sjsu.edu

[4] http://mechatronic.me.hfu.edu.tw

[5] http://web.iitd.ac.in

18A2102301- Essential Electrical and electronics Engineering

Lecture – Tutorial:	2-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Algebra , simple integral equations & simple differential equations (**Mathematics**)

Course Objectives:

1) To learn the basic principles of electrical law's and analysis of networks.
2) To understand the principle of operation and construction details of DC and AC Machines
3) To understand the principle of operation and construction details of transformer.
4) To study the operation of PN junction diode, half wave, full wave rectifiers and Transistors.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Analyze the various electrical networks.
CO2	Able to understand the principle of operation of DC machines
CO3	Understand the principle of operation of AC machines
CO4	Understand the principle of operation of transformer.
CO5	Analyze the operation of half wave, full wave rectifiers and Transistor configurations
CO6	Able to analyze the operation of OP-AMPS

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2-Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**3**	**3**	**1**	--	--	--	--	--	--	--	--	--
CO2	**3**	**2**	--	--	--	--	--	--	--	--	--	--
CO3	**2**	**2**	--	--	--	--	--	--	--	--	--	--
CO4	**3**	**2**	--	--	--	--	--	--	--	--	--	--
CO5	**3**	**2**	--	--	--	--	--	--	--	--	--	--
CO6	**3**	**2**	**2**	1	--	--	--	--	--	--	--	--

UNIT I

FUNDAMENTALS OF ELECTRICAL CIRCUITS : Basic definitions, Types of network elements, Ohm's Law, Kirchhoff's Laws, inductive networks,capacitive networks, series, parallel circuits and star-delta and delta-star transformations.

UNIT II

OVERVIEW OF GENERATORS AND MOTORS: DC Machines: Principle of operation of DC generator – emf equation -types – DC motor types –torque equation – applications – Swinburne's Test, speed control methods.

AC Machines: Principle of operation of alternators – regulation by synchronous impedance method – principle of operation of 3-Phase induction motor – slip-torque characteristics - efficiency – applications

UNIT III

OVER VIEW OF TRANSFORMERS: Principle of operation of single phase transformers – emf equation – losses –efficiency and regulation .OC and SC test.

UNIT IV

FUNDAMENTALS OF DIODES AND TRANSISTERS: PN junction diodes, diode applications (Half wave and bridge rectifiers). PNP and NPN junction transistor, transistor as an amplifier, configurations (CE,CB,CC).Relations between α,β and γ.

TEXT BOOKS:

1) Principles of Electrical Engineering by V.K Mehta, S.Chand Publications.
2) Elec., Technology by Edward Hughes
3) Electronics Devices and Circuits , S.Salivahanan ,N.SureshKumar,A.Vallava Raj, TMH publications , 4^{th} edition

REFERENCE BOOKS:

1) Basic Electrical Engineering by M.S.Naidu and S.Kamakshiah,TMH Publications.
2) Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications, 2nd edition.
3) Basic Electrical Engineering by Nagsarkar, Sukhija, Oxford Publications, 2nd edition.
4) Industrial Electronics by G.K. Mittal, PHI.

E-RESOURCES:

1. http://nptel.ac.in/courses.php

2. http://jntuk-coeerd.in/

18A2103491-MATERIALS TESTING AND METALLURGY LAB

practical	2Hours	**Internal Marks:**	40
Credits:	1	**External Marks:**	60

Prerequisites:

Engineering Physics, Engineering Chemistry, Engineering mechanics

Course Objectives:

1) This course provides to acquire knowledge of destructive test
2) To understand the mechanical properties of the materials.
3) Gian knowledge in testing the tensile, hardness, impact for a material
4) Basic knowledge of materials, preparation of specimen
5) To understand the evaluation of microstructure
6) To understand the concept of heat treatment practically

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Prepare the specimens as per standards.
CO2	Observe microstructure of different materials.
CO3	Analyse the properties of materials based on microstructure.
CO4	Perform hardness test and heat treatment of steels.
CO5	Perform the UTM test of a material.
CO6	Perform various test to know the mechanical properties of a material.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2-Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	3	-	2	-	-	-	-	-	2	-	-
CO2	1	2	-	2	-	-	-	-	-	-	-	-
CO3	-	3	-	2	-	-	-	-	-	-	-	-
CO4	-	3	-	2	-	-	-	-	-	-	-	-
CO5	-	3	-	-	-	1	-	-	-	-	-	-
CO6	-	2	-	3	-	-	1	-	-	-	-	-

List of Experiments

1) Study the stress-strain relation of mild steel by conducting test on UTM.
2) Determination of Young's modulus of given material by deflection test on Simply supported beam.
3) Determination of Young's modulus of given material by deflection test on Cantilever beam.
4) Determination of modulus of rigidity of circular rod by conducting Torsion Test.
5) Determination of Hardness Number for given specimen by Brinell's Hardness Test
6) Find the impact strength of a given material by conducting Izod Impact Test .
7) Find the impact strength of a given material by conducting Charpy Impact Test .
8) Tests on helical spring - Determination of Modulus of Rigidity of Helical spring material.

9) Preparation and study of the microstructure of Iron and steels.

10) Preparation and study of microstructure of Cast Irons.

11) Preparation and study of the microstructure of Copper and its alloys

12) Preparation and study of microstructure of Aluminum and its alloy.

13) Fabrication of FRP composite by hand lay-up method.

14) Hardness of various treated and untreated steels.

Note: Minimum of 12 Experiment need to be performed
Any 6 experiments from each section A and B.

EQUIPMENT REQUIRED

1) Simple supported beam
2) Cantilever beam
3) Universal testing machine
4) Impact test
5) Hardness test
6) Compression machine
7) Spring test
8) Hot mounting press
9) Stand polishing machine
10) Disc polishing machine
11) microscopes

REFERENCE BOOKS:

1.U.C Jindal and Atish Mozumber, Material since and metallurgy, Pearson education-2012

18A2103492-MANUFACTURING PROCESS LAB

practical	2Hours	**Internal Marks:**	40
Credits:	1	**External Marks:**	60

Prerequisites:

Basic fundamentals of primary manufacturing processes.

Course Objectives:

1. To impart the practical exposure on primary manufacturing processes like casting.
2. To impart hands-on practical exposure on manufacturing processes like welding.
3. To impart hands-on practical exposure on manufacturing processes like metal forming processes.
4. To impart hands-on practical exposure on manufacturing processes and equipment.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Know how to design and making the pattern and mold preparation in sand castings.
CO2	Know to design the different types of weld joints and operating the weld machines
CO3	Know the difference between gas cutting gas welding operations and equipment.
CO4	Find out the performance characteristics of the different metal forming processes.
CO5	Know the different types of plastic processing types.
CO6	Able to determine the ripple factor of half wave & full wave rectifiers.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2-Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	2	1	3	-	-	-	-	-	-	-	-
CO2	2	2	1	3	-	-	-	-	-	-	-	-
CO3	2	2	1	3	-	-	-	-	-	-	-	-
CO4	2	2	1	3	-	-	-	-	-	-	-	-
CO5	2	2	1	3	-	-	-	-	-	-	-	-
CO6	2	2	1	3	-	-	-	-	-	-	-	-

List of Experiments -

List of Experiments:

1 . Pattern Design and making - for one casting drawing.

2. Sand properties testing - for strength and permeability

3. Mould preparation, Melting and Casting

4. Gas welding

5. Gas cutting

6. Manual metal arc welding - Lap & Butt Joints

7. TIG/MIG Welding

8. Resistance Spot Welding

9. Brazing and soldering

10. Blanking & Piercing operations and study of simple, compound and progressive dies.

11. Deep drawing and extrusion operations.

12. Bending and other operations

13. Basic powder compaction and sintering

14. Injection Moulding

15. Blow Moulding

Note: Minimum of 12 Experiments need to be performed

18A2102391- ESSENTIAL ELECTRICAL&ELECTRONICS ENGINEERING LAB

practical	2Hours	**Internal Marks:**	40
Credits:	1	**External Marks:**	60

Prerequisites:

Basics of electrical & electronics concepts

Course Objectives:

1) To predetermine the efficiency of dc shunt machine using Swinburne's test.
2) To predetermine the efficiency and regulation of 1-phase transformer with O.C and S.C tests
3) To obtain performance characteristics of DC shunt motor &3-phase induction motor.
4) To find out regulation of an alternator with synchronous impedance method.
5) To control speed of dc shunt motor using speed control methods.
6) To find out the characteristics of PN junction diode & transistor & determine the ripple factor of half wave full wave rectifiers.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Able to find out the efficiency of dc shunt machine without actual loading of the machine.
CO2	Able to estimate the efficiency and regulation for different load conditions and power factors of single phase transformer with OC and SC test.
CO3	Able to analyze the performance characteristics and to determine efficiency of DC shunt motor &3-phase induction motor.
CO4	Able to pre-determine the regulation of an alternator by synchronous impedance method. Able to control the speed of dc shunt motor using speed control methods.
CO5	Able to find out the characteristics of PN junction diode & transistor
CO6	Able to determine the ripple factor of half wave & full wave rectifiers.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2-Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	2	1	3	-	-	-	-	-	-	-	-
CO2	2	2	1	3	-	-	-	-	-	-	-	-
CO3	2	2	1	3	-	-	-	-	-	-	-	-
CO4	2	2	1	3	-	-	-	-	-	-	-	-
CO5	2	2	1	3	-	-	-	-	-	-	-	-
CO6	2	2	1	3	-	-	-	-	-	-	-	-

List of Experiments -

Section A: Electrical Engineering.

1. Swinburne's test on D.C. Shunt machine (Predetermination of efficiency of a given D.C Shunt machine working as motor and generator).

2. OC and SC tests on single phase transformer (Predetermination of efficiency and regulation at given power factors).

3. Brake test on 3-phase Induction motor (Determination of performance characteristics)

4. Regulation of alternator by Synchronous impedance method.

5. Speed control of D.C. Shunt motor by a) Armature Voltage control b) Field flux control method

6. Brake test on D.C. Shunt Motor.

Section B: Electronics Engineering.

1. PN junction diode characteristics a) Forward bias b) Reverse bias (Cut in voltage and resistance calculations)

2. Transistor CE characteristics (Input and output)

3. Half wave rectifier with and without filters.

4. Full wave rectifier with and without filters.

5. CE amplifiers.

6. OP- Amp applications (inverting, non inverting, integrator and differentiator) OP- Amp applications (inverting, non inverting, integrator and differentiator)

Note: Minimum of 10 Experiments need to be performed

Any 5 experiments from each section A and B.

18A2200201

EM-IV - PROBABILITY AND STATISTICS

Lecture – Tutorial:	L-T Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Course Objectives:

1.To familiarize the techniques in central tendency, curve fitting, correlation and regression.
2. To familiarize the techniques in probability and random variables.
3. To familiarize the techniques in probability distribution.
4. To familiarize the techniques in large and small sample tests.
5.To equip the students to solve problems in their disciplines.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Find the measures of central tendency and relation between them. (L1)
CO2	Evaluate the correlation coefficient, rank coefficient and regression. (L5)
CO3	Understand probabilities of events and expectations of random variables for elementary problems. (L2)
CO4	Solve problems related to binomial and passion distribution. (L3)
CO5	Compare situations in which it is appropriate to consider the relevance of the Normal distribution. (L4)
CO6	Construct hypothesis and carryout appropriate tests to checks its acceptability. (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2	2	--	--	--	--	--	--	--	--
CO2	3	3	2	2	--	--	--	--	--	--	--	--
CO3	3	3	2	2	--	--	--	--	--	--	--	--
CO4	3	3	2	2	--	--	--	--	--	--	-	--
CO5	3	3	2	2	--	--	--	--	--	--	-	--
CO6	3	3	2	2	--	--	--	--	--	--	--	--

UNIT I

Descriptive statistics and methods for data science

(Pre-requisite: Data science, Statistics Introduction, Population vs Sample, Collection of data, primary and secondary data, Type of variable: dependent and independent Categorical and Continuous variables, Data visualization. --- No Question selects from the above part)

Measures of Central tendency: Arithmetic Mean – Median – Mode - Geometric Mean- Harmonic Mean and Relations between them- Merits and Demerits.

Measures of Dispersion: Range – Quartile Deviation – Variance, Standard Deviation –Skewness - Kurtosis.

Curve Fitting and Principles of Least Squares.

Correlation- correlation coefficient - rank correlation - Regression coefficients - Regression lines.

UNIT II

Probability

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 III

Distributions

Probability distribution - Binomial, Poisson approximation to the binomial distribution and normal distribution-their properties.

UNIT IV

Estimation and Testing of hypothesis: Large sample tests Small sample tests

Estimation-parameters, statistics, sampling distribution, point estimation, Formulation of null hypothesis, alternative hypothesis, the critical and acceptance regions, level of significance, two types of errors and power of the test.

Large Sample Tests: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems

Small Sample Tests: Student t-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), $\chi 2$ - test for goodness of fit, $\chi 2$ - test for independence of attributes.

TEXT BOOKS:

1. Miller and Freund, Probability and Statistics for Engineers,7/e, Pearson, 2008.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

REFERENCE BOOKS:

1. S. Ross, A First Course in Probability, Pearson Education India, 2002.

W. Feller, an Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.

E-RESOURCES:

1.nptel

18A2203401- DESIGN OF MACHINE MEMBERS – I

Lecture – Tutorial:	**2-1 Hours**	**Internal Marks:**	**40**
Credits:	**3**	**External Marks:**	**60**

Prerequisites:

ENGINEERING MECHANICS, MECHANICS OF MATERIALS

Course Objectives:

1. The student shall gain appreciation and understanding of the design function in mechanical engineering, the steps involved in designing and the relation of design activity with manufacturing activity
2. Selection of proper materials to different machine elements based on their physical and mechanical properties.
3. Learn and understanding of the different types of failure modes and criteria.
4. Procedure for the different machine elements such as fasteners, shafts, couplings, keys, axially loaded joints etc.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Estimate safety factors of machine members subjected to static and dynamic loads.
CO2	Apply multi dimensional static failure criteria in the analysis and design of mechanical components.
CO3	Identify the loads, the machine members subjected and calculate static and dynamic stresses to ensure safe design.
CO4	Design fasteners subjected to variety of loads.
CO5	Select of standard machine elements such as keys, shafts, couplings.
CO6	Analyze and design mechanical springs

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	3	**3**	3	**2**	**2**	**2**			**2**	**2**		**3**
CO2	3	**3**	3	**2**	**2**	**2**			**2**	**2**		**3**
CO3	3	**3**	3	**2**	**2**	**2**			**2**	**2**		**3**
CO4	3	**3**	3	**2**	**2**	**2**			**2**	**2**		**3**
CO5	3	**3**	3	**2**	**2**	**2**			**2**	**2**		**3**
CO6	3	**3**	3	**2**	**2**	**2**			**2**	**2**		**3**

UNIT I

INTRODUCTION: General considerations in the design of Engineering Materials and their properties – selection –Manufacturing consideration in design, tolerances and fits –BIS codes of steels.

STRESSES IN MACHINE MEMBERS: Simple stresses – combined stresses – torsional and bending stresses – impact stresses – stress strain relation – various theories of failure – factor of safety – design for strength and rigidity – preferred numbers. The concept of stiffness in tension, bending, torsion and combined situations.

UNIT II

STRENGTH OF MACHINE ELEMENTS: Stress concentration – theoretical stress concentration factor – fatigue stress concentration factor notch sensitivity – design for fluctuating stresses – endurance limit – estimation of endurance strength – Goodman's line – Soderberg's line – modified Goodman's line.

Bolted joints – Design of bolts with pre-stresses – design of joints under eccentric loading – locking devices .

UNIT III

RIVETED AND WELDED JOINTS – design of joints with initial stresses – eccentric loading. **KEYS, COTTERS AND KNUCKLE JOINTS:** Design of keys-stresses in keys-cotter joints-spigot and socket - knuckle joints.

UNIT IV

SHAFTS: Design of solid and hollow shafts for strength and rigidity – design of shafts for combined bending and axial loads – shaft sizes. Shaft Coupling: Rigid couplings – muff, split muff and flange couplings, flexible couplings – flange coupling (modified).

MECHANICAL SPRINGS: Stresses and deflections of helical springs – extension - compression springs – energy storage capacity – helical torsion springs – co-axial springs, leaf springs.

TEXT BOOKS:

1. Machine Design/V.Bandari/ TMH Publishers
2. Machine design / NC Pandya & CS Shah/Charotar Publishing House Pvt. Limited
3. Design data book of Engineers

REFERENCE BOOKS:

1. Design of Machine Elements / V.M. Faires/McMillan
2. Machine design / Schaum Series/McGrawHill Professional
3. Machine Design/ Shigley, J.E/McGraw Hill.
4. Design data handbook/ K.Mahadevan & K. Balaveera Reddy/ CBS publishers.
5. Design of machine elements-Spotts/Pearson Publications
6. Machine Design –Norton/ Pearson publishers

E-RESOURCES:

1. https://nptel.ac.in/courses/112105124/
2. https://www.youtube.com/watch?v=mzWMdZZaHwI&list=PL3D4EECEFAA99D9BE

18A2203402-FLUID MECHANICS& HYDRAULIC MACHINES

Lecture – Tutorial:	2-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Fundamentals of Engineering Mechanics

Course Objectives:

1. Student will know the concept of fluid and its properties, manometry, hydrostatic forces acting on different surfaces and also problem solving techniques.
2. Student will be exposed to the basic laws of fluids, flow patterns, viscous flow through Pipes and their corresponding problems.
3. Student will be aware of the concepts related to boundary layer theory and dimensional analysis.
4. Student will know the hydrodynamic forces acting on vanes and their performance evaluation
5. Student will be in a position to evaluate the performance characteristics of hydraulic turbines.
6. Student will be aware of the importance, function and performance of hydro machinery.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Define fluid properties and explain procedure of dimensional analysis
CO2	Explain procedure of measurement of fluid pressure and manometry
CO3	Apply laws of conservation of mass, momentum and energy to fluid flow
CO4	Analyze flow through different pipes
CO5	Analyze the impact of jet on the vanes
CO6	Evaluate performance of hydraulic machines

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	**2**	2									
CO2	3	**2**	1									
CO3		**3**	2									
CO4	3	**3**	2									
CO5	3	**3**	2									
CO6	3	**3**	2									

UNIT I

Fluid statics:

Physical properties of fluids- specific gravity, viscosity, surface tension- vapor pressure and their influence on fluid motion- atmospheric gauge and vacuum pressure –measurement of pressure Piezometer, U-tube and differential manometers. Total pressure, center of pressure,

Hydro Static Forces on surfaces and submerged bodies: hydrostatic forces on vertical, inclined and curved surfaces, Buoyancy, center of buoyancy, Meta center Stability of floating bodies and applications.

UNIT II

Fluid Kinematics:
Classification of flows, Stream line, path line and streak lines and stream tube, differential equation of continuity, Acceleration.
Fluid dynamics: Surface and body forces –Eule's and Bernoulli's equations for flow along a stream line, momentum equation and its application on force on pipe bend, Viscous flow through pipe, Dimensional analysis, Boundary layer, displacement thickness, momentum thickness, energy thickness Navier-stokes equation

UNIT III

Flow through Pipes:
Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line. Measurement of flow: pilot tube, venturimeter and orifice meter.
Basics of turbo machinery: Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency flow over radial vanes

UNIT IV

Hydraulic Turbines:
Classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design – draft tube theory-functions and efficiency. Geometric similarity, Unit and specific quantities, characteristic curves, selection of turbine, cavitation, surge tank, water hammer.
Hydraulic Pumps: Classification of pumps, Centrifugal pumps-work done, efficiency, specific speed, characteristic curves, Reciprocating pumps, -work done Slip and indicator diagram

TEXT BOOKS

1. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH. standard book house.
2. Frank M.White, "Fluid Mechanics", McGraw-Hill, 7th Edition, New Delhi, 2011.

REFERENCE BOOKS:

1. Fluid Mechanics and Hydraulic Machines by Rajput. S. Chand Publishers
2. Fluid mechanics and hydraulic machines by R. K. Bansal, Laxmi Publications Ltd.,
3. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.
4. Hydraulic Machines by Banga & Sharma, Khanna Publishers.
5. Fluid Mechanics and Hydraulic Machines by Domkundwar & Domkundwar, Dhanpatrai & Co.

E-RESOURCES:

1. https://nptel.ac.in

18A2203403- KINEMATICS OF MACHINERY

Lecture – Tutorial:	2-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites:

Engineering Mechanics, Engineering Drawing

Course Objectives:

1. The objective of this unit is to make student understand the purpose of kinematics, Kinematic joint and mechanism and to study the relative motion of parts in a machine without taking into consideration the forces involved. And various mechanisms for straight line motion and their applications.
2. The objective of this unit is to make student understand the velocity and acceleration concepts and the methodology using graphical methods and principles and application of four bar chain. To understand the application of slider crank mechanism etc. and study of plane motion of the body
3. The objective of this unit is to make student understand the theories involved in cams. Further the students are exposed to the applications of cams and their working principles. And understand various power transmission mechanisms and methodologies and working principles. Students are exposed to merits and demerits of each drive. To help the students develop effective writing skills through paragraph writing.
4. The objective of this unit is to make student understand gears, power transmission through different types of gears including gear profiles and its efficiency.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand Kinematic joint and mechanism and study the relative motion of parts in a machine without taking into consideration the forces involved.
CO2	Understand various mechanisms for straight line motion and their applications.
CO3	Draw the velocity and acceleration of four bar chain and slider crank chain graphically.
CO4	Apply working principles of cams and also design the profile of cams.
CO5	Decide the no of teeth on a gear and also select the gear teeth depending on the application in the unit of Gears.
CO6	Understand various power transmission mechanisms and methodologies and working principles. Students are exposed to merits and demerits of each drive.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	**1**										
CO2	2	**3**	1	**1**								
CO3	1	**2**	3	**3**	**3**							
CO4	1	**2**	3	**3**	**3**							
CO5	1	**3**	3	**3**	**3**							
CO6	1	**1**	2	**3**	**3**							

UNIT I

MECHANISMS : 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 . Grublers criterion , Grashoff's law , Degrees of freedom, Kutzbach criterion for planar mechanisms, Mechanism and machines – classification of machines – kinematic chain – inversion of mechanism – inversion of mechanism – inversions of quadric cycle, chain – single and double slider crank chains.

LOWER PAIR MECHANISM: Exact and approximate copiers and generated types –

Peaucellier, Hart and Scott Russel – Grasshopper – Watt T. Chebicheff and Robert Mechanisms and straight line motion, Pantograph.

UNIT II

KINEMATICS: Velocity– Motion of a link in machine – Determination of Velocity diagrams – Instantaneous centre of rotation, centroids and axodes – relative motion between two bodies – Three centres in line theorem – Graphical determination of instantaneous centre, diagrams for simple mechanisms ,Graphical method – Application of relative velocity method four bar chain.
Acceleration – Determination acceleration diagrams – Graphical method –acceleration analysis of for a given mechanism, Coriolis acceleration, determination of Coriolis component of acceleration.

UNIT III

CAMS Definitions of cam and followers – their uses – Types of followers and cams – Terminology –Types of follower motion: Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases. Analysis of motion of followers: Roller follower – circular cam with straight flank.
Power Transmissions : Introduction, Belt and rope drives, selection of belt drive- types of belt drives,V-belts, materials used for belt and rope drives, velocity ratio of belt drives, slip of belt, creep of belt, tensions for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt, Chains- length, angular speed ratio, classification of chains.

UNIT IV

GEARS Higher pairs, friction wheels and toothed gears–types – law of gearing, condition for constant velocity ratio for transmission of motion, Form of teeth: cycloidal and involute profiles. Velocity of sliding – phenomena of interferences – Methods of interference. Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact – Introduction to Helical, Bevel and worm gearing.
GEARS TRAINS Introduction to gear Trains, Train value, Types – Simple and reverted wheel train – Epicyclic gear Train. Methods of finding train value or velocity ratio – Epicyclic gear trains. Selection of gear box-Differential gear for an automobile.

TEXT BOOKS:

1. Theory of Mechanisms and machines – A.Ghosh & A.K.Malik – East West Press Pvt. Ltd.
2. Theory of Machines – S. S Rattan- TMH
3. Theory of machines and Mechanisms – J.J Uicker, G.R.Pennock & J.E.Shigley - Oxford

REFERENCE BOOKS:

1. Theory of Machines Sadhu Singh, Pearsons Edn
2. Theory of machines and Machinery /Vickers /Oxford .
3. Theory of Machines by Thomas Bevan/ CBS
4. Kinematics of Machinery through Hyper Works – J.S. Rao – Springer Publ

E-RESOURCES:

1. http://www.roboanalyzer.com/mechanalyzer.html
2. https://nptel.ac.in/courses/112104121/
3. https://ocw.mit.edu/courses/mechanical-engineering/2-003j-dynamics-and-control-i-fall-2007/index.htm
4. https://engineering.dartmouth.edu/academics/courses/engg240

18A2203404- IC ENGINES AND GAS TURBINES

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites: Thermodynamics.

Course Objectives:

1. To provide an insight of fundamentals and salient features of internal combustion engines.
2. To impart the basic combustion phenomenon in both SI and CI engines.
3. To enable the students the concepts of actual cycles and their analysis
4. To imbibe the knowledge of testing and performance characteristics of IC engines.
5. To enable the students learn basics and working of Gas turbines.
6. To impart the knowledge of Rockets and jet propulsion systems.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the working of various internal combustion engine components and their working Principles.
CO2	Analyze the combustion phenomenon of SI engines and CI engines.
CO3	Comprehend the air standard, fuel air and actual cycles.
CO4	Compute the two stroke and four stroke engine performance characteristics.
CO5	Describe the components, functioning and performance of gas turbines.
CO6	Apply the principles of gas turbines and jet propulsion systems.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	2	**1**					**1**					
CO2	3	**1**				**1**	1					
CO3	3	**2**	1				1					
CO4	2	**2**	2	**1**								
CO5	1	**2**	1									
CO6	2					**1**	1					

UNIT I

INTRODUCTION: Heat engine, Classification of IC Engines, Basic Engine Components and Nomenclature,Working principles of 4-Stroke and 2-Stroke Spark Ignition and Compression Ignition Engines, Valve and Port timing diagrams, Applications of I.C. Engines.

ENGINE SYSTEMS: Introduction, Layout of Fuel supply system for SI Engine-Simple Carburetor, Fuel supply system for CI Engine-Solid Injection-Individual pump type, Common rail type only. Super charging and turbo charging of IC engines. Cooling systems, Air cooling, Water cooling, Comparison, Radiators and cooling fans, Lubricating systems, Mist lubrication, Wet sump lubrication, and Dry sump lubrication system, Ignition systems, Battery, Magneto and Electronic ignition system. Principle of wankle engine.

UNIT II

COMBUSTION IN SI ENGINES: Introduction, Homogeneous and Heterogeneous mixture, stages

of combustion in SI engines, flame front propagation, factors influencing the flame speed, Normal combustion, Abnormal combustion, phenomenon of knock in SI engines, effect of engine variables on knock, combustion chambers for SI engines- Fuel requirement and fuel rating, anti knock additives.

COMBUSTION IN CI ENGINES: Introduction, stages of combustion in CI engines, factors affecting the delay period, phenomenon of knock in CI engines, comparison of knock in SI and CI engines, Combustion Chambers for CI engines, Nozzles, Fuel requirement and fuel rating.

UNIT III

ACTUAL CYCLES AND THEIR ANALYSIS: Introduction, composition of cylinder gases, dissociation, comparison of air-standard and fuel-air cycles. comparison of air-standard and actual cycles, time loss factor, heat loss factor, exhaust blow down, loss due to rubbing friction, actual and fuel-air cycles of engines.

ENGINE TESTING AND PERFORMANCE: Introduction, Parameters of performance-measurement of cylinder pressure, Measurement of Fuel consumption, Air intake, Brake power, Determination of Frictional power and Indicated power, Performance tests, Heat Balance sheet. Engines exhaust emissions- CO, NOx, SOx, HC, and Soot.

UNIT IV

GAS TURBINES: Introduction, Classification of Gas Turbines, Simple Gas Turbine Plant-Ideal Cycle, Closed Cycle -Open Cycle - Efficiency, Work Ratio and Optimum Pressure Ratio For Simple Gas Turbine Cycle and Basic Problems. Actual Cycle, Analysis Of Simple Cycles & Cycles With Inter Cooling, Reheating and Regeneration.

JET PROPULSION SYSTEMS: Introduction- Working of Turbojet, Turbo Fan, Turboprop, Ramjet, applications.

REFERENCE BOOKS:

TEXT BOOKS:

1. V.Ganesan, Internal Combustion Engines – Tata McGraw-Hill, 3rd Edition 2008.
2. P.W.Gill ,J.H.Smith&Ziurys ,Fundamentals of I.C.Engines - IBH & Oxford publications, 4th Edition 1959.
3. Mahesh M. Rathode, Thermal Engineering, Tata McGraw-Hill, 5th Edition 2010.
4. R.K.Rajput, Thermal Engineering, Laxmi publications, 5th Edition, 2005.

REFERENCES:

1. John B.Heywwod, Internal Combustion Engine Fundamentals ,Tata McGraw- Hill,2012.
2. M.L.Mathur&R.P.Sharma, A Course in I.C. Engines ,DhanpatRai New Delhi, 7th Edition 2000.
3. Pulkrabek, Engineering Fundamentals of I.C.Engines – PHI 2nd Edition 2004.
4. T.D Eastop and A. McConkey, Applied Thermodynamics, Pearson 5th Edition 2013.
5. R. Yadav ,Thermodynamics and Heat Engines,Vol-II,Central Book Depot,5th Edtn,1999.
6. R.S.Khurmi ,Thermal Engineering , S.Chand & Company, 1st Edition , 2012.
7. Thermal Engineering / PL Ballaney, Khanna Publishers.

E-RESOURCES:

1. https://www.youtube.com/watch?v=fTAUq6G9apg
2. https://edisontechcenter.org/resources.html
3. https://nriblogspot.org/resources.html

4. http://www.vssut.ac.in/lecture_notes/lecture1429900545.pdf
5. Ignition system, http://www.ignou.ac.in/upload/unit%204.pdf
6. Cooling system, http://www.iitg.ernet.in/scifac/qip/public_html/cd_cell/chapters/uk_saha_internal_combustion_engine/qip-ice-25-cooling%20systems.pdf
7. http://hillagric.ac.in/edu/coa/agengg/lecture/243/Lecture%207%20Cooling%20and%20lubrication.pdf 4.lubrication system,
8. http://www.iitg.ernet.in/scifac/qip/public_html/cd_cell/chapters/uk_saha_internal_combustion_engine/qip-ice-23-lubrication%20systems.pdf
9. http://144.162.92.233/faculty/mwhitten/presentations/1306/lubricationsystem.pdf
10. http://scienceandtechnicalprojects.blogspot.in/2007/12/lubrication-system-of-ic-engine.html

18A2203601- BASICS OF MECHANICAL ENGINEERING

Lecture – Tutorial:	**2-1 Hours**	**Internal Marks:**	**40**
Credits:	**3**	**External Marks:**	**60**

Prerequisites:

NONE

Course Objectives:

1. Understand the fundamental principles of thermodynamics.
2. Learn about the engineering materials, their types, properties and applications.
3. Understand the concepts of engineering mechanics like analysis of coplanar concurrent systems and friction.
4. Understand the power transmission using belts, ropes and gear trains.
5. Learn the simple stresses and strains, types, their significance in design.
6. Study the basic manufacturing processes used in manufacturing of products.
7. Learn about industrial safety, its requirement, goals, training, procedures followed in industries.
8. Solve the problems of thermodynamics, mechanics, belts, ropes and gear trains, simple stresses and strains.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Familiarize with the Engineering materials, their types, properties and applications.
CO2	Analyze coplanar concurrent systems and friction
CO3	Design Power transmission systems using belts, ropes and gear trains.
CO4	Solve Simple problems in stresses and strains
CO5	Familiarize with Basic manufacturing processes used in manufacturing of products.
CO6	Appreciate the Industrial safety, its requirement, goals, training, procedures followed in industries.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	3	**1**	1									**3**
CO2	3	**2**	1									
CO3	3	**2**	1									
CO4	3	**2**	1									
CO5	3	**2**	1									
CO6	3	**2**	1									

Unit-I

Introduction to Engineering materials:

Engineering materials, classification - Properties and applications of Metals: Ferrous and Non-ferrous; Nonmetals: Glasses- Ceramics; Polymers: PVC & HDPV; Biomaterials- Composite materials.

Basic Manufacturing Processes: Casting: Classification, Steps involved in making a casting - Advantage of casting and its applications. Welding: Classification of welding processes, Fundamental treatment of various welding processes, Soldering and Brazing.

Mechanical working of metals-Hot and cold working, Fundamental treatment of different metal working processes- Rolling, Forging and Extrusion

Unit-II

System of forces: Types of Force systems - Coplanar Concurrent Forces - Resultant - Moment

of a Force -Resultant of a Force System -Conditions of Equilibrium - Equilibrium analysis of Coplanar Force Systems -Free body diagrams.

Unit-III

Fundamentals of Thermodynamics: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics - Concept of quality of Temperature. First law of Thermodynamics, First law applied to Non flow systems-simple problems,

IC Engines: Classification and working principle of IC Engines.

Heat Transfer: Introduction to conduction, convection and radiation. Heat exchangers-Condensor, evaporators.

Unit-IV

Power transmission through belts, ropes and gear trains: Introduction to belt and rope drives, types of belt drives, velocity ratio of belt drives, slip of belt drives, tensions for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt, condition for transmission of maximum power.Gear trains: Introduction, types - simple, compound, reverted, and Epi-cyclic gear trains.

Industrial Safety: Safety and Health Goals, New Employee Orientation, Safety & Training, Employee Responsibilities, Accident Investigation/Reporting, Personal Protective Equipment, Safety Rules, Safety Committee, Emergency Action Plan, Safety Discipline.

TEXTBOOKS:

1. Thermal Engineering, R.K.Rajput, Laxmi publications.
2. A text book of Material science and metallurgy – O.P. Khanna/ Dhanpat rai publications.
3. Engineering Mechanics – Statics and Dynamics - A. K. Tayal, Umesh Publications.
4. Theory of Machines – S.S. Rattan- TMH.
5. Mechanics of solids – R. K. Bansal/ Laxmi Publications
6. Elements of Manufacturing Processes - PARASHAR, B.S. NAGENDRA, MITTAL, R. K.
7. Industrial Safety Management – L M DESHMUKH- TMH.

REFERENCE BOOKS:

1. Thermodynamics – An Engineering Approach – Yunus Cengel & Boles /TMH
2. Engineering Thermodynamics – K. Ramakrishna / Anuradha Publishers.
3. Engineering Mechanics – Dr. D.S. Kumar/ S.K Kataria and sons publishers
4. Engineering Mechanics, SS Bhavikatti & KG Rajasekharappa, New Age International
5. Materials Science and Metallurgy – C. Daniel Yesudian, D. G. Harris Samuel.
6. The Science and Engineering of Materials - Donald R. Askeland, Pradeep P. Fulay, Wendelin J. Wright
7. Theory of Machines by Thomas Bevan
8. Mechanics of solids by Punmia
9. Mechanics of solids by R.K. Bansal
10. Production Technology, K.L.Narayana, S.V.Ramana & P. Vamsi Krishna, first edition, I.K. Books
11.Engineering Thermodynamics / PK Nag /TMH
International, 2006.
12. Production Technology Vol I, O.P. Khanna & M. Lal, Dhanpat Rai Publicati

E-RESOURCES:

1. https://nptel.ac.in

18A2203601-INDUSTRIAL MATERIALS
(OPEN ELECTIVE)

Lecture – Tutorial:	**2-1 Hours**	**Internal Marks:**	**40**
Credits:	**3**	**External Marks:**	**60**

Prerequisites:

ENGINEERING MECHANICS, MECHANICS OF MATERIALS

Course Objectives:

1. Understand the concept of industrial materials, their classification, structure, properties and applications.
2. Learn the concepts of composite materials.
3. Study and understand smart materials and nano materials.
4. Study and understand the importance of industrial materials using case studies.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Familiarize with the concepts of industrial materials, their classification, properties and applications.
CO2	Appreciate the types, structure and characteristics of composite materials.
CO3	Elaborate the applications of composite materials.
CO4	Understand the shape memory concept and its use in industry.
CO5	Elaborate nano materials and importance of nano materials over bulk materials
CO6	Examine the case studies and explore the significance of selection of materials in applications like aerospace, boiler tubes, turbine blades, automobiles, eco sustainable materials.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	3	**2**	1									
CO2	3	**2**	1									
CO3	3	**2**	1									
CO4	3	**2**	1									
CO5	3	**2**	1					**1**	**1**			
CO6	3	**2**	1					**1**	**1**			

UNIT-I

Selection of materials: Service requirement, Structure-Property correlations and reappraisal of the role of crystal structure and structural defects on properties. Classification -Metallic materials, non-metallic materials properties and typical alloys with reference to their applications.

UNIT-II

Composite materials: Geometric and Physical definitions, natural and man-made composites, applications, types and classification of composites. Fibers- glass, silica, carbon, ceramic and aramid fibers; Matrices- polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. Particulate composites, Thermoplastics, Thermosets, Metal matrix and ceramic matrix composites.

UNIT-III

Smart materials: Shape Memory Alloys, Varistors and Intelligent materials for bio-medical applications from industry. Development, important properties and applications of these materials.

NANO MATERIALS: Introduction-properties at nano scales-advantages & disadvantages-applications in comparison with bulk materials (nano – structure, wires, tubes, composites). state of art nano advanced- topic delivered by student.

UNIT IV

Case study: Case study of the failure of components due to wrong selection of materials. Study and analysis of appropriate material for some specific application like aerospace, boiler tubes, turbine blades, automobiles, eco sustainable materials.

TEXT BOOKS:

1. Engineering Material Technology, 5th edition, by James A. Jacobs & Thomas F. Kilduff. Prentice Hall. Copyright 2005.
2. Nano material /A.K. Bandyopadyay/New age Publishers
3. Material science and Technology: A comprehensive treatment/Robert W.Cahn,/VCH
4. Engineering Mechanics of Composite Materials / Isaac and M Daniel/Oxford University Press
5. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994

REFERENCE BOOKS:

1. Mechanics of Composite Materials / R. M. Jones/ Mc Graw Hill Company, New York, 1975.
2. Analysis of Laminated Composite Structures / L. R. Calcote/Van Nostrand Rainfold,NY 1969
3. Analysis and performance of fibre Composites /B. D. Agarwal and L. J. Broutman /Wiley-Interscience,New York, 1980
4. Mechanics of Composite Materials - Second Edition (Mechanical Engineering) /Autar K.Kaw / CRC Press.

E-RESOURCES:

1. https://nptel.ac.in

18A2203301- COMPUTER AIDED MACHINE DRAWING PRACTICE

PRACTICAL:	**3 Hours**	**Internal Marks:**	**40**
Credits:	**1.5**	**External Marks:**	**60**

Prerequisites:

Engineering Drawing

Course Objectives:

5. To acquire the knowledge of drafting software.
6. To provide hands on experience to develop 2D models of machine components.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Demonstrate the conventional representations of materials and machine components.
CO2	Model riveted, welded and key joints using CAD system.
CO3	Create solid models and sectional views of machine components.
CO4	Generate solid models of machine parts and assemble them.
CO5	Translate 3D assemblies into 2D drawings.
CO6	Create manufacturing drawing with dimensional and geometric tolerances.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3											2
CO2	3		2		1							2
CO3	3		2		1							2
CO4	3		2		2							2
CO5	3		2		2							2
CO6	3		2		2							2

The following contents are to be done by any 2D software package

Conventional representation of materials and components:

Detachable joints: Drawing of thread profiles, hexagonal and square-headed bolts and nuts, bolted joint, bolted joint with washer and locknut, stud joint, screw joint.

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. Shaft coupling, bushed pin-type flange coupling, universal coupling, Oldham's coupling.

The following contents to be done by any 3D software package

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, carburetor, piston, connecting rod, eccentric, screw jack, plumber block, axle bearing, and pipe vice, clamping device, Geneva cam, and universal coupling.

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.

TEXT BOOKS:

1. K.L.Narayana, P.Kannaiah, A text book on Engineering Drawing, SciTech Publications, 2014

REFERENCE BOOKS:

1. Cecil Jensen, Jay Helsel and Donald D.Voisinet, Computer Aided Engineering Drawing, Tata Mcgraw-Hill, NY, 2000.
2. James Barclay, Brain Criffiths, Engineering Drawing for Manufacture, Kogan page Science, 2003.
3. N.D.Bhatt, Machine Drawing, Charotar, 501e,2014.
4. K.L.Narayana, Production Drawing, NewAge International publishers, 31e,2014

E-RESOURCES:

1. https://nptel.ac.in

18A2203491- -
FLUID MECHANICS & HYDRAULIC MACHINES LAB

Practice	3	**Internal Marks:**	40
Credits:	1.5	**External Marks:**	60

Prerequisites:

Fundamentals of fluid mechanics,

Course Objectives:

1. Determination of coefficient of discharge using venture meter.
2. To impart hands-on practical exposure on , orifice meter and mouth piece.
3. To impart hands-on practical exposure on measure the losses in pipes.
4. To impart hands-on practical exposure on jet on vanes
5. To impart hands-on practical exposure on Bernoulli's theorem
6. To impart hands-on practical exposure on the performance of hydraulic machines viz. Turbines and Pumps.

COURSE OUTCOMES:

Upon successful completion of the course, the student will be able to:

CO1	Find coefficient of discharge for venture meter
CO2	Demonstrate the concepts of discharge through orifice meter and mouth piece.
CO3	Explain the concepts of loses in the pipe flow
CO4	Explain the concepts of jet on vanes
CO5	Demonstrate the concept of Bernoulli's theorem.
CO6	Analyze the performance of deferent turbines of and pumps.

Contribution of Course Outcomes towards achievement of Program Outcomes

(1– Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	3	**2**								**1**		
CO2	3	**2**								**1**		
CO3	3	**3**								**1**		
CO4	3	**3**								**2**		
CO5	3	**3**								**2**		
CO6	3	**2**								**2**		

List of Experiments:

1. Determination of coefficient of impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Performance Test on Single Stage Centrifugal Pump.
6. Performance Test on Multi Stage Centrifugal Pump.
7. Performance Test on Reciprocating Pump.
8. Determination of coefficient of discharge for Venturimeter.
9. Determination of coefficient of discharge for Orifice meter.
10. Determination of friction factor for a given pipe line.
11. Determination of loss of head due to sudden contraction in a pipeline.
12. Calibration of Turbine flow meter.
13. To verify the Bernoulli's Theorem.
14. Determination of coefficient of discharge for mouthpiece.
15. To find critical Reynolds number for a pipe flow.
16. To determine coefficient of discharge of Rectangular /Triangular Notch.
17. To determine coefficient of discharge for a small orifice by constant head method.

(Any TEN of the above experiments are to be covered)

REFERENCE BOOKS:

1 P. N Modi, S.M Seth, Fluid mechanics and hydraulic machines,14th edition standard book house,2002.

2. R.K Bansal, A text book of Fluid mechanics and hydraulic machines, reprint , Lakshmi publications limited,2019.
3. Fluid mechanics and hydraulic machines lab manual by Department of Mechanical Engineering. NRIIT, Pothavarappadu.

E-RESOURCES:

1. https://www.autoform.com/
2. https://www.omniamfg.com/fluid mechanics.

18A2203492- THERMAL ENGINEERING LAB

Practice:	3	**Internal Marks:**	40
Credits:	1.5	**External Marks:**	60

Prerequisites: ICGT, Thermal Engineering

Course Objectives:

1. To learn the construction and working principle of I.C. Engines practically.
2. To understand the working principle and performance of air compressor practically.
3. To learn the heat balance test of an I.C. Engine.
4. To acquire the priorities given to the efficient use of energy and the minimization of Environmental pollution.
5. To understand the usage of data acquisition systems.
6. To learn the concepts of boiler terms.

COURSE OUTCOMES:

After the completion of the course, students should be able to

CO1	Find the efficiency and performance of an I.C. engine system for a given set of conditions.
CO2	Calculate the various energy losses and heat balance of Internal Combustion Engines.
CO3	Evaluate the performance parameters of refrigeration system and Solar flat plate.
CO4	Analyze the Volumetric efficiency of air compressor.
CO5	Develop skills in data acquisition systems.
CO6	Study the various parameters of boilers

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2-Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	3	2	1	1						2		1
CO2	3	2	1	1						2		1
CO3	3	2	1	1						2		1
CO4	3	2	1	1						2		1
CO5	3	2	1	1						2		1
CO6	3	1								2		1

List of Experiments: (Any 10 experiments):

1. I.C. Engines Valve & Port Timing Diagrams
2. Performance Test on single cylinder 4 –Stroke Diesel Engine by using Mechanical Dynamometer.
3. Evaluation of performance parameters of three cylinder 4-stroke petrol engine by using Hydraulic Dynamometer.
4. Determination of performance characteristics of 2-Stroke Petrol Engine.
5. Heat Balance of 4 stroke single cylinder diesel engine.
6. Evaluation of engine friction power by conducting Morse test on Multi cylinder 4-Stroke Petrol Engine.
7. Determination of FP by retardation and motoring test on IC engine.

8. Economical speed test of an IC engine.
9. Performance Test on Variable Compression Ratio single cylinder 4-Stroke petrol Engine.
10. Performance Test on Reciprocating Air – Compressor.
11. Dis-assembly / assembly of different parts of 2 wheelers and 4 wheelers.
12. Study of boilers.
13. Determination of COP of Vapour Compression Refrigeration Unit.
14. Estimate the Dryness fraction of steam.
15. Performance evaluation of Solar flat plate collector.

EQUIPMENT REQUIRED:

1. Internal Combustion Engines of Diesel and Petrol
2. Compressor, Refrigerator, throttling and separating calorimeter, Solar flat plate collector.
3. Boilers Models and parts of I.C. Engines.

REFERENCE BOOKS:

1.Thermal engineering lab manuals, NRI Institute of Technology, Pothavarappadu
2. V.Ganesan, Internal Combustion Engines – Tata McGraw-Hill, 4th Edition 2012.

E-RESOURCES:

1. https://www.youtube.com/watch?v=fTAUq6G9apg
2. http://www.vssut.ac.in/lecture_notes/lecture1429900545.pdf
3. https://nriblogspot.org/resources.html

18a2200801- PROFESSIONAL ETHICS AND HUMAN VALUES

Lecture – Tutorial:	2-0 Hours	**Internal Marks:**	40
Credits:	0	**External Marks:**	60

Prerequisites: Basic understanding about Engineering profession.

Course Objectives:

1. To create awareness on engineering ethics and human values.
2. To understand social responsibility of an engineer.
3. To instill moral and social values and loyalty.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Grooms themselves as ethical, responsible and societal beings.
CO2	Discuss ethics in society and apply the ethical issues related to engineering.
CO3	Exhibit the understanding of ethical theories in professional environment.
CO4	Recognize their roe as social experimenters (engineers) and comprehend codes of ethics.
CO5	Identify the risks likely to come across in the professional world, analyzing them and find solutions.
CO6	Realize the responsibilities and rights of engineers in the society.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	1	1	2	-	-	-	1
CO2	-	-	-	-	-	1	1	2	-	-	-	1
CO3	-	-	-	-	-	1	1	2	-	-	-	1
CO4	-	-	-	-	-	1	1	2	-	-	-	1
CO5	-	-	-	-	-	1	1	2	-	-	-	1
CO6	-	-	-	-	-	1	1	2	-	-	-	1

UNIT I

Human Values: Objectives, Morals, Values, Ethics, Integrity, Work ethics, Service learning , Virtues, Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Challenges in the work place.

UNIT II

Engineering ethics Senses of 'Engineering Ethics' — Variety of moral issues — Types of inquiry — Moral dilemmas — Moral Autonomy — Kohlberg's theory — Gilligan's theory — Consensus and Controversy — Models of professional roles — Theories about right action — Self-interest — Customs and Religion — Uses of Ethical Theories

UNIT III

Engineering as Social Experimentation: Engineering as experimentation, Engineers as responsible experimenters, Codes of ethics, Industrial standards, A balanced outlook on law, Case study: The challenger.

UNIT IV

Safety, Responsibilities and Rights: Safety and risk, types of risks, Assessment of safety and risk, Safe exit, Risk-benefit analysis, safety lessons from 'the challenger' , Case study: Power plants, Collegiality and loyalty, Collective bargaining, Confidentiality, Conflict of interests, Occupational crime, whistle blowing, Intellectual property rights, professional rights.

TEXT BOOKS:

- A Text book on Professional Ethics and Human Values by R.S Naagarazan- New Age International Publishers.
- " Engineering Ethics includes Human Values" by M. Govindarajan, S. Natarajan and V. S. Senthil Kumar- PHI Learning Pvt. Ltd-2009

REFERENCE BOOKS:

"Professional Ethics and Human Values" by A. Alavudeen, R. Kalil Rahman and M. Jayakumaran- Laxmi Publications.

E-RESOURCES:

- www.onlineethics.org
- www.nspe.org
- www.globalethics.org
- www.ethics.org