NORTH MAHARASHTRA UNIVERSITY,

JALGAON (M.S.)

Second Year Engineering

(Mechanical Engineering)

Faculty of Engineering and Technology

Teacher and Examiner's Manual

SEMESTER – III

W.E.F 2013 – 2014

Fluid Mechanics Theory

Teacher, Paper setter and Examiner should follow the following guidelines.

Unit - I

1. Teacher should facilitate learning of

1.	Fluid properties & Hydrostatic		Lectures required
	a	Fluid properties & its definitions, definition of fluid, Viscosity, Bulk modulus of elasticity, Vapour pressure, Surface tension, Capillarity, Manometers (No numerical on manometers)	02
	b	Pascal's law, Hydrostatic law its derivation	03
	c	Total pressure & Centre of pressure on vertical, horizontal, inclined, curved surface its derivation	04
	d	Concept Of buoyancy & flotation Meta centre, metacentric height its derivation. Stability, unstability, equilibrium of floating & submerged body	03

Guidelines for Paper Setters:
Theoretical and numerical questions to be asked on **Unit-I. a, b, c, d.**
Note-Paper Setters should not ask numerical questions on **Manometers from (1.a).**

Unit - II

2. Teacher should facilitate learning of

2.	FLUID KINEMATICS AND DYNAMICS		Lectures required
	a	Types of flow, Definition of steady, Unsteady, Uniform, Non uniform, Laminar, Turbulent, Compressible, incompressible, rotational, Irrotational flow, 1D-2D flows, Stream line, Streak line, Path line, concept of Velocity, potential & stream function flow net (no numerical treatment)	01
	b	Continuity equation for steady, Unsteady, Uniform, Non uniform, Compressible incompressible,2D Euler's equation, Bernoulli's equation along a stream line for incompressible flow	04
	c	Practical applications of Bernoulli's equation - Pitot tube, Venturi meter, Orifice meter.	03

Guidelines for Paper Setters:
Theoretical question is to be asked on **Unit-II. a, b, c.**
Note-Paper Setters should ask numerical questions on **2.b and 2c.**

Unit – III

3. Teacher should facilitate learning of

3.	VISCOUS AND BOUNDARY LAYER FLOW		Lectures required
	a	Introduction to flow of viscous fluid through circular pipes, two parallel plates derivation	03
	b	kinetic and momentum energy correction factor (only theory no numerical)	01
	c	Power absorbed in viscous flow, viscous resistance to journal bearing, footstep bearing, collar bearing.	03
	d	Introduction to boundary layer flow, laminar and turbulent boundary layer, laminar sub layer, boundary layer thickness, displacement thickness, momentum thickness, separation of boundary layer. (No numerical treatment)	01

Guidelines for Paper Setters:
Theoretical questions to be asked on **Unit-III. a, b, c, d.**
Note-Paper Setters should ask numerical only on **3.a & 3.c**

Unit – IV

4. Teacher should facilitate learning of

4.	Dimensional analysis and Flow through Pipes		Lectures required
	a	Introduction to dimensional analysis, dimensional homogeneity, methods of dimensional analysis- Rayleigh's method, Buckingham's π-theorem, dimensionless numbers. (No numerical treatment)	01
	b	Loss of energy in pipes, loss of energy due to friction, minor energy losses, concept of HGL and TEL, flow through syphon, flow trough pipes in series or compound pipes, equivalent pipe, parallel pipes, branched pipes.	05
	c	Power transmission through pipes. Water hammer phenomenon (No numerical on water hammer)	01

Guidelines for Paper Setters:
Theoretical questions is to be asked on **Unit-IV. a, b, c.**
Note-Paper Setters should not ask numericals on **4.a & Water hammer phenomenon from 4c.**

Unit - V

5. Teacher should facilitate learning of

5.	CENTRIFUGAL AND RECIPROCATING PUMP		Lectures required
	a	Introduction to main parts of centrifugal pump, working & construction of Centrifugal pump, types of impellers, types of casings, priming.	01
	b	Work done on centrifugal pump, various heads and efficiencies of centrifugal pump, minimum starting speed of a centrifugal pump, multistage centrifugal pump, principles of similarity applied to centrifugal pump.	03
	d	Specific speed, NPSH, cavitations in pumps.	01
	e	Introduction to main parts of Reciprocating pump, construction & working of Reciprocating pump, classification of Reciprocating pump, slip of reciprocating pump, air vessels. (No numerical on Reciprocating pump)	02

Guidelines for Paper Setters:
Theoretical & numerical question is to be asked on **Unit-V. a, b, c, d, e.**
Note-Paper Setters should not ask numerical on **reciprocating pump from 5.e.**

References

1. Introduction to Fluid Mechanics and Fluid Machines, S.K. Som and G. Biswas, Tata McGraw Hill Education Publishing Company Limited, 2007.

2. Fluid Mechanics, F.M. White, McGraw-Hill, 2005.

3. Fluid mechanics and Hydraulic machines, Dr. R. K. Bansal , Laxmi Publication, Delhi, 2005

4. Fluid Mechanics and Machines, Kotharduraon and Rudramoorthy, New Age Internationals, 2007

5. Hydraulics And Fluid Mechanics Including Hydraulics Machines, Dr. P.N.Modi , Dr. S.M. Seth, Standard Book House / Rajsons Publications p ltd, Delhi, 2011.

6. Fluid Mechanics, Mohanty A.K., Prentice Hall of India, 2005.

7. Fluid Mechanics, Streeter, Tata McGraw Hill (SI).

8. Fluid Mechanics and Hydraulic Machines, S C Gupta, Pearson Publication.

Engineering Thermodynamics (Theory)

Teacher, Paper setter and Examiner should follow the following guidelines.

Unit - I

Teacher should facilitate learning of Use of Basics of thermodynamics, System, boundary, control volume, Macroscopic and Microscopic view point, Thermodynamic Properties, Process and Cycle, Pressure, Temperature and Energy and its forms.

1.	**Introduction to Engineering Thermodynamics No. of Lectures : 09**		**Lectures required**
	a	Scope and applications of thermodynamics, System, surroundings, boundary, control volume, types of system, unit and dimensions.	01
	b	Macroscopic and Microscopic view point, Thermodynamic Properties, Path function, Point function,	01
	c	State and Equilibrium, Process, Cycle, Quasi-static process and its significance.	01
	d	Energy, Flow Energy, Potential energy, Kinetic energy, Heat transfer, sign convention. Elementary Numerical on Energy and heat transfer.	01
	e	Work transfer, shaft work, displacement work, power. Elementary Numerical on work transfer.	01
	f	Zeroth law of thermodynamics, temperature, temperature scales	01
	g	Numerical on temperature measurement.	01
	h	Pressure, Absolute and gauge pressure, simple manometer, Bourdon's pressure gauge. And Numerical on Pressure Measurement	02

Guidelines for Paper Setters:

Theoretical question is to be asked on **1.a, 1.b, 1.c, 1.d, 1.f and 1.h.**

Paper Setters should ask numerical only on **1.d Elementary Numerical on Energy and heat transfer, 1.e Elementary Numerical on work transfer & 1.g Numerical on temperature and Pressure measurement.**

Unit - II

Teacher should facilitate learning of

Joule's experiment, First Law of thermodynamics, PMM-I, Steady flow Energy Equation (S F E E), its applications and $\int -vdP$ work.

2.	First Law Of Thermodynamics No. of Lectures : 08		Lectures required
	a	Joule's experiment, internal energy as a property, 1st law of thermodynamics	01
	b	First Law applied to closed system undergoing a process/ a cycle, PMM-I	01
	c	Enthalpy and internal energy of an ideal gas, specific heat, Cv and Cp.	01
	d	Numerical on application of 1st law to closed system.	01
	e	Principles of conservation of mass and energy, steady state steady flow process, continuity equation.	01
	f	Steady flow energy equation (SFEE), applications of SFEE to various engineering devises.	01
	g	Significance of -∫vdP, relation between ∫Pdv and -∫vdP,	01
	h	Numerical on application of 1st law to steady flow systems.	01

Guidelines for Paper Setters:

Theoretical question is to be asked on **2.a, 2.b, 2.d, 2.e, 2.f and 2.g** only.

Examiners should ask numerical only on **2.c application of 1st law to closed system, 2.g & 2.h application of 1st law to steady flow systems.**

Unit – III

Teacher should facilitate learning of

Limitations of First Law, Second law of Thermodynamic, statements of 2nd law, their equivalence, PMM-II, Carnot Cycle, Irreversibility, Carnot theorem, Absolute temperature scale, Entropy, Clausius theorem, Clausius Inequality.

3.	**Second Law of Thermodynamics No. of Lectures : 08**		**Lectures required**
	a	Limitations of First Law, thermal reservoir, heat engine & its efficiency, Refrigerator and Heat pump, Coefficient of Performance.	01
	b	Statements of second law, Equivalence of statements of second law, PMM-II	01
	c	Numerical on application of 2nd law.	01
	d	Reversibility and Irreversibility, Causes of irreversibility, Carnot cycle, Reversed Carnot cycle, their analysis.	01
	e	Carnot theorem, Absolute temperature scale	01
	f	Numerical on Carnot cycle, Carnot theorem and temperature scales.	01
	g	Entropy – Introduction, Law for two isentropic path, Entropy as property, Clausius theorem. (No numerical)	01
	h	Clausius statement, Clausius inequality, Entropy principle	01

Guidelines for Paper Setters:

Theoretical question is to be asked on **3.a, 3.b, 3.d, 3.e, 3.g and 3.h.**

Examiners should ask numerical on **3.c application of 2nd law & 3.f Carnot cycle, Carnot theorem and temperature scales only. No numerical treatment** for entropy and change in entropy during a process**.**

Unit – IV

Teacher should facilitate learning of Ideal gas, gas laws, Equation of state, Universal gas constant, Characteristic gas constant, Gas Processes, their presentation and analysis for heat transfer, work transfer, change in properties.

4.	**Properties of Ideal Gases** **No. of Lectures : 08**		**Lectures required**
	a	Ideal gas, Laws for an ideal gas, Equation of state, Universal gas constant Characteristic gas constant, Relation between Cp, Cv and R.	01
	b	Numerical on above syllabus.	01
	c	Ideal Gas Processes, their presentation on p-v, T-S plane, Analysis for Heat transfer, Work transfer, change in Internal Energy, enthalpy and Entropy –Isobaric, Isochoric and Isothermal processes.	01
	d	Numerical on above gas processes.	01
	e	Reversible Adiabatic process, presentation on p-v, T-S plane, Analysis for Heat transfer, Work transfer, and change in Internal Energy, enthalpy and Entropy.	01
	f	Reversible Polytropic process, presentation on p-v, T-S plane, Analysis for Heat transfer, Work transfer, and change in Internal Energy, enthalpy and Entropy.	01
	g	Numerical on above gas processes.	01
	h	Numerical on cyclic gas processes.	01

Guidelines for Paper Setters:

Theoretical question is to be asked on **4.a, 4.c. 4.e and 4.f.**
Numerical question is to be asked only on **4.b gas laws, 4.d, 4.g, & 4.h gas processes.**

Unit - V

Teacher should facilitate learning of pure substance, Phases of pure substances, Phase change, terminology used, use of steam table and Mollier Chart, Measurement of dryness fraction, vapor processes.

5.	**Properties of Steam No. of Lectures : 08**		**Lectures required**
	a	Pure substance, Phases of pure substances, Phase change diagrams (p-v, p-T, T-s) for water substance at standard atmospheric pressure, sensible heat and latent heat of steam.	01
	b	Terminology: dry, superheated, wet steam, saturation temperature, critical point and triple point, use of steam table.	01
	c	Numerical using steam table.	01
	d	Numerical using Mollier chart.	01
	e	Measurement of dryness fraction by using separating and throttling calorimeter. Numerical.	01
	f	Vapor processes- sketch on P-V, T-S, H-S diagrams, analysis for property changes, heat and work transfer.	01
	g	Numerical on steam processes	01
	h	Numerical on steam processes	01

Guidelines for Paper Setters:

Theoretical question is to be asked on **5.a, 5.b, 5.e and 5.f.**

Numerical question is to be asked only on **5.c Numerical using steam table, 5.d numerical using Mollier chart, 5.e separating and throttling calorimeter, 5.g & 5.h steam processes.**

References:

1	Engineering thermodynamics, P K Nag; Tata McGraw Hill.
2	Thermodynamics, C P Arora;Tata McGraw Hill.
3	Fundamentals of classical thermodynamics, G J Van Wylen, Richard E Sonntag; Wiley.
4	Engineering thermodynamics, Y V C Rao; Universities Press.
5	Engineering thermodynamics, J B Jones and R E Dugan; PHI.
6	Thermodynamics, 6th Edition, Yunus Cengel and M A Boles; Tata McGraw Hill.
7	Basic Engineering Thermodynamics, A. Venkatesh; Universities Press.

Other Guidelines for Paper Setter and Examiner for ESE:

1. On each unit, **THREE** sub questions of **08** marks should be asked. Students should be asked to solve **any TWO** sub questions.
2. Use of steam table/Mollier chart provided by College/Institute and Electronic non-programmable calculator is allowed.

Strength of Material (Theory)

Teacher, Paper setter and Examiner should follow the following guidelines.

Unit - I

1. Teacher should facilitate learning of

1.	**Introduction to Strength of material**		**Lectures required**
	a	Concept of stress and strain (linear, lateral, shear and volumetric), Hook's law, Poisson's ratio, modulus of elasticity, modulus of rigidity, stress-strain diagram for ductile and brittle materials, factor of safety and working stress, concept of 3-D stress state, bulk modulus, inter relation between elastic modulus.	02
	b	Axial force diagram, stress-strain, deformations in determinate homogeneous and composite bars of following types. 1) Prismatic 2) Linearly varying 3) Stepped section under concentrated loads and self-weights.	03
	c	Axial stresses and strain in determinate members –axial stress, strain and deformation in following indeterminate, homogeneous and composite bars. 1) Prismatic 2) Linearly varying 3) Stepped section under concentrated loads, self-weights.	03
	d	Temperature stresses & strain for Prismatic, Linearly varying & composite bars	02

Guidelines for Paper Setters:
Theoretical & numerical question is to be asked on **Unit-I. a, b, c, d.**

Unit - II

2. Teacher should facilitate learning of

2.	PRINCIPLE STRESSES AND STRAINS		Lectures required
	a	Introduction to Normal and shear stress on any oblique plane, concept of principle plane.	01
	b	Derivation of expression for principle stresses and planes and plane of max. Shear stress, position of principle plane and plane of max. Shear,	02
	c	Graphical solution using Mohr's circle of stresses.	01
	d	Combined effect of shear and bending in beams.	01
	e	Strain energy and impact-concept of stain energy, derivation and use of expression for deformation of axially loaded members under gradual, sudden and impact loads. Strain energy due to self-weight.	03

Guidelines for Paper Setters:
Theoretical & numerical question is to be asked on **Unit-II. a, b, c, d, e.**

Unit – III

3. Teacher should facilitate learning of

3.	SHEAR FORCE AND BENDING MOMENT DIAGRAM		Lectures required
	a	Introduction to different types of beams, different types of supports & loads.	01
	b	Concept and definition of shear force and bending moment in determinant beams due to concentrated loads, UDL, UVL and couple.	01
	c	Relation between SF, BM and intensity of loading, construction of shear force and bending moment diagram for cantilever, simple and compound beams, defining critical and maximum value and position of point of contra flexure.	03
	d	Construction of BMD and load diagram from SFD, Construction of load diagram and SFD from BMD.	02

Guidelines for Paper Setters:
Theoretical & numerical question is to be asked on **Unit-III. a, b, c, d.**

Unit – IV

4. Teacher should facilitate learning of

4.	BENDING STRESSES		Lectures required
	a	Theory of simple bending, assumptions in bending theory, Derivation of flexural formula	01
	b	Area center and moment of inertia of common cross section (regular section, T- section, channel section, I-section) with respect to centroidal and parallel axis, bending stress distribution diagram, moment of resistance and section modulus calculations.	02
	c	Direct and bending stresses in short column with eccentric point loads, concept of core section, middle third rule.	01
	d	Shear stresses: - Concept, derivation of shear stress distribution formula, shear stress distribution diagram for common cross section, maximum and average shear stresses, shear connection between flange and web.	03

Guidelines for Paper Setters:
Theoretical & numerical question is to be asked on **Unit-IV. a, b, c, d.**

Unit - V

5. Teacher should facilitate learning of

5.	TORSION IN CIRCULAR SHAFTS		Lectures required
	a	Stresses, strains and deformations in solid and hollow shafts, homogeneous and composite circular cross-sections subjected to torsion.	01
	b	Derivation of torsion equation. Stress due to combined torsion, bending and axial force on shafts.	03
	c	Thin and thick walled pressure vessels: - Stress, strain and deformation in thin wall seamless cylindrical and spherical vessel due to internal fluid pressure, change in volume, constants, effects of additional compressible and incompressible fluid injected under pressure.	04

Guidelines for Paper Setters:
Theoretical & numerical question is to be asked on **Unit-V. a, b, c.**

REFERENCE BOOKS

1) Timoshenko, Mechanics of Materials, CBS Publisher &Distributor.
2) Ramamruthum, Strengths of Materials, Dhanpat Rai Publication.
3) Junnarkar & Advi, Mechanics of Structure, Charorar Publication House, ANAND.
4) Bear &Johnson, Mechanics of Materials.
5) Shigley J.E., Mechanical Engineering Design.

Material Science and Metallurgy (Theory)

Teacher, Paper setter and Examiner should follow the following guidelines.

Unit - I

1. Teacher should facilitate learning of

Structure-Property-Processing-Performance relationship, elastic and plastic deformation and its mechanism, relation of crystal structure with plastic deformation, dislocation theory of slippage, strain hardening, crystal defects and their effects on plastic deformation. Plastic deformation in polycrystalline metals, cold working, recovery, recrystalisation, grain growth and hot working.

Strengthening mechanisms in metals like solid solution strengthening, Strain hardening, dispersion and precipitation hardening, phase transformation.

1.	**Nature of Metals and Alloys**		**Lectures required**
	a	1. Relationship between Structure-Property-Processing-Performance. 2 .Elastic and plastic deformation and its mechanism i.e. slip and twinning.	01
	b	Relation of crystal structure with plastic deformation i.e. effects of BCC, FCC or HCP structure on plastic deformation.	01
	c	Dislocation theory of slippage, strain hardening.	01
	d	Crystal defects and their effects on plastic deformation	01
	e	Plastic deformation in polycrystalline metals.	01
	f	Cold working- recovery, recrystllisation, grain growth and hot working.	01
	g	Strengthening mechanisms in metals - solid solution strengthening, Strain hardening.	01
	h	Dispersion and precipitation hardening, phase transformation.	01

2. Guidelines for Paper Setters:

Paper Setters should ask theoretical question on **any topic from 1.a. to 1.h**

Unit - II

1. Teacher should facilitate learning of

Tension test , engineering and true stress-strain curves, evaluation of properties, ductility, brittleness and toughness. Types of engineering stress-strain curve, compression test, hardness testings- Brinell, Poldi, Rockwell, Vickers, durometers, microhardness. Relation among the various hardness test and hardness to tensile strength. Impact test - charpy and izod. Fatigue and creep test.

Non-destructive test of metals-dye penetrant , magnetic particle, ultrasonic, radiography and eddy current testing.

2.	**Properties of Metals and Testing**		**Lectures required**
	a	Tension test, engineering and true stress-strain curves, evaluation of properties, ductility, brittleness and toughness.	01
	b	Types of engineering stress-strain curve, compression test.	01
	c	Hardness testings- Brinell hardness Test, Poldi hardness Test, Rockwell hardness Test , Vickers hardness Test.	01
	d	Durometers, microhardness. Relation among the various hardness test and hardness to tensile strength.	01
	e	Impact test- charpy and izod impact test.	01
	f	Fatigue and creep test.	01
	g	Non-destructive test of metals-dye penetrant test, magnetic particle test.	01
	h	Ultrasonic testing, radiography and eddy current testing.	01

2. Guidelines for Paper Setters:

Paper Setters should ask theoretical question on **any topic from 2.a to 2.h**

Unit – III

1. Teacher should facilitate learning of

Iron, allotropy, cooling curves and volume changes of iron, Iron-carbon equilibrium diagram, critical temperatures, various phase reactions, solubility of carbon in iron. Microstructures of slowly cooled steels. Non - equilibrium cooling of steels.

Cast Irons, types like gray, nodular , austempered, white, malleable C.I. Effects of various parameters on structure and properties of C.I. like carbon equivalent, cooling rate during eutectic reaction and alloying additions, properties , compositions, applications and specifications of C.I.

3.	**Ferrous Metals and its Alloys**		**Lectures required**
	a	Iron, allotropy, cooling curves and volume changes of iron.	01
	b	Iron-carbon equilibrium dig., critical temperatures, various phase reactions, solubility of carbon in iron.	01
	c	Microstructures of slowly cooled steels.	01
	d	Non - equilibrium cooling of steels.	01
	e	Cast Irons- types like gray cast iron, nodular cast iron.	01
	f	Austempered cast iron, white cast iron, malleable C .I .	01
	g	Effects of various parameters on structure and properties of C.I. like carbon equivalent, cooling rate during eutectic reaction and alloying additions.	01
	h	Properties, compositions, applications and specifications of C.I.	01

2. Guidelines for Paper Setters:

Paper Setters should ask theoretical question on **any topic from 3.a to 3.h**

Unit – IV

1**.** Teacher should facilitate learning of

Introduction and principles of heat treatment of steels, processing heat treatments for steels like full annealing, normalizing, process and stress relief anneal, spheroidization.

Heat treatments for non-ferrous metals.

Strengthning heat treatments for steels, isothermal transformation diagram, tempering of martensite, continuous cooling transformations, Jominy test for hardenability and its considerations. Quench media, austempering and martempering.

Surface hardening of steels , flame, induction , laser and electron beam hardening, gas , pack and liquid carburizing, nitriding , ionnitriding. Heat treatment furnaces and atmospheres, classification of furnaces, heat treatment and energy and controlled atmospheres.

4.	**Heat Treatments**		**Lectures required**
	a	1. Introduction and principles of heat treatment of steels, processing heat treatments for steels like full annealing, normalizing, process and stress relief anneal, spheroidization. 2 .Heat treatments for non-ferrous metals.	01
	b	Strengthening heat treatments for steels, isothermal transformation diagram.	01
	c	Tempering of martensite, continuous cooling transformations.	01
	d	Jominy test for hardenability and its considerations. Quench media, austempering and martempering.	01
	e	Surface hardening of steels- flame, induction , laser and electron beam hardening	01
	f	Pack, gas and liquid carburizing, nitriding ionnitriding.	01
	g	Heat treatment furnaces and atmospheres, classification of furnaces.	01
	h	Heat treatment and energy and controlled atmospheres.	01

2. Guidelines for Paper Setters:

Paper Setters should ask theoretical question on **any topic from 4.a to 4.h**

Unit - V

1. Teacher should facilitate learning of

Alloy steels – Limitation of plain carbon steels, effects of major alloying elements in steels, classification of alloying elements, examples of alloy steels, stainless steels and tool steel.

Introduction of Advanced materials- types and properties of composite materials, high temperature materials, engineering ceramics.

5.	**Alloy Steels and Advanced Materials**		**Lectures required**
	a	Alloy steels – Limitation of plain carbon steels, effects of major alloying elements in steels.	01
	b	Classification of alloying elements, examples of alloy steels.	01
	c	Stainless steels –classification , heat treatment of stainless steels.	01
	d	Tool steels-classification, cold work and hot work tool steels.	01
	e	High speed tool steels , heat treatment of high speed tool steel, special purpose tool steels.	01
	f	Introduction of Advanced materials- types and properties of composite materials.	01
	g	High temperature materials.	01
	h	Engineering ceramics.	01

2. Guidelines for Paper Setters:

Paper Setters should ask theoretical question on **any topic from 5.a to 5.h**

Reference Books:

1. Degarmo's "Materials and processes in manufacturing", by J.T. Black,Ronald A. Kosher, Willey student edition.
2. "Material Science and Metallurgy for Engineers", by V.D.Kodgire, Everest Publishing House. Pune

3. “Introduction to Engineering Materials”, by B. K. Agrawal, Tata Mcgraw Hill, New Delhi.
4. “An Introduction to Physical Metallurgy”, by S.H. Avner, Tata Mcgraw Hill, New Delhi.
5. ”Fundamentals of modern manufacturing materials, processesand systems” , by Mikell P. Groover, Wiley student edition, New Delhi.
6. “Material Science and Metallurgy”, by Parashivamurthy K. I., Pearson Publication
7. “Material Science and Metallurgy”, by U. C. Jindal, Pearson Publication
8. “Introduction to Materials Science for Engineers”, by James F. Shackleford & Madanapalli K. Muralidhara, Pearson Publication
9. “A textbook of Material Science and Metallurgy”, by O. P. Khanna, Dhanpat Rai Publication
10. “Metallurgy”, by A.S.Gholap and Dr. M.S. Kulkarni, “Nirali Prakashan.

Manufacturing Engineering-I (Theory)

Teacher, Paper setter and Examiner should follow the following guidelines.

Unit - I

1. Teacher should facilitate learning of

Material processing, Basic requirement of casting processes, casting terminology, Solidification process, Molten metal problems, Gating system, Pattern Materials and Allowances, Sand properties ad defects, Melting furnaces.

1.	**Fundamental of Casting**		**Lectures required**
	a	Introduction to Casting. Material processing, casting and basic requirement of casting processes	01
	b	Casting terminology. Mould cavity, Pouring cup, Sprue, Runner, Core, Core print, Cope and drag, Flask, Parting line, Chaplets, Gating system and its role, Riser & Riser design.	02
	c	Pattern and sand casting Pattern Types of Pattern, Pattern Materials, Pattern Allowances. Properties of Sand casting, Sand related defects.	02
	d	Solidification and Molten metal problems Solidification process, Cooling curves, Prediction of solidification time, Chvorinov's rule, Molten metal problems, Fluidity and pouring temperature, , Solidification shrinkage.	02
	e	Melting furnaces Cupola's, Arc furnaces, Induction furnaces, Indirect fuel fire furnaces.	01

2. Guidelines for Paper Setters:

- Examiners should ask theoretical question on **1. a, b, c, d & e.**
- Paper Setters should note that, he should ask theoretical question from **1.e** only for working, Applications, advantages and limitations of given melting furnaces.
- Paper Setters should not ask any numerical on unit-I.

Unit - II

1. Teacher should facilitate learning of

Basic metal forming processes, Rolling processes, Forging processes, Drawing processes.

2.	**Metal Forming Processes**		**Lectures required**
	a	Introduction Classification of deformation processes.	01
	b	Rolling Basic rolling processes, Hot and cold rolling processes, Rolling mill configuration, Principle of roll pass design, Thread rolling.	02
	c	Forging Open die and Close die forging, Hammer forging, Impression die, Press forging, Upset forging, Roll forging.	02
	d	Extrusion Extrusion methods, Metal flow in extrusion, Extrusion of hollow shape, Hydrostatic extrusion, Continuous extrusion.	02
	e	Drawing Wire, Rod and Tube drawing.	01

2. Guidelines for Paper Setters:

- Examiners should ask theoretical question on **2. a, b, c, d & e**.
- No Numerical question is to be asked on Unit-II.

Unit - III

1. Teacher should facilitate learning of

   Basic of welding and joining processes, Welding joints, Fusion welding, Pressure welding, Riveting, Soldering and brazing

3.	Welding and Joining Processes		Lectures required
	a	Introduction welding and joining processes, Classification of welding and thermal cutting process	01
	b	Welding joints Types of Welding joint, Edge preparation, Welding fixtures, Weldability, Design process and metallurgical consideration.	02
	c	Fusion welding Gas welding, Arc welding, Submerge arc welding, Inert gas welding, CO2 welding, Thermit welding, Welding equipments	02
	d	Pressure welding Solid phase welding, Resistance welding, Friction welding, Process capability and applications	02
	e	Riveting, Soldering and brazing	01

2. Guidelines for Paper Setters:

- Examiners should ask theoretical question on **3. a, b, c, d & e.**
- Paper Setters should note that, he should ask theoretical question from **3.d** on resistance Welding types such as Spot Welding, Seam Welding and Projection Welding only.
- Paper Setters should also note that, he should ask theoretical question from **3.e** on Rivet joint only for definition.
- No Numerical question is to be asked on Unit-III

Unit - IV

1. Teacher should facilitate learning of

Lathe machine operations, Milling machine, Drilling Machine Operations, Grinding, Finishing operations

4.	**Metal Removing Processes**		**Lectures required**
	a	Lathe machine Introduction to machine tools- Principal parts of lathe machines(Tail stock, Head stock, Carriage, Bed) Lathe specification, Cutting speed, Feed, Depth of cut, Machining time	01
	b	Lathe Machine operations Facing, Turning, Boring, Parting, Drilling, Reaming, Knurling, Capstan and turret lathe- Tool layout for simple jobs.	02
	c	Milling machine Milling machine operations, types of milling cutters, table feed in milling	01
	d	Drilling Machine Operations Drilling, Boring, Reaming, Spot facing, Counter boring, Counter sinking, Tapping, Drill speed and feed	02
	e	Grinding Grinding wheel, Selection and specifications, Dressing and truing of grinding wheels	01
	f	Finishing operations Lapping, Honing.	01

2. Guidelines for Paper Setters:

- Examiners should ask theoretical question on **4. a, b, c, d, e & f.**
- No Numerical question is to be asked on Unit-IV.

Unit - V

1. Teacher should facilitate learning of

Basic process of powder metallurgy, Powder testing and evaluation, Powder Metal production, Secondary operations.

5.	Powder Metallurgy		Lectures required
	a	Introduction Basic process, Powder manufacturing, Rapidly solidify powder(Micro crystalling and Amorphous)	01
	b	Powder testing and evaluation	02
	c	Powder Metal production Powder mixing and bending, Compacting, Sintering and hob isostatic pressing, Metal injection molding and other techniques to produce high density Powder Metal production	03
	d	Secondary operations Properties of powder metallurgy products, Advantages and disadvantages of powder metallurgy.	02

2. Guidelines for Paper Setters:

- Examiners should ask theoretical question on **5. a, b, c & d.**
- No Numerical question is to be asked on Unit-V.

Reference Books

1. Materials and processes in manufacturing , J T Black, Ronald A. Kosher, De Garmos, , Wiley student edition
2. Manufacturing technology , P. N. Rao , vol-I & II McGrow Hill publications
3. A Textbook of Production Engineering , P. C. Sharma, , S. Chand & Company. Ltd.
4. A Textbook of Production Technology , P. C. Sharma, S. Chand & Company. Ltd.
5. Process And Material Of Manufacturing, S. Chand Publication. Roy A Lindberg, prentice Hall of india pvt ltd,
6. Elements of Workshop Technology Volume I&II , Hajara Choudhari, Bose S.K.
7. Manufacturing Technology –S. K. Garg- Fire wall media ltd.

8. Fundamental of modern manufacturing, Mikell P groover, Wiely asia student edition
9. Manufacturing process and system, Phillip C Ostawald, jairo Munoz, wiely India.
10. Manufacturing Technology, D.K. Singh, Pearson New Delhi.
11. Manufacturing process Vol-I, H. S. Shah, Pearson New Delhi.
12. Manufacturing Engineering and Technology, Serope Kalpakjian, Pearson New Delhi.
13. Manufacturing Processes, Serope Kalpakjian, Pearson New Delhi.

Soft Skills – III

Teacher, Paper setter and Examiners should follow the guidelines as given below.

Unit - I

Teacher should facilitate the learning basic foundation of mathematics.

1.	Arithmetic-1		Lecture required	Reference No
	a	**Number Systems** Basic Formulae, Divisibility Rules, Speed Maths, Remainder Theorem, Different Types of Numbers, Applications	01	01
	b	**HCF, LCM and Linear Equations** HCF – Successive Division and Prime Factorization Methods, LCM – Successive Division and Prime Factorization Methods, Applications, Linear Equations – Elimination Method, Substitution Method, Applications	01	01
	c	**Averages and Mixtures** Concept of Average, Faster Ways of Finding It, The Allegation Method, Applications	01	01

Unit II

Teacher should facilitate the learning basic foundation of mathematics.

2.	Arithmetic-2		Lecture required	Reference No
	a	**Percentages** Concept of Percentage, Working with Percentages Applications	01	01
	b	**Profit and Loss** Difference between Cost and Selling Price, Concept of Profit Percentage and Loss Percentage, Applications	01	01
	c	**Time and Work** Basic Time and Work Formula, Relation between Time and Work, Applications	01	01

Unit III

Teacher should facilitate the learning basic foundation of mathematics.

3.	Arithmetic-3		Lecture required	Reference No
	a	**Permutations and Combinations** Sum Rule of Disjoint Counting, Product Rule of Counting Concept of Factorial, Permutations, Linear Permutations, Combinations, Circular Permutations, Applications	01	01
	b	**Probability** Definition and Laws of Probability, Mutually Exclusive Events, Independent Events, Equally Likely Events, Exhaustive Events, Cards, Dice, Applications	01	01
	c	**Time and Distance** Speed, Conversion Factors for Speed, Average Speed, Moving Bodies – Passing, Crossing and Overtaking, Relative Speed, Boats and Streams, Applications	01	01

Unit IV

Teacher should facilitate learning of critical thinking.

4.	Non-Verbal Reasoning		Lecture required	Reference No
	a	**Analogies** Different type of examples of analogies and its Applications	01	02
	b	**Classification** Different type of examples of analogies and its Applications	01	02
	c	**Sequences** Different type of examples of analogies and its Applications		02

Unit V

Teacher should facilitate the learning of a deep sense of analysis towards solving a problem

5.	Analytical Reasoning		Lecture required	Reference No
	a	**Analytical Puzzles** Classification Puzzles, Ordering Puzzles, Assignment puzzles, Applications	01	03
	b	**Letter and Number Series** Different Types of Letter Series, different types of Number Series, mixed Series	01	03
	c	**Coding and Decoding** Letter Coding, Number Coding, Mixed Coding, Odd Man Out, Applications	01	03

Reference Books:

1. R. S. Aggarwal, "Quantitative Aptitude", S. Chand Publication, New Delhi, 2012.
2. R. S. Aggarwal, "A Modern Approach to Verbal Reasoning", S. Chand Publication, New Delhi, 2012.
3. R. S. Aggarwal, "A Modern Approach to Non-Verbal Reasoning", S. Chand Publication, New Delhi, 2012.

Engineering Thermodynamics Lab

Teacher and Examiner should follow the following guidelines.

1. Teacher should facilitate any **EIGHT** of the following lab experiments:

A.	Engineering Thermodynamics Lab		Lab hours required
	1	**Study and Demonstration of Pressure measuring devices.** Study the principle, construction and working of pressure measurement devices. Demonstrate construction and working of pressure measurement devices practically. Student Activity: Discuss relative merits and demerits of above devices.	02
	2	**Study and Demonstration of Temperature measuring devices.** Study the principle, construction and working of Temperature measuring devices. Demonstrate construction and working of Temperature measuring devices practically. Student Activity: Discuss relative merits and demerits of above devices.	02
	3	**Study and Demonstration of Centrifugal Pump.** Study the principle, construction and working of Centrifugal Pump. Demonstrate construction and working of Centrifugal Pump practically. Student Activity: Discuss application of 1st law to Centrifugal Pump.	02
	4	**Study and Demonstration of Joule's paddle wheel experiment.** Study the Joule's paddle wheel experiment. Demonstrate of Joule's paddle wheel experiment practically. Student Activity: Discuss conclusion of Joule's paddle wheel experiment.	02
	5	**Determination of Dryness fraction using separating throttling calorimeter.** Study the separating throttling calorimeter. Demonstrate of construction, working and determination of dryness fraction using separating throttling calorimeter practically. Student Activity: Discuss merits and demerits of separating throttling calorimeter	02
	6	**Determination and Verification of SFEE for Nozzle.** Study application of SFEE to nozzle. Demonstrate of application of steady flow energy equation to nozzle practically.	02

		Student Activity: Verify SFEE using nozzle.	
	7	**Determination of actual Coefficient of performance of House hold refrigerator.** Study 2nd law of thermodynamics using house hold refrigerator. Demonstrate of application of 2nd law to house hold refrigerator practically. Student Activity: Verify second law using house hold refrigerator.	02
	8	**Numerical Assignment on Unit III (Minimum five Problems)**	02
	9	**Numerical Assignment on Unit IV. (Minimum five Problems)**	02
	10	**Numerical Assignment using steam table/Mollier chart on Unit V. (Minimum five Problems)**	02

Reference Books:

1	Engineering thermodynamics, P K Nag; Tata McGraw Hill.
2	Thermodynamics, C P Arora;Tata McGraw Hill.
3	Fundamentals of classical thermodynamics, G J Van Wylen, Richard E Sonntag; Wiley.
4	Engineering thermodynamics, Y V C Rao; Universities Press.
5	Engineering thermodynamics, J B Jones and R E Dugan; PHI.
6	Thermodynamics, 6th Edition, Yunus Cengel and M A Boles; Tata McGraw Hill.
7	Basic Engineering Thermodynamics, A. Venkatesh; Universities Press.

Guidelines for ICA:

ICA will based on Practical and Assignment submitted by student in form of journal.

References:

1	Engineering thermodynamics, P K Nag; Tata McGraw Hill.
2	Thermodynamics, C P Arora;Tata McGraw Hill.
3	Fundamentals of classical thermodynamics, G J Van Wylen, Richard E Sonntag; Wiley.
4	Engineering thermodynamics, Y V C Rao; Universities Press.
5	Engineering thermodynamics, J B Jones and R E Dugan; PHI.
6	Thermodynamics, 6th Edition, Yunus Cengel and M A Boles; Tata McGraw Hill.
7	Basic Engineering Thermodynamics, A. Venkatesh; Universities Press.

Other Guidelines for Paper Setter and Examiner for ESE:

1. On each unit, **THREE** sub questions of **08** marks should be asked. Students should be asked to solve **any TWO** sub questions.
2. Use of steam table/Mollier chart provided by College/Institute and Electronic non-programmable calculator is allowed.

Fluid Mechanics Lab

Teacher and Examiner should follow the following guidelines.

1. Teacher should facilitate following lab experiments:

	Fluid Mechanics Lab		Lab hours required
	1	Experiment on determination of metacentric height of a floating body	02
	2	Experiment on Bernoulli's theorem	02
	3	Study of manometers	02
	4	Experiment on Red wood viscometer	02
	5	Experiment on Reynolds's apparatus	02
	6	Experiment on flow measurement by orifice meter	02
	7	Experiment on flow measurement by venturi meter	02
	8	Trial on centrifugal pumps	02
	9	Experiment on determination of major and minor losses for flow through pipes	02
	10	Study of sharp edged circular orifice / mouthpieces	02
	11	Study of velocity distribution in boundary layer and its thickness.	02

Note: Lab file should contain at list EIGHT experiments from above mentioned list.

ESE (Practical Examination)

• The Practical Examination will comprise of performing the experiment and viva on the practical's.

References:

1. Introduction to Fluid Mechanics and Fluid Machines, S.K. Som and G. Biswas, Tata McGraw Hill Education Publishing Company Limited, 2007.

2. Fluid Mechanics, F.M. White, McGraw-Hill, 2005.

3. Fluid mechanics and Hydraulic machines, Dr. R. K. Bansal , Laxmi Publication, Delhi, 2005

4. Fluid Mechanics and Machines, Kotharduraon and Rudramoorthy, New Age Internationals, 2007

5. Hydraulics And Fluid Mechanics Including Hydraulics Machines, Dr. P.N.Modi , Dr. S.M. Seth, Standard Book House / Rajsons Publications p ltd, Delhi, 2011.

6. Fluid Mechanics, Mohanty A.K., Prentice Hall of India, 2005.

7. Fluid Mechanics, Streeter, Tata McGraw Hill (SI).

8. Fluid Mechanics and Hydraulic Machines, S C Gupta, Pearson Publication.

Material Science and Metallurgy Lab

Teacher and Examiner should follow the following guidelines.

1. Teacher should facilitate following lab experiments:

	Group A		Lab hours required
	1	Tensile test, to compare tensile strength, yield point and ductility of three metallic materials.	02
	2	Brinell or Poldi hardness test on steel, cast iron, brass.	02
	3	Vickers hardness test on steel, cast iron, brass .	02
	4	Rockwell and Rockwell superficial hardness measurement.	02
	5	Izod or Charpy impact test to compare impact values of cast iron and mild steel or alluminum and brass.	02
	6	Erichsen Cupping Test	02
	7	Non-destructive tests: Dye penetrant test, Magnetic particle testing, ultrasonic testing ,eddy current test.(any two)	02

	Group B		Lab hours required
	8	Micro Specimen Preparation and use of metallurgical microscope .	02
	9	Study and drawing microstructure of mild steel, medium carbon, eutectoid steel, hypereutectoid steel .	02
	10	Demonstration of Annealing, Normalising and Hardening of medium carbon steel specimens and measurements of hardness and drawing microstructures.	02
	11	Jominy Hardenability test.	02
	12	Study and drawing microstructure of white, Malleable, Gray and Ductile cast iron or any four non-ferrous metals.	02
	13	Study and drawing the microstructures of heat affected zones of fusion welded joint.	02

Note: The student should maintain a journal keeping record of <u>any four</u> experiments from <u>group A</u> and <u>group B</u> each.

Reference Books:

1. Degarmo's "Materials and processes in manufacturing", by J.T. Black,Ronald A. Kosher, Willey student edition.
2. "Material Science and Metallurgy for Engineers", by V.D.Kodgire, Everest Publishing House. Pune
3. "Introduction to Engineering Materials", by B. K. Agrawal, Tata Mcgraw Hill, New Delhi.
4. "An Introduction to Physical Metallurgy", by S.H. Avner, Tata Mcgraw Hill, New Delhi.
5. "Fundamentals of modern manufacturing materials, processesand systems" , by Mikell P. Groover, Wiley student edition, New Delhi.
6. "Material Science and Metallurgy", by Parashivamurthy K. I., Pearson Publication
7. "Material Science and Metallurgy", by U. C. Jindal, Pearson Publication
8. "Introduction to Materials Science for Engineers", by James F. Shackleford & Madanapalli K. Muralidhara, Pearson Publication
9. "A textbook of Material Science and Metallurgy", by O. P. Khanna, Dhanpat Rai Publication
10. "Metallurgy", by A.S.Gholap and Dr. M.S. Kulkarni, "Nirali Prakashan.

Workshop Practice III

Teacher and Examiner should follow the following guidelines.

1. Teacher should facilitate following lab experiments:

	Workshop Practice III		Lab hours required
	1	**Carpentry shop** Preparation and manufacturing of solid wooden pattern for foundry shop involving Wood Turing lathe machine	04
	2	**Foundry Shop** Mould making Practice: Preparation of mould of above pattern, casting from this mould. Actual weight calculation, yield & casting of item should be performed.	04
	3	**Welding Shop** One job on welding (fabrication) preparing a component comprising welding joints such as shoe rack, book rack, stands for flower pots, house hold applications, stools etc. (any one job for Group of 4 to 5 Students)	04
	4	**Machine shop-I (Turning Shop)** One job (**by each Student**) consisting of Turning, Thread Cutting (Internal, External), Facing, Plain turning, Taper turning, Step Turning, chamfering, Grooving, Drilling, boring, Reaming, Knurling etc. operations.	10

Note:

1. Candidates are required to finish the job to the following limits

   Machine Shop: + 0.5mm -0.5mm

   Welding & Casting Shop: +2mm -2mm

2. Workshop book to be submitted comprising of Job drawing, process sheet for a given job along with the sketches of tools used for operations.
3. No separate journal or file is to be prepared.

Reference Books:

1. Element of Workshop Technology Volume I and II -Hajara Chaudhary and Bose S.K., Asia Publishing House.

2. Production Technology Volume I and II –P.N.Rao, Tata McGraw Hill Publication.

3. Production Technology- R.K.Jain, Khanna Publications.

4. Production Technology- P.C.Sharma, Khanna Publication.

5. Workshop Technology-Chapman W.A.J., ELBS Publication.

6. Production Technology- HMT, Tata McGraw Hill Publication.

Engineering Mathematics-III

Teacher, Paper setter and Examiner should follow the following guidelines.

Unit - I

1. Teacher should facilitate learning the Solution of nth order Linear Differential Equations.

1.	Linear Differential Equations		Lectures required
	a	Introduction to nth order Linear Differential Equation, Auxiliary Equation , Complimentary Functions;	01
	b	Solution of nth order L.D.E using General Method	01
	c	Particular Integral using short cut Methods	03
	d	Solution of 2^{nd} order L.D.E using Variation Parameter Methods	01
	e	Solution of Cauchy's D.E.	01
	f	Solution of Legendre's D.E	01

Unit - II

1. Teacher should facilitate learning of

Mathematical Model of mass spring system and its solution; Introduction to One Dimensional Heat Flow equation and its solution using method of separation of variables; Introduction to Two Dimensional Heat Flow equation and its solution using method of separation of variables

2.	Applications of Linear Differential Equations and Partial Differential equations		Lectures required
	a	Mathematical Model of mass spring system and its solution	02
	b	Introduction to One Dimensional Heat Flow equation and its solution using method of separation of variables	03
	c	Introduction to Two Dimensional Heat Flow equation and its solution using method of separation of variables	03

Unit – III

1. Teacher should facilitate learning of Basics of Laplace and Inverse Laplace transform, Solution of differential equations using Laplace Transform.

3.	**Laplace Transform**		**Lectures required**
	a	Definition of Laplace Transform; Existence of Laplace Transform; Laplace Transform of standard Functions	1
	b	Theorems and properties of Laplace transform and its use	2
	c	Inverse Laplace Transform of standard Functions	1
	d	Properties of Inverse Laplace Transform and its use	2
	e	Laplace Transform of Unit Step Functions	1
	f	Solution of Differential equations using Laplace Transform	1

Unit – IV

1. Teacher should facilitate learning of Basics of statistics and some probability distributions

4.	**Statistics and Probability distributions**		**Lectures required**
	a	Introduction to Mean, Mode, Median standard deviation, Variance, Coefficient of Variation	02
	b	Moments, Skewness and kurtosis	02
	c	Correlation and Regression	02
	d	Introduction to Binomial, Poisson's Distributions	01
	e	Introduction to Normal Distributions	01

Unit - V

Teacher should facilitate learning of Basic of Fourier Transform and vector differentiation

5.	Fourier Transform and Vector Differentiation		Lectures required
	a	Introduction to Fourier Integral theorem Fourier Transforms, Fourier Cosine Transforms, Fourier Sine Transform and their inverse.	04
	b	Gradient of Scalar point function.	01
	c	Directional Derivatives of scalar point functions	02
	d	Divergence and curl of vector field	01
	e	Solenoidal and Irrotational vector fields	01

Reference Books:

1. H.K. Dass - Advanced Engineering Mathematics (S. Chand Publication) New Delhi, 2008.
2. Erwin Kreyszig - Advanced Engineering Mathematics (Wiley Eastern Ltd.) Tenth Edition.
3. B.S. Grewal - Higher Engineering Mathematics, Khanna Publication, Delhi, 42nd Edition,2012.
4. Wylie C.R. & Barrett - Advanced Engineering Mathematics - Mc Graw Hill, 6th revised edition, 1995.
5. B.V. Raman - Engineering Mathematics - Tata Mc- Graw – Hill, 2007.
6. A Text Book of Engineering Mathematics, By N. P. Bali, Laxmi Publication,2004 .

Theory of Machines-I (Theory)

Teacher, Paper setter and Examiner should follow the following guidelines.

Unit - I

1. Teacher should facilitate learning of

Basics of mechanisms-kinematic link, pair, chain, mechanism and machines & types, strcucture, joints in a chain, degrees of freedom, Kutzbach & Grubler's critereia, inversions of mechanisms(no numerical treatment), velocity analysis by ICR method & relative velocity method

1.	**Simple Mechanisms**		**Lectures required**
	a	Introduction, Kinematics, Kinetics, Static & Dynamics, Machine, Kinematic link or element, Type of links, Structure, Difference Between a Machine and a structure, Types of Constrained Motions, Classification of Kinematic Pairs.	01
	b	Kinematic Chain, Types of Joints in a Chain, Types of Kinematic Chains, Mechanism, Number of Degrees of Freedom for Plane Mechanisms, Application of Kutzbach Criterion to Plane Mechanisms, Grubler's Criterion for Plane Mechanisms**.**	01
	c	Inversion of Mechanism, Four Bar Chain or Quadric Cycle Chain, Inversions of Four Bar Chain, Single Slider Crank Chain, Inversions of Single Slider Crank Chain, Double Slider Crank Chain, Inversions of Double Slider Crank Chain(no numerical treatment)	01
	d	Introduction, Relative & Absolute velocity, Velocity of a point on a link by Instantaneous Centre of Rotation (ICR) method, Properties of ICR, Location of ICRs, Space and Body Centrodes.	01
	e	Kennedy's or Three Centres in Line Theorem, ICR method for different Mechanisms	02
	f	Relative Velocity Method, Relative Velocity of Two Bodies Moving in Straight Lines, Motion of a Link, Velocity of a Point on a Link by Relative Velocity Method, Velocities in a Four bar mechanism, Slider Crank Mechanism & other inversions, Rubbing Velocity at a Pin Joint, Mechanical Advantage	03

2. Guidelines for Paper Setters:

Theoretical questions should be asked on sections **1.a, 1.b and 1.c** only.

Numerical questions should be asked on sections **1.d, 1.e and 1.f** only.

Unit - II

1. Teacher should facilitate learning of

Basics of acceleration, types-linear, angular, centripetal & tangential acceleration, acceleration polygon for plane mechanisms, coriolis component of acceleration, Klein's construction

2.	**Acceleration in Mechanisms**		**Lectures required**
	a	Introduction to Linear, Angular, Centripetal, Tangential acceleration, Acceleration Diagram for a Link, Acceleration of a Point on a Link, Acceleration in the Four bar Mechanisms	02
	b	Acceleration in the Slider Crank Mechanism and other inversions.	02
	c	Introduction to Coriolis Component of Acceleration, magnitude and direction, Coriolis Component of Acceleration for different mechanisms.	02
	d	Klien's Construction, different cases of slider crank mechanisms	02

2. Guidelines for Paper Setters:

Theoretical and numerical questions should be asked on Unit-II.

Unit – III

2. Teacher should facilitate learning of

D' Alembert's principle, analytical analysis of slider-crank mechanism, forces on parts of an IC engine, equivalent dynamical system (analytical method), mechanism with lower pairs, Hooke's joint

3.	**Inertia Forces in Reciprocating Parts**		**Lectures required**
	a	Introduction, D-Alembert's Principle, Analytical Method for Velocity and Acceleration of slider-crank mechanism, Forces on the Reciprocating Parts of an Engine	02
	b	Equivalent Dynamical System, Determination of Equivalent Dynamical System of Two Masses by Analytical Method,	02

		Correction Couple, Analytical Method for Inertia Torque	
	c	Mechanisms with Lower Pairs, Pantograph, Straight Line Mechanism, Approximate Straight Line Motion Mechanisms, Steering Gear Mechanism,	02
	d	Universal or Hooke's Joint, Double Hooke's Joint	02

2. Guidelines for Paper Setters:

Theoretical questions should be asked on sections **3a, 3b, 3c and 3d.**

Numerical questions should be asked on sections **3a, 3b and 3d only.**

Unit – IV

2. Teacher should facilitate learning of

Basics of friction-introduction, types, laws of solid and fluid friction, limiting friction, friction of a body lying on a rough inclined plane, friction in Screw Jack, friction in journal bearing, friction clutches

4.	**Friction**		**Lectures required**
	a	Introduction, Types of Friction, Friction Between Lubricated Surfaces, Limiting Friction, Laws of Solid Friction, Laws of Fluid Friction, Coefficient of Friction, Limiting Angle of Friction, Angle of Repose, Friction of a Body Lying on a Rough Inclined Plane, Efficiency of Inclined Plane	02
	b	Screw friction, Terminology of screw, Screw Jack, Torque requirements, Efficiency, Friction of a V-thread	02
	c	Friction in Journal Bearing- Friction Circle, Friction of Pivot and Collar Bearing, Flat Pivot Bearing, Conical Pivot Bearing, Trapezoidal or Truncated Conical Pivot Bearing, Flat Collar Bearing	03
	d	Friction Clutches, Single Disc or Plate Clutch, Multiple Disc Clutch, Centrifugal Clutch	02

2. Guidelines for Paper Setters:

Theoretical questions should be asked on sections **4a, 4b, 4c & 4d.**

Numerical questions should be asked on sections **4a, 4b & 4c only.**

Unit - V

1. Teacher should facilitate learning of

Belt drive- selection, types, material, slip & creep of belt, length of open and cross belt drive, ratio of driving tensions, centrifugal tension in belt, condition for transmission of maximum power, initial tension, V-belt drive, driving tensions for V-belt, rope drive, fibre ropes, wire ropes, chain drives- terminology, advantages and disadvantages, classification, chain speed, length of chain

5.	**Belt, Rope and Chain Drives**		**Lectures required**
	a	Introduction, Selection of a Belt Drive, Types of Belt Drives, Types of Belts, Material used for Belts, Types of Flat Belt Drives, Velocity Ratio, Slip of Belt, Creep of Belt	01
	b	Length of an Open Belt Drive and Cross Belt Drive, Power Transmitted, Ratio of Driving Tensions, Angle of Contact, Centrifugal Tension, Condition For the Transmission of Maximum Power, Initial Tension	03
	c	V-belt drive, Advantages and Disadvantages, Driving Tensions for V-belt, Rope Drive, Fiber Ropes, Advantages, Sheave for Fiber Ropes, Wire Ropes	02
	d	Chain Drives, Kinematic of Chain Drive, Classification, Advantages and Disadvantages, Terminology, Chain Speed and Angular Velocity of Sprocket, Length of Chain	02

2. Guidelines for Paper Setters:

Theoretical questions should be asked on sections **5a, 5b, 5c & 5d.**

Numerical questions should be asked on sections **5b, 5c and 5d only.**

Reference Books:

1. Theory of Machines, S. S. Rattan, Tata McGraw Hill, New Delhi.
2. Theory of Mechanisms & Machines, Jagdish Lal, Metropolitan Book Co.
3. Theory of Machines, Longman's Green & Co., London.
4. Theory of Machines, W. G. Green, Blackie & Sons, London
5. Theory of Machines, V.P. Singh, Dhanpat Rai & Co.
6. Theory of Machines and Mechanisms, Shigley, J.E and Uicker, J.J, McGraw-

Hill International Book Co.
7. Mechanisms and Machines theory, Rao J.S. and Dukkipati R.V, Wiley Eastern Ltd.
8. The Theory of Machines through solved problems by J.S.Rao. *New age international publishers.*
9. A text book of Theory of Machines by Dr.R.K.Bansal. *Laxmi Publications (P) Ltd*.
10. Theory of Machines by Sadhu Singh, Pearson Publication

Applied Thermodynamics (Theory)

Teacher, Paper setter and Examiner should follow the following guidelines.

Unit - I

1. Teacher should facilitate learning of

Layout of Steam power plant, Boiler: Classification, selection, Modern boilers, IBR, Energy conservation opportunities, waste heat recovery boiler, Equivalent evaporation, boiler efficiency (direct and indirect Method), Heat balance for a boiler, Boiler Draught, Natural & Artificial draught, losses, Condition for maximum discharge through chimney.

1.	**Boiler and Boiler Performance**		**Lectures required**
	a	Steam Power Plant layout, Classification and selection of boilers, Stocker fired boiler.	01
	b	Modern boilers with various fossil fuels, IBR act, Energy conservation opportunities, waste heat recovery boiler.	01
	c	Boiler performance - Equivalent evaporation, boiler efficiency (direct and indirect Method).	01
	d	Numerical on boiler performance.	01
	e	Heat balance for a boiler.	01
	f	Numerical on boiler Heat balance.	01
	g	Boiler Draught, Natural & Artificial draught, losses, Condition for maximum discharge through chimney.	01
	h	Numerical on Boiler draught.	01

2. Guidelines for Paper Setter:

Theoretical question (4 or 8 marks only) is to be asked on -**1.a, 1.b, 1.c, 1.e and 1.g**.

Paper Setter should ask numerical (8 marks only) on **1.d boiler performance, 1.f boiler Heat balance and 1.h Boiler draught**.

Unit - II

1. Teacher should facilitate learning of

Basics of Vapor Processes, Carnot Cycle, Rankine cycle, Analysis of Rankine cycle, Comparison of Rankine and Carnot cycle, Methods to improve Rankine cycle efficiency - Regeneration, Reheating, Co-generation, Condenser, classification and Need of condenser, Condenser efficiency, Vacuum efficiency, cooling water required, Air leakage and its effect on condenser performance, Air extraction pump, cooling towers.

2.	**Vapor Power Cycle and Steam Condenser**		**Lectures required**
	a	Fundamentals of Vapor Processes, Steam power cycles- Carnot Cycle, Rankine cycle.	01
	b	Analysis of Rankine cycle for work ratio, efficiency, Power output, specific steam consumption, heat rate. Comparison of Rankine and Carnot cycle.	01
	c	Numerical on Analysis of Rankine cycle, Comparison of Rankine and Carnot cycle.	01
	d	Methods to improve Rankine cycle efficiency - Regeneration, Reheating, Co-generation.	01
	e	Numerical on reheat Rankine cycle, regenerative Rankine cycle.	01
	f	Condenser, classification of condenser, Necessity of condenser, Vacuum measurement, Condenser efficiency, Vacuum efficiency, Calculation of cooling water required.	01
	g	Air leakage and its effect on condenser performance, Air extraction pump, cooling towers.	01
	h	Numerical on condenser performance and Air leakage.	01

2. Guidelines for Paper Setter:

Theoretical question (4 or 8 marks only) is to be asked on -**2.a, 2.b, 2.d, 2.f and 2.g**.

Examiner should ask numerical (8 mark only) on **2.c Rankine cycle, 2.e reheat Rankine cycle, regenerative Rankine cycle and 2.h condenser performance and Air leakage.**

Unit – III

1. Teacher should facilitate learning of

Compressible fluid flow, Static and Stagnation properties, Sonic velocity, Mach number, type of nozzles and diffusers, One dimensional steady isentropic flow through nozzles and diffusers, Critical pressure ratio, maximum discharge, choked flow, Effect of variation in back pressure on nozzle characteristics, Effect of friction and nozzle Efficiency, Super saturated flow Fanno line, Rayleigh lines.

3.	**Compressible Flow and Steam Nozzle**		**Lectures required**
	a	Compressible fluid flow, Static and Stagnation properties, numerical on the same.	01
	b	Sonic velocity, Mach number, type of nozzles and diffusers.	01
	c	One dimensional steady isentropic flow through nozzles and diffusers, Critical pressure ratio, maximum discharge, choked flow.	01
	d	Numerical on flow through nozzles and diffusers.	01
	e	Effect of variation in back pressure on nozzle characteristics, Effect of friction and nozzle Efficiency.	01
	f	Numerical on Effect of friction and nozzle Efficiency.	01
	g	Super saturated flow Fanno line, Rayleigh lines (No numerical).	01
	h	Normal and oblique shock losses. (No numerical)	01

2. Guidelines for Paper Setter:

Theoretical question (4 or 8 marks only) is to be asked on – **3.a, 3.b, 3.c, 3.e, 3.g, and 3.h.**

Examiners should ask numerical (8 mark only) on **3.d flow through nozzles and diffusers and 3.f Effect of friction and nozzle Efficiency.**

Unit – IV

1**.** Teacher should facilitate learning of

Introduction, use of compressed air, terminology and classification of compressors, Construction and working of single stage compressor, analysis of reciprocating compressor without clearance volume, Isothermal Efficiency, Effect of clearance, analysis of reciprocating compressor with clearance volume, volumetric efficiency, FAD, Actual Indicator diagram, Improvements in volumetric efficiency, multistage compression, Condition for minimum work, Intercooler, after cooler, heat rejected.

4.	**Reciprocating Air Compressor**		**Lectures required**
	a	Introduction, use of compressed air, terminology used in compressor, Classification of compressors.	01
	b	Construction and working of single stage compressor, Thermodynamic analysis of reciprocating air compressor without clearance volume, Isothermal Efficiency, Double acting Compressor.	01
	c	Numerical of reciprocating air compressor without clearance.	01
	d	Effect of clearance, analysis of reciprocating air compressor with clearance volume, volumetric efficiency, FAD, Actual Indicator diagram.	01
	e	Numerical of reciprocating air compressor with clearance.	01
	f	Improvements in volumetric efficiency, multistage compression, Condition for minimum work of compression, Intercooler, after cooler, heat rejected.	01
	g	Numerical on multistage reciprocating air compressor.	01
	h	Numerical on multistage reciprocating air compressor.	01

2. Guidelines for Paper Setter:
Theoretical question (4 or 8 marks only) is to be asked on – **4.a, 4.b, 4.d and 4.f.**

Examiners should ask numerical (8 marks only) on **4.c reciprocating air compressor without clearance, 4.e reciprocating air compressor with clearance and 4.g, 4.h multistage reciprocating air compressor.**

Unit - V

1. Teacher should facilitate learning of

Introduction, classification of rotary compressors; construction, working, analysis and application of roots blower, Construction, working, analysis and application of vane type compressor, Construction, working, analysis and application of screw type compressor.

Introduction, classification of fans and blowers, Fan characteristics, Construction and working of centrifugal fan and axial flow fan.

5.	**Rotary air Compressor**		**Lectures required**
	a	Introduction, classification of rotary compressors; construction, working, analysis and application of roots blower.	01
	b	Construction, working, analysis and application of vane type compressor	01
	c	Construction, working, analysis and application of screw type compressor	01
	d	Introduction, classification of fans and blowers, Fan characteristics.	01
	e	Construction and working of centrifugal fan and axial flow fan.	01
	f	Numerical only on centrifugal fan.	01
	g	Numerical only on axial flow fan.	01

2. Guidelines for Paper Setters:

Theoretical question (4 or 8 marks only) is to be asked on – **5.a, 5.b, 5.c, 5.d and 5.e.**

Examiners should ask numerical (8 marks only) on **5.f centrifugal fan and 5.g axial flow fan.**

References:

1	Thermodynamics: an Engineering Approach, Y A Cengel and M A Boles, Tata McGraw Hill.
2	Applied Thermodynamics for Engineering Technologists, T. D. Eastop and A. McConkey, Pearson Education India

3	Course in Thermal Engineering, C. P. Kothandaraman, Domkundwar, Domkundwar S, Dhanpat Rai & Company (P) Limited.
4	Power Plant Technology, M. M. El-Wakil, Tata McGraw Hill.
5	Turbines, compressors and fans, S M Yahya, Tata McGraw Hill.
6	Applied Thermodynamics, R K Rajput, Laxmi Publication New Delhi.
7	Engineering Thermodynamics, P.K. Nag, Tata McGraw Hill

Other Guidelines for Paper Setter and Examiner for ESE:

3. On each unit, **THREE** sub questions of **08** marks should be asked. Students should be asked to solve **any TWO** sub questions.
4. Use of steam table/Mollier chart provided by College/Institute and Electronic non-programmable calculator is allowed.

Basic Electrical Drives and Controls (Theory)

Teacher, Paper setter and Examiners should follow the guidelines as given below.

Unit – I

1. Teacher should facilitate learning of Basics of Electrical power measurement, Electrical Energy measurement, Illumination

1.	**Electric power measurement, Electric Energy measurement, Illumination**		**Lecture required**
	a	**Electrical power measurement:** Three phase power measurement by single watt meter method, two Watt meter method, three watt meter method	03
	b	Effect of load power factor on wattmeter reading. Measurement of reactive power by one wattmeter method	01
	c	**Electrical Energy measurement:** Single phase energy meter (construction and working).	01
	d	**Illumination:** Various term related to illumination, types	01
	e	Requirement of good lighting scheme, special purpose lighting	02

2. Guidelines for Paper Setters:

Theoretical questions should be asked on sections **1.a, 1.b, 1.c, 1.d and 1.e** only

No Numerical on Unit-I.

Unit – II

1. Teacher should facilitate learning of Basic of D C machine and its Application and Basics of Special purpose Machines

2	**DC Machines**		**Lecture required**
	a	**DC machine :** Constructional, Working principle of D.C.generator, Types of D.C. generator EMF Equation of D.C. Generator (Theoretical concept only). **(Numerical)**	02

	b	Working principle of D.C.Motor, back EMF, EMF Equation Types of D.C.Motor, and torque equation for D.C.Motor. **(Numerical)**	02
	c	Characteristics of Shunt, series, compound motors, methods for speed control of D.C. Shunt and series motor & applications of DC motor.	02
	d	Explain the necessity of starter and types.	02
	e	**Special purpose machines**: Principle, working and application of stepper motor, servo motor.	01

2. Guidelines for Paper Setters:

Theoretical questions should be asked on sections **2.a, 2.b, 2.c, 2.d and 2.e**

Numerical questions should be asked on sections **2.a and 2.b** only.

Unit – III

1. Teacher should facilitate learning of fundamental of Single phase & three phase transformers, three phase Induction motors.

3.	**Single phase & Three phase transformers & Three Phase Induction Motor**		**Lecture required**
	a	**Single phase Transformers** Working Principle & Construction of Single phase transformer & derive EMF equation. Efficiency of Transformers & condition for maximum efficiency of Transformer	02
	b	Auto Transformer, CT,PT and their application	02
	c	**Three phase Induction motors :** Constructional features of induction motor and Working principle of three phase induction motor, types	02
	d	Define slip and derive torque equation , explain torque slip characteristics, power stages	02
	e	Explain different types of starters and applications of induction motors.	01

2. Guidelines for Paper Setters:

Theoretical questions should be asked on sections **3.a, 3.b, 3.c, 3.d and 3.e** only No Numerical on Unit-III.

Unit – IV

1. Teacher should facilitate learning of Synchronous Machines, Single phase Induction motors

4.	**Single phase Induction motors & Synchronous Generator**		**Lecture required**
	a	**Single phase Induction motors** - principle of operation, types, and applications.	02
	b	**Synchronous Generator**: Constructional features (Salient and Non-salient) of alternators and principle of operation	01
	c	Pitch Factor or Chording Factor & Distribution Factor or winding factors, EMF equation,	02
	d	Alternator on load, concept of synchronous reactance and impedance, Phaser diagram of loaded alternator.	02
	e	Voltage regulation of alternator by Direct loading method and synchronous impedance method.	01

2. Guidelines for Paper Setters:

Theoretical questions should be asked on sections **4.a, 4.b, 4.c, 4.d and 4.e** only No Numerical on Unit-IV.

Unit – V

1. Teacher should facilitate learning of Sensors, Robotics, DAS and Relays

5.	**Sensors, Robotics, DAS and Relays**		**Lecture required**
	a	**Sensors:** Proximity sensors, Light sensors,	02
	b	Hall effect sensors, Ultrasonic sensors.	02
	c	Robotics, Block diagram and operation of Data acquisition system.	02
	d	**Relays:** Electromechanical control relays, solid state relays, Timing and Latching relays	02

2. Guidelines for Paper Setters:

Theoretical questions should be asked on sections **5.a, 5.b, 5.c and 5.d** only No Numerical on Unit-V.

References:

1	B L Theraja and A K Theraja, "A Text book of Electrical Technology- Vol-I", S. Chand,
2	B L Theraja and A K Theraja, "A Text book of Electrical Technology- Vol-II", S. Chand
3.	Ashfaq Husain, Fundamental of Electrical Engineering,Dhanpat Rai & co.
4	Electrical machines D P Kothari and I J Nagrath, Tata McGraw Hill, Third Edition
5	Electrical Machinery S.K. Bhattacharya TTTI Chandigad
6	Electrical Technology Edward Hughes Pearson Education
7	Art and Science of Utilization of Electrical Energy H Pratap Dhanpat Rai and Co, Third Edition

Manufacturing Engineering-II (Theory)

Teacher and Examiner should follow the following guidelines

Unit – I

1. Teacher should facilitate learning of

Introduction to single point cutting tool, Angle & forces of single point cutting tool, Tool life & Tool wear, Measurement of cutting forces, Cutting power

1	**Theory Of Metl Cutting**		Lectures Required
	a	Introduction to single point cutting tool Cutting tool, tool geometry, Concept of cutting variables, cutting action and effect of these on cutting forces.	2
	b	Angle & forces of single point cutting tool Determination of shear angle, Merchant's circle of forces. Estimation of cutting forces.	2
	c	Tool life & Tool wear Machinability, Tool life, Tool wear, economics of metal cutting, cutting fluids.	2
	d	Measurement of cutting forces Measurement of cutting forces by Tool dynamometers, Cutting power estimation, Design of single point cutting tool.	1
	e	Cutting power Cutting power estimation, Design of single point cutting tool.	1

2. Guidelines for Paper Setters:

- Examiners should ask theoretical question on **1. a, b, c, d & e.**
- Paper Setters should ask only numerical from **1.b** on Merchant's circle of forces(Graphical method and with equation), and from **1.c** on Tool life, Economics of metal cutting

Unit – II

1. Teacher should facilitate learning of

Introduction to jigs and fixtures, Design principle, Clamping, Drill bushes Fixtures

2	**Design Of Jigs And Fixtures**		Lectures Required
	a	Introduction to jigs and fixtures Need of jigs and fixtures, Elements of jigs and fixtures.	1
	b	Design principle Design principle of jigs and fixture, Principle of location, Locating devices.	2
	c	Clamping Principle of clamping, Types of clamp.	1

	d	Drill bushes Drill bushes, Drill bushes Types, Applications, Indexing devices, Types of jigs,	2
	e	Fixtures Milling fixture Types of Milling fixture (plain string, gang and indexing), Types of turning fixtures.	2

2. Guidelines for Paper Setters:

- Examiners should ask theoretical question on **2. a, b, c, d & e.**
- Paper Setters should note that, he should ask theoretical question from **2.e** on Milling fixture only for plain string, gang and indexing fixture
- No Numerical question is to be asked on Unit-II.

Unit – III

1. Teacher should facilitate learning of

Introduction to press tool, Design of dies, Selection of die and presses.

3	**Sheet Metal Working**		Lectures Required
	a	Introduction to press tools Elementary treatment of press working, Operation on presses, Press devices and classification of presses.	2
	b	Design of dies Design of blanking, Piercing, compound, progressive, bending, forming, and drawing dies, Load calculations.	3
	c	Selection of die and presses Development of blanks, scrap strip layout, Design of punches, Selection of die sets, stock guides, strippers, pilots, stops, etc, selection of presses, capacities and other details.	3

2. Guidelines for Paper Setters:

- Examiners should ask theoretical question on **3. a, b, c.**
- Paper Setters should ask numerical only on cutting forces, Shear angles, Drawing, Strip layout, Die and punch design.

Unit – IV

1. Teacher should facilitate learning of

Introduction to broaching, Gear manufacturing, Introduction to Numerical controls and machine centers.

4	Gear Manufacturing And CNC Machine		Lectures Required
	a	Introduction to broaching Broaching, Broach tool geometry, Types of broaching machines and operations	2
	b	Gear manufacturing Gear cutting process - Forming and generations, Gear cutting, Milling, Hobbing, Gear Shaping, Shaving, lapping, Grinding.	2
	c	Introduction to Numerical controls and machine centers- Introduction to CNC machine, Comparisons with conventional machine tools, advantages and disadvantages of CNC machine, Manual part programming (Point to point part programming only)	4

2. Guidelines for Paper Setters:

- Examiners should ask theoretical question on **4. a, b, c.**
- Paper Setters should note that, he should ask part program from **4.c** on Point to point part programming only.

Unit –V

1. Teacher should facilitate learning of

Introduction to Mechanical Processes, Thermal processes, Electrochemical machining, Electric discharge machining.

5	Unconventional Machining Processes		Lectures Required
	a	Mechanical Processes Ultra sonic machining- principle and applications process parameters, abrasive and water abrasive jet machining, Mechanism of metal removal parameters involved.	2
	b	Thermal processes Electron beam machining- Generation of beam principle and applications, Laser beam machining applications, Plasma arc machining, concept and generation of plasma, principle of PAM, applications	3
	c	Electrochemical machining Classifications, fundamentals, Electromechanical milling.	1
	d	Electric discharge machining Wire EDM, Mechanism of material removal, process parameters, advantages and applications.	2

2. Guidelines for Paper Setters:

- Examiners should ask theoretical question on **5. a, b, c, d.**
- No Numerical question is to be asked on Unit-V

Reference Books:

1. Workshop technology – Raghuwanshi vol-1 &2, Dhanpatrai , New delhi.
2. Workshop technology – Hajra Choudhary vol-1 &2, Media promoters, Mumbai
3. Plastic technology- W.J. Patton
4. Manufacturing technology (Foundary forming & welding) P. N. Rao, McGraw Hill publications, New Delhi
5. Manufacturing science- Ghosh and Malik
6. P. C. Sharma, A Textbook of Production Engineering by - S. Chand & Company. Ltd.
7. P. C. Sharma, A Textbook of Production Technology by - S. Chand & Company. Ltd.
8. Production Technology- R K Jain, Khanna, publication.
9. Materials and processes in manufacturing , J T Black, Ronald A. Kosher, DeGarmos, Wiley student edition
10. Fundamental of modern manufacturing , Mikell P groover, , Wiely asia student edition
11. Manufacturing process and system , Phillip C Ostawald, jairo Munoz, , wiely india
12. Manufacturing Technology, D.K. Singh, Pearson New Delhi.
13. Manufacturing process Vol-I, H. S. Shah, Pearson New Delhi.
14. Manufacturing Engineering and Technology, Serope Kalpakjian, Pearson New Delhi.
15. Manufacturing Processes, Serope Kalpakjian, Pearson New Delhi.

Machine Drawing (Theory)

Teacher and Examiner should follow the following guidelines.

Sr. No.	Machine Drawing (Theory)	Lectures required
1	Introduction to Machine Drawing, Types of Machine Drawing, Sheet layout and Sketching - Sheet layout – Sheet sizes, Margin, Border lines, Title block , Scale and Scale drawing , Sketching and its materials.	01
2	Dimensioning – Dimensioning terms and notations, General rules for dimensioning, placing of dimensions, methods of dimensioning common features such as diameters,radii,position of holes, curved surfaces, key way, taper features, screw threads, etc.	01
3	Assembly and details of Drawing- Introduction, Types of Assembly drawing, Details of machines drawing, Accepted norms to be observed for assembly drawing, Sequences of preparing the assembly drawing, Bill of materials.	03
4	Elements of Production Drawing – Introduction to Geometric tolerances and Dimensional tolerances, Representation of Geometric tolerances and Dimensional tolerances on a drawing,	02
5	Fits- The Indian standard system of limits and fits, Types of fits, Selection of fits, Hole basis system and Shaft basis system.	02
6	Surface Roughness – Terminology for surface roughness, Machining symbols, Roughness symbols, values, and grades recommended by BIS, Representation of Surface Roughness on drawing.	02
7	Conventional Representation of machine Components -Screw Threads, springs, Gears, Bearings, etc.	01
8	Riveted joints and Welded joints- Introduction to Riveting, Forms and proportion of rivet heads, Types of riveted joints, Introduction to welded joints, Representation of welded joints.	02

Note: Teacher should guide students about fundamentals of machine drawing through classroom aids like lectures, presentations and illustrations. The same knowledge should be applied during laboratory sessions. There is no separate evaluation for theory other than machine drawing lab.

Reference Books:

1. Machine Drawing, N. D. Bhatt, Chorotar Publishing House, Anand, India.
2. Mechanical Engineering Design, J. E. Shingle & C. R. Mischke,Tata McGraw Hill Publications, New Delhi.
3. Machine Drawing, N. Sidheswar & Kannaiah, Tata McGraw Hill Publications, New Delhi.
4. Machine Drawing, N. D. Junnarkar, Pearson Education.

Machine Drawing Lab

Teacher and Examiner should follow the following guidelines.

Sr. No.	Machine Drawing Lab	Lab hours required
1	**Sheet No. 1 and 2- Assembly and Details of a machine unit.** This project consisting of a **full imperial size sheets** each involving assembly drawing with a part list, overall dimensions, and detailed drawing of couplings, bearings, lathe parts, screw jack, vices, valves, etc. manufacturing tolerances, surface finish symbols, and geometric tolerances should be specified so as to make it a working drawing.	12
2	**Sheet No. 3 and 4- Assembly and Details of a machine unit.** This project consisting of a **full imperial size sheets** each involving assembly drawing with a part list, overall dimensions, and detailed drawing of couplings, bearings, lathe parts, screw jack, vices, valves, etc. manufacturing tolerances, surface finish symbols, and geometric tolerances should be specified so as to make it a working drawing.	12
3	**Assignment:** It should contain all the machining symbols, tolerances and welding symbols, etc. **on A4 size sheet**.	04

Note: 1. All four sheets and assignment are compulsory.

2. ICA will be based on four drawing sheets and assignment submitted by the Student in the form of journal.

Reference Books:

1. Machine Drawing, N. D. Bhatt, Chorotar Publishing House, Anand, India.
2. Mechanical Engineering Design, J. E. Shingle & C. R. Mischke,Tata McGraw Hill Publications, New Delhi.
3. Machine Drawing, N. Sidheswar & Kannaiah, Tata McGraw Hill Publications, New Delhi.
4. Machine Drawing, N. D. Junnarkar, Pearson Education.

Basic Electrical Drives and Controls Lab

Teacher and Examiner should follow the following guidelines.

1. Teacher should facilitate following lab experiments:

	BASIC ELECTRICAL DRIVES AND CONTROLS		**Lab hours required**
	1	Speed control of DC Shunt motor by armature control and flux control methods. a) Determine Speed control of DC shunt Motor using Armature voltage control method. b) Determine Speed control of DC shunt Motor using Flux control method.	02
	2	Load test on DC Shunt Motor a) Determine Efficiency of DC shunt motor by using load test on DC shunt motor	02
	3	Load test on DC Series Motor a) Determine Efficiency of DC series motor by using load test on DC series motor	02
	4	Measurement of active power in a three phase balanced inductive load using two wattmeter methods. a) Calculating power using the two-wattmeter method b) Verification of the two-wattmeter method by use of a DMM c) Phasor diagram construction	02
	5	Regulation of an alternator by synchronous impedance method a)Carry OC Test b) Carry SC Test c) Calculate Synchronous impedance $Zs = \frac{Voc}{Isc}$ d) Calculate the excitation emf Eo and voltage regulation for full- load e) $Eo = \sqrt{[(V\cos\phi + Ia\,Ra)^2 + (V\sin\phi + Ia\,Xs)^2]}$ + sign is for lagging pf load. - sign is for leading pf load. V = rated terminal voltage per phase of alternator $\%Regulation = \frac{Eo - V}{V} \times 100$	02

	6	Regulation of an alternator by Direct Loading method a) Note no load voltage E b) Note full load voltage v c) $\% \text{ regulation} = \frac{E - V_t}{V_t} \times 100$	02
	7	Load Test on three Phase Induction Motor i) Set the apparatus as shown in the block diagram. ii) Set the rated line voltage, VL, and for each different value note the values of line current, IL, the total true 3-phase power, WT, and the total reactive power, Q, using measuring unit when you are applying Load on the DC Generator using Brake Control Unit. For P and Q Measurement refers to Appendix of Manual. iii) Measure the total power using the concept of 2-wattmeter method for 3-phase measurement. iv) Note the values of torque, T, the output power, Pout, and the motor speed, Nr, are measured from the brake control unit (BCU) for each value. v) Calculate the values of power factor, cos Φ, % slip and the efficiency, vi) Plot the graphs as mentioned	02
	8	Study of a) D.C. Motor Starters i) Two Ponit Starter **ii)** Three Point Starter **iii)** Four Point Starter b) Three Phase Induction Motor Starter. **i)** Auto Transformer ii) Star-Delta Starter iii) Direct on-line Starter	02

Note: All Eight experiments are compulsory.

Reference Books:

1	B L Theraja and A K Theraja, "A Text book of Electrical Technology-Vol-I", S. Chand,
2	B L Theraja and A K Theraja, "A Text book of Electrical Technology-Vol-II", S. Chand
3.	Ashfaq Husain, Fundamental of Electrical Engineering,Dhanpat Rai & co.
4	Electrical machines D P Kothari and I J Nagrath, Tata McGraw Hill, Third Edition
5	Electrical Machinery S.K. Bhattacharya TTTI Chandigad
6	Electrical Technology Edward Hughes Pearson Education
7	Art and Science of Utilization of Electrical Energy H Pratap Dhanpat Rai and Co, Third Edition

Applied Thermodynamics Lab

Teacher and Examiner should follow the following guidelines.

Teacher should facilitate following lab experiments:

1	Performance Practical [THREE]		Lab hours required
	1	**Determination of heating value of a solid / liquid fuel using Bomb Calorimeter.** Illustration of calorific value of fuel and its measurement. Preparation of experiment prior to lab like granules of fuel, fuse wires, etc. Conduction of experiment, calculations and result of experiment.	02
	2	**Exhaust gas analysis using Gas Analyzer OR Orsat Apparatus.** Illustration of dry and wet flue gas analysis. Preparation of experiment prior to lab like chemicals, availability of flue gas/exhaust gas, electricity, etc. Conduction of experiment, calculations and result interpretation of experiment.	02
	3	**Determination of Isothermal and Volumetric efficiency of reciprocating air compressor.** Illustration of Isothermal efficiency and Volumetric efficiency. Preparation of experiment prior to lab like compressor set-up, electricity, etc. Conduction of experiment, calculations and result interpretation of experiment.	02

2	Study Practical [Any FIVE]		Lab hours required
	4	**Study of boiler draught.** Study the principle, construction and working of boiler draught. Demonstrate definition, types and working of boiler draught using	02

		chart/model/multimedia. Student Activity: Discuss and compare working of different types of draught. Write down their findings in journal.	
	5	**Study of High pressure boiler.** Study the principle, construction and working of various boiler. Demonstrate construction and working of boilers using chart/model/multimedia. Student Activity: Discuss relative merits and demerits of boilers.	02
	6	**Study of Steam condensers and cooling towers.** Study the principle, construction and working of various condensers. Demonstrate construction and working of boilers using chart/model/multimedia. Student Activity: Discuss relative merits and demerits of condensers.	02
	7	**Study of Steam nozzles.** Study the principles of flow through nozzles and diffusors. Illustrate flow equations of nozzle using chart/model/multimedia.	02
	8	**Study of Steam Power Plant.** Study the principle, layout and working of Steam Power Plant. Demonstrate principle, layout and working of Steam Power Plant using chart/model/multimedia. Student Activity: Discuss working of steam power plant.	02
	9	**Visit to thermal power plant.** Study the principle, layout and working of Steam Power Plant. Demonstrate principle, layout and working of Steam Power Plant through actual visit. Student Activity: Submit an individual report of the visit, citing his own observations during the visit.	
	10	**Evaluation of Boiler efficiency by Direct and Indirect Method (Through Numerical).** Illustration of Boiler efficiency and boiler performance. Solution of select numerical to illustrate above terms to students. Teacher shall encourage students to solve numerical on their own.	02

Note:

FIVE Compulsory Assignment on **EACH** unit shall be included in the journal. Each assignment should have at least **FIVE** solved numerical. These assignments should be thoroughly conducted over tutorial sessions under teacher guidance.

References:

1	Thermodynamics: an Engineering Approach, Y A Cengel and M A Boles, Tata McGraw Hill.
2	Applied Thermodynamics for Engineering Technologists, T. D. Eastop and A. McConkey, Pearson Education India
3	Power Plant Engineering, P K Nag, Tata McGraw Hill.
4	Power Plant Technology, M. M. El-Wakil, Tata McGraw Hill.
5	Thermal Engineering, R K Rajput, Laxmi Publication New Delhi.
6	Steam & Gas Turbines & Power Plant Engineering, R. Yadav, Central Publishing House, Allahabad
7	Engineering Thermodynamics, P.K. Nag, Tata McGraw Hill
8	Course in Thermal Engineering, C. P. Kothandaraman, Domkundwar, Domkundwar S, Dhanpat Rai & Company (P) Limited.

Guide lines for ESE:-

End Semester Examination (ESE) **(Oral Exam)** will be based on practical and assignment submitted by the student in the form of journal.

Evaluation will be based on paper work.

Theory of Machines-I Lab

Teacher and Examiner should follow the following guidelines.

1. Teacher should facilitate following lab experiments:

	Theory of Machines-I Lab		Lab hours required
	1	**Drawing sheets on ICR method (2 problems), relative velocity and acceleration method (4 problems) and Klein's construction (2 problems)**	08
	2	**To study the various inversions of kinematic chains. (Assignment)**	02
	3	**To determine slip and creep for a belt-pulley combination.**	02
	4	**To determine mass moment of inertia of compound pendulum.**	02
	5	**To determine mass moment of inertia of rigid body by using bifilar or trifilar suspension method.**	02
	6	**To study the different types of clutches.(Assignment)**	02

Note: All six experiments are compulsory.

Reference Books:

1. Theory of Machines, S. S. Rattan, Tata McGraw Hill, New Delhi.
2. Theory of Mechanisms & Machines, Jagdish Lal, Metropolitan Book Co.
3. Theory of Machines, Longman's Green & Co., London.
4. Theory of Machines, W. G. Green, Blackie & Sons, London
5. Theory of Machines, V.P. Singh, Dhanpat Rai & Co.
6. Theory of Machines and Mechanisms, Shigley, J.E and Uicker, J.J, McGraw-Hill International Book Co.
7. Mechanisms and Machines theory, Rao J.S. and Dukkipati R.V, Wiley Eastern Ltd.

8. The Theory of Machines through solved problems by J.S.Rao. *New age international publishers.*
9. A text book of Theory of Machines by Dr. R. K. Bansal. *Laxmi Publications (P) Ltd*.
10. Theory of Machines by Sadhu Singh, Pearson Publication

Workshop Practice-IV

Teacher and Examiner should follow the following guidelines.

1. Teacher should facilitate following lab experiments:

		Workshop Practice IV	Lab hours required
	1	**Machine shop-II** One composite job by each student involving different machining operations on Lathe, Milling, Drilling, Shaper, Grinding Machines	10
	2	**CNC Lathe** One job for programming and manufacturing on CNC lathe machine for each student consisting operations like Turning, Thread Cutting (Internal or External), Facing, Plain turning, Taper turning, Step Turning, Chamfering, Grooving, Drilling etc. operations.	06
	3	**VMC (CNC Milling)** One job for programming and manufacturing on VMC, CNC Milling machine for each student performing drilling, tapping, milling etc	06

Note:

1. Candidates are required to finish the job to the following limits

   Machine Shop: + 0.5mm or -0.5mm

   CNC Machine: +0.01mm or -0.01mm
2. Workshop book to be submitted comprising of Job drawing, process sheet for a given job along with the sketches of tools used for operations.
3. CNC Programming restricted to class only.

2. Guide lines for ESE:-

End Semester Examination (ESE) **(Practical Examination)** will be performed based on above mention syllabus either in CNC shop or conventional machine shop. The students should perform the practical in front of the examiner. The workshop instructors will only provide the raw material, tools, and equipments to students and arrange the set up required for conducting workshop practical in CNC shop or conventional machine shop.

Examiner activities:

1. To assign the job drawing as practical to the student,
2. To check the process sheet and CNC program written by student of the assign practical.
3. To check the tool path generation of CNC tool.

4. To allow the students to enter the program in CNC.
5. To check the CNC program entered by student using graphical simulation in CNC before actual manufacturing.
6. To observe each student at the time of performing the practical in different shop.
7. To ask the questions to student at the time performing practical in related to manufacturing processes, machines, tools, tool holding devices, job holding devices, maintenance of machines and safety of machines (working, principles, construction details, advantages and disadvantages) etc.
8. Evaluation of practical examination will be based on performance of student (handling of machines, tools, equipments), job accuracy (dimension of job as per assign drawing, accuracy within given tolerances), time required to complete the job and oral examination.

Reference Books:

1. Element of Workshop Technology Volume I and II -Hajara Chaudhary and Bose S.K., Asia Publishing House.
2. Production Technology Volume I and II –P.N.Rao, Tata McGraw Hill Publication.
3. Production Technology- R.K.Jain, Khanna Publications.
4. Production Technology- P.C.Sharma, Khanna Publication.
5. Workshop Technology-Chapman W.A.J., ELBS Publication.
6. Production Technology- HMT, Tata McGraw Hill Publication.