PSN COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution)

Approved by AICTE, Affiliated to ANNA University, Accredited by NBA& NAAC and Recognized by UGC u/s 2(f)

Melathediyoor, Palayamkottai (TK), Tirunelveli (DT), Pin: 627 152

An ISO 9001:2008 Certified Institution

Department of Mechanical Engineering

B.E – MECHANICAL ENGINEERING

REGULATION-2014 (FULL TIME)

CURRICULUM

3RD SEMESTER

S.No	Course code	Course title	L	T	P	C
THEORY						
1		Applied Mathematics - II	3	1	0	4
2		Primary Manufacturing	3	0	0	3
3		Engineering Thermodynamics	3	1	0	4
4		Fluid Mechanics and Machinery	3	1	0	4
5		Solid Mechanics	3	1	0	4
6		Electrical Drives and Control	3	0	0	3
PRACTICAL						
7		Strength of Materials Lab	0	0	3	2
8		Fluid Mechanics and Machinery Laboratory	0	0	3	2
9		Electrical Engineering Laboratory	0	0	3	2
		TOTAL	**20**	**4**	**9**	**28**

4TH SEMESTER

S.No	Course code	Course title	L	T	P	C
THEORY						
1		Heat and Mass Transfer	3	1	0	4
2		Applied Mathematics - III	3	1	0	4
3		Design of Machine Elements	3	0	0	3
4		Machine Tools & Machining	3	0	0	3
5		Kinematics of Machinery	3	1	0	4
6		Electronics and Microprocessor	3	0	0	3
PRACTICAL						
7		Manufacturing Technology Lab	0	0	3	2
8		Computer Aided Machine Drawing Lab	0	0	3	2
		TOTAL	**20**	**3**	**6**	**25**

5TH SEMESTER

S.No	Course code	Course title	L	T	P	C
THEORY						
1		Probability & Statistics	3	1	0	4
2		Control Engineering	3	1	0	4
3		Thermal Engineering	3	1	0	4
4		Dynamics of Machinery	3	1	0	4
5		Engineering Materials & Metallurgy	3	0	0	3
6		Engineering Metrology & Measurements	3	0	0	3
PRACTICAL						
7		Thermal Engineering Lab – I	0	0	3	2
8		Dynamics Lab	0	0	3	2
9		Metrology & Measurements Lab	0	0	3	2
		TOTAL	**20**	**4**	**9**	**28**
Mandatory Course						
1		Renewable Sources of Energy	2	0	0	1

6TH SEMESTER

S.No	Course code	Course title	L	T	P	C
THEORY						
1		Principles of Management	3	0	0	3
2		Gas Dynamics and Jet Propulsion	3	1	0	4
3		Design of Transmission Systems	3	1	0	4
4		Automobile Engineering	3	0	0	3
5		Power Plant Engineering	3	0	0	3
6		Elective – I	3	0	0	3
PRACTICAL						
7		Design & Fabrication Project	0	0	3	2
9		Communication Skills Lab	0	0	3	2
10		CAD / CAM Lab	0	0	3	2
		TOTAL	**19**	**3**	**9**	**26**

7TH SEMESTER

S.No	Course code	Course title	L	T	P	C
THEORY						
1		Total Quality Management	3	0	0	3
2		Mechatronics	3	1	0	4
3		Integrated Design & Manufacturing	3	1	0	4
4		Finite Element Analysis	3	1	0	4
5		Elective – II	3	0	0	3
6		Elective – III	3	0	0	3
PRACTICAL						
7		Simulation & Analysis Laboratory	0	0	3	2
8		Mechatronics Lab	0	0	3	2
		TOTAL	**19**	**3**	**6**	**25**

8TH SEMESTER

S.No	Course code	Course title	L	T	P	C
THEORY						
1		Engineering Economics and Cost Analysis	3	0	0	3
2		Elective – IV	3	0	0	3
3		Elective - V	3	0	0	3
PRACTICAL						
4		Comprehension	0	0	2	1
5		Project Work	0	0	20	6
		TOTAL	9	0	22	16

ELECTIVE LIST

S.No	Course code	Course title	L	T	P	C
Elective I (6TH Semester)						
1		IC Engines &Refrigeration	3	0	0	3
2		Non Destructive Evaluation & Testing	3	0	0	3
3		Vibration & Noise Control	3	0	0	3
4		Turbo Machines	3	0	0	3
5		Quality Control & Reliability Engineering	3	0	0	3
Elective II (7TH Semester)						
1		Nuclear Engineering	3	0	0	3
2		Design of Jigs, Fixtures & Press Tools	3	0	0	3
3		Composite Materials	3	0	0	3
4		Computational Fluid Dynamics	3	0	0	3
Elective III (8TH Semester)						
1		Artificial Intelligence &Robotics	3	0	0	3
2		Process Planning & Cost Estimation	3	0	0	3
3		Pressure Vessels & Piping Design	3	0	0	3
4		Design & Analysis of Algorithms	3	0	0	3
Elective IV (8TH Semester)						
1		Professional Ethics In Engineering	3	0	0	3
2		Entrepreneurship Development	3	0	0	3
3		Maintenance Engineering	3	0	0	3
4		Operations Research	3	0	0	3
Elective V (8TH Semester)						
1		Fundamentals of Nanoscience	3	0	0	3
2		Production Planning and Control	3	0	0	3
3		Advanced I.C. Engines	3	0	0	3
4		Design of Heat Exchangers	3	0	0	3

201001	APPLIED MATHEMATICS - II	L	T	P	C
	(For all branches of B.E./B. Tech. except Marine Engg)	4	0	0	4

OBJECTIVE:

The objective of this course is to strengthen the innovative knowledge of the students on application of mathematics familiarizing on standard concepts and tools that are useful in their profession in industrial sector, corporate sector and multinational companies.

UNIT I ORDINARY DIFFERENTIAL EQUATIONS I 12

Ordinary differential equations of first order and higher degree – Higher order linear differential equations with constant coefficients – Second order linear differential equations with variable coefficients – Cauchy's and Legendre's linear equations – Applications.

UNIT II ORDINARY DIFFERENTIAL EQUATIONS II 12

Method of variation of parameters – Simultaneous linear differential equations Power series method for the solution of differential equations of order two – Solution near an ordinary point and solution near a regular singular point.

UNIT III FOURIER SERIES 12

Fourier series – Dirichlet's conditions – General Fourier series –Fourier series of periodic functions with different periods - Fourier series of Odd functions – Fourier series of even functions – Half range Fourier sine series – Half range Fourier cosine series – Root mean square value - Parseval's identity – Harmonic analysis.

UNIT IV PARTIAL DIFFERENTIAL EQUATIONS I 12

Concept of dependent and independent variables - Formation of partial differential equations – solution of partial differential equations – the four standard forms – Equations of the form f(p, q) = 0 – Clairauts equation – Equation solvable for x – Equation solvable for y – Solution of Lagrange's linear partial differential equations Pp + Qq = R.

UNIT V PARTIAL DIFFERENTIAL EQUATIONS II 12

Linear homogeneous partial differential equation of n^{th} order with constant coefficients – Non homogeneous linear partial differential equation with constant coefficients – Equations reducible to linear partial differential equations with constant coefficients.

TOTAL: 60 Periods

TEXT BOOKS:

1. Sudhir K. Pundir and Rimple Pundir, Advanced Partial Differential Equations (with boundary value problems), Pragati Prakashan publications, 3rd edition, 2010.
2. George F.Simmons, Differential Equation and its applications with Historical Notes,Tata McGraw Hill publications 3rd edition, 2006.

REFERENCE BOOKS:

1. N.P.Bali and Dr.Manish Goyal, A text book of Engineering Mathematics, Lakshmi publications, New Delhi, 8th edition, 2011.
2. B.S.Grewal, Higher Engineering Mathematics, Khanna publishers, 40th edition, 2007.
3. H.K.Dass, Engineering Mathematics, S. Chand and Company Limited, Seventh Revised Edition,1998.

OUTCOME:

At the end of this course, the student will have sufficient knowledge to tackle problems on ordinary and partial differential equations.

210001	PRIMARY MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES:

To introduce the students on the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining and metal forming and to understand the basic concepts of unconventional machining.

UNIT I METAL CASTING PROCESSES 9

Sand casting – Sand moulds - Type of patterns – Pattern materials – Pattern allowances – Types of Moulding sand – Properties – Core making – Melting furnaces – Working principle of Special casting processes – Shell, investment casting – Ceramic mould – Lost Wax process – Pressure die casting – Centrifugal casting – Defects in Casting .

UNIT II METAL JOINING PROCESSES 9

Fusion welding processes – Types of Gas welding – Equipments used – – Filler and Flux materials - Arc welding equipments - Electrodes – Coating and specifications-– Principles of Resistance welding - Submerged arc welding – TIG welding –Principle and application of special welding processes - Plasma arc welding – Thermit welding-– Electron beam welding – Weld defects.

UNIT III BULK DEFORMATION PROCESSES 9

Hot working and cold working of metals – Forging processes – Types of Forging Machines – Typical forging– Rolling of metals – Types of Rolling mills - Defects in rolled parts - Principle of rod and wire drawing -Tube drawing-Principles of Extrusion – Types of Extrusion.

UNIT IV SHEET METAL PROCESSES 9

Sheet metal characteristics - Typical shearing operations, bending and drawing operations –– Working principle and application of special forming processes - Hydro forming – Rubber pad forming – Metal spinning – Introduction to Explosive forming, Magnetic pulse forming, Peen forming, Super plastic forming.

UNIT V UNCONVENTIONAL MACHINING PROCESSES 9

Introduction – Working Principle - Electric discharge machining – Electro Chemical machining – Electrolytic Grinding – Chemical Milling – Ultrasonic machining – High energy rate forming- Other non conventional machining processes.

TOTAL: 45 Periods

TEXT BOOKS

1. S. Gowri, P. Hariharan, A. Suresh Babu, Manufacturing Technology I, Pearson Education, 2008.
2. Roy. A. Lindberg, "Process and Materials of Manufacture", PHI / Pearson Education Fourth Edition 2006.
3. Rao. P.N " Manufacturing Technology", Metal Cutting and Machine Tools, Tata Mc Graw – Hill, New Delhi, 2003.

REFERENCES

1. Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J. White. "Machine ToolPractices", Prentice Hall of India, 1998
2. HMT – Production Technology, Tata Mc Graw Hill, 1998.
3. Geofrey Boothroyd, Fundamentals of Metal Machining and Machine Tools, Mc Graw Hill, 1984.
4. Hajra Choudhury S.K and Hajra Choudhury. A.K., Elements of Workshop Technology,Volume I and II, Media Promoters and Publishers Private Limited,Mumbai, 1997.
5. Paul Degarma E, Black J.T. and Ronald A. Kosher, Elighth Edition, Materials and Processes, in Manufacturing Prentice – Hall of India, 1997.
6. Sharma, P.C., A Text book of Production Technology, S. Chand and Co. Ltd.,2004.
7. P.N. Rao, Manufacturing Technology Foundry, Forming and Welding, TMH-2003; 2nd Edition, 2003

210002	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	1	0	4

OBJECTIVE

To understand the principles of thermodynamics and to be able to use it in accounting for the bulk behavior of the simple physical systems, to provide in-depth study of thermodynamic principles, thermodynamics of state, basic thermodynamic relations, Principle of Psychrometry & Properties of pure substances and enlighten the basic concepts of vapour power cycles.

UNITI FUNDAMENTALCONCEPTS OF THERMODYNAMICS 12

Basic concepts - Thermodynamic systems - closed, open and isolated. Property, state, path and process, quasi-static process, work, modes of work, concept of continuum, macroscopic approach, Zeroth law of thermodynamics–concept of temperature and heat. Concept of ideal and real gases. First law of thermodynamics–application to closed and open systems, Thermodynamic analysis of control volume - Steady flow energy equation-unsteady flow processes -Applications.

UNITII CONCEPTS OF ENTROPY AND AVALIABILITY 12

Second law of thermodynamics–Kelvin's and Clausius statements of second law.Reversibilityandirreversibility.Carnottheorem,Carnotcycle,reversedcarnotcycle, efficiency, COP. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, Entropy generation in a closed and open system – Third law of Thermodynamics –available energy, availability in closed and open systems.

UNITIII CONCEPTS OF IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS 12

Gas mixtures–properties ideal and real gases, Avogadro's Law, Equation of state, vander walls - Dieterici - Berthelot - Redlick - kwang equations, Virial expansions, compressability factor, compressability chart–Dalton's law of partial pressure. Thermodynamic relations: Exact differentials, T-D relations, Maxwell's relations, Clausius Clapeyron equations, Joule–Thomson coefficient

UNIT IV PROPERTIESOFPURESUBSTANCEANDSTEAMPOWER CYCLE 12

Properties of pure substances –Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T,T-V,T-S,H-S diagrams, Steam formation, thermodynamic properties of steam., PVT surface, Use of steam tables and Mollier chart -Calculations of work done and heat transfer in non- flow and flow processes. Standard Rankine cycle, Reheat and regenerative cycle - dryness fraction measurement.

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UNITV PSYCHROMETRY 12

Psychrometry and psychrometric charts, property calculations of air vapour mixtures. Psychrometric process–Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling - comfort indices, Load calculations.

TOTAL: 60 Periods

TEXTBOOKS

1. P. L. Ballaney, "Thermal Engineering", Khanna Publication, 2010, Edition – 5
2. E. Rathakrishnan," Fundamentals of Engineering Thermodynamics", Prentice - hall of India, 2008, Edition
3. Nag. P.K., "Engineering Thermodynamics", Tata Mc Graw-Hill,NewDelhi,2008.
4. Cengel, 'Thermodynamics– An Engineering Approach 'Third Edition–2011Tata McGraw Hill, New Delhi.

REFERENCEBOOKS

1. Holman. J. P., "Thermodynamics", 3rd Ed. Mc Graw-Hill, 1995.
2. Venwylenand Sontag, "Classical Thermodynamics", Wiley Eastern,1987
3. Arora C.P," Thermodynamics",TataMcGraw-Hill,NewDelhi,2008.
4. Merala C, Pother, Craig W, Somerton, "Thermodynamics for Engineers", Schaum Outline Series, TataMcGraw-Hill,NewDelhi,2009.

201003	FLUID MECHANICS AND MACHINERY	L	T	P	C
	(Common to Mech, Aero and Mech. & Auto under Regulation 2014)	3	1	0	4

OBJECTIVES:

The student is introduced to the mechanics of fluids through a thorough understanding of the properties of the fluids. The dynamics of fluids is introduced through the control volume approach which gives an integrated understanding of the transport of mass, momentum and energy. To familiarized the students with conservation laws and dimensional analysis to fluid flow problems and also with flow through closed conduits and hydraulic machines

UNIT I FLUID PROPERTIES & CHARACTERISTICS 9 + 3

Basic Concept and fluid Properties - Density – Specific Weight – Specific Gravity – viscosity – surface tension – capillary rise –compressibility - Hydrostatic Law – Pressure Variation in static fluid – Hydrostatic force on a submerged plane surfaces – Location of hydrostatic force - Manometers – Simple U tube and differential manometers – Buoyancy – Meta-centric height – determination of stability of floating bodies and submerged bodies.

UNIT II EQUATIONS OF MOTION AND DIMENSIONAL ANALYSIS 9 + 3

Basic Equations of Motion - Types of fluid flow – Continuity Equation, momentum and energy equations – Euler's and Bernoulli's Equation and its applications - Orifice meter - Venturi meter - Pitot tube. Dimensional Analysis - Buckingham's ∏ Theorem – Non dimensional numbers – Similitude - Model studies.

UNIT III FLOW THROUGH PIPES 9 + 3

Laminar and Turbulent flow - Reynolds experiment – Major and minor losses in pipes – Darcy weisbach's equation and Chezy's formula – Pipes in series, parallel and branched – Total energy line – Hydraulic gradient line – Equivalent pipe.

UNIT IV HYDRAULIC TURBINES 9 + 3

Classification of hydraulic turbines – Working principle of Pelton wheel, Francis and Kaplan turbines – Velocity triangles – Work done – Specific Speed – Performance Curve for turbine -Draft tube – Hydraulic turbine characteristics.

UNIT V HYDRAULIC PUMPS **9 + 3**

Centrifugal Pumps - Definition – Operations – Velocity Triangles – Performance curves – Cavitations – Multi staging.

Reciprocating Pumps - Operation – Slip – indicator Diagram – Separation – Air vessels, and performance curve, Cavitations in pumps Rotary pumps Working Principles of gear and vane pumps.

L: 45, T: 15, TOTAL: 60 Periods

TEXT BOOKS:

1. R. K. Bansal. "Fluid Mechanics & Hydraulics Machines", 9th Edition, Laxmi Publications, 2010.
2. Modi. P. N., Seth S. M., "Hydraulics and Fluid Mechanics", Standard Book House, 2011.

REFERENCE BOOKS:

1. Kumar K. L., "Engineering Fluid Mechanics", 8th Edition, Eurasia Publication, 2010.
2. Streeter V.L. and Wylie E.B., "Fluid Mechanics ", McGraw Hill, 1983.
3. Ramamirtham S., "Fluid Mechanics, Hydraulics and Fluid Machines ", DhanpatRai & Sons, Delhi, 1988.
4. Govinda Rao N. S., "Fluid Flow Machines", 2nd Edition, Tata McGraw Hill, New Delhi, 1990, Digitized 2008.
5. Douglas. J. F., Gasiorek.J.M. , Swaffield.J.A., "Fluid Mechanics ELBS", 4th Edition, Prentice Hall, 2000.

LEARNING OUTCOMES:

Knowledge of basic principles of fluid mechanics, Ability to analyze fluid flow problems with the application of the momentum and energy equations and Capability to analyze pipe flows as well as fluid machinery.

201004	SOLID MECHANICS	L	T	P	C
	(Common to Mech, Aero and Mech. & Auto under Regulation 2014)	3	1	0	4

OBJECTIVES

To gain knowledge of simple stresses, strains and deformation in components due to external loads, to assess stresses and deformations through mathematical models of beams, twisting bars or combinations of both, to understand the effect of component dimensions and shape on stresses and deformations.

UNIT I SIMPLE STRESS AND STRAIN **9 + 3**

Rigid and Deformable bodies – Stresses; Tensile, Compressive and Shear – stresses in simple and compound bars under axial load - Elastic constants and it's relations - Thermal stress – Principle stress and strain due to combination of stresses – Mohr's circle.

UNIT II STRESSES IN BEAMS **9 + 3**

Types of beams: Supports and Loads – Shear force and Bending Moment in beams –Cantilever, Simply supported and Overhanging beams – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced – Shear stresses in beams – Shear flow.

UNIT III DEFLECTION OF BEAMS **9 + 3**

Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method, Macaulay Method, and Moment-area Method

UNIT IV TORSION & SPRINGS **9 + 3**

Stresses and strains in pure torsion of solid circular shafts and hollow circular shafts - Power transmitted by shafts subjected to combination of bending and torsion. Open and closely coiled springs under torque and moment – Laminated Spring.

UNIT V COLUMNS, THIN CYLINDERS AND SPHERES 9 + 3

Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns - Thin Cylinders and Spheres - Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.

L: 45, T: 15 Total: 60 Periods

TEXT BOOKS:

1. R.K. Bansal, "Strength of Materials", Laxmi Publication, New Delhi, 2001, Revised 5th edition, 2012.
2. Bhavikatti. S, "Solid Mechanics", Vikas Publishing House Pvt. Ltd., New Delhi, 2013

REFERENCE BOOKS:

1. Jindal U.C., "Strength of Materials", Galgotia Publication, New Delhi, II Edition, 2008.
2. Sadhu Singh, "Strength of Materials", Khanna Publishers, New Delhi, 2000.
3. Hibbler R.C., "Mechanics of Materials", Prentice Hall, New Delhi, 1994.
4. Popov Eger P., "Engineering Mechanics of solids", Prentice Hall, New Delhi, 1998.
5. Pytel A H and Singer F L, *"Strength of Materials",* Harper Collins, New Delhi.
6. Beer P F and Johson (Jr) E R, *"Mechanics of Materials",* SI Version, McGraw Hill, NY.

LEARNING OUTCOMES:

This course provides the fundamentals for the analysis of problems involving statically determinate structures; it develops understanding of stress/strain relations, behaviors of beams and columns under loads, transformations of stresses and strains & deformations of determinate beams and torsion.

209003	ELECTRICAL DRIVES AND CONTROL	L	T	P	C
	(Common to Mech and Mech. & Auto under Regulation 2014)	3	0	0	3

OBJECTIVES

To understand the basic concepts of different types of electrical machines and their performance, to study the different methods of starting D.C motors and induction motors and to study the conventional and solid-state drives.

UNIT I INTRODUCTION **9**

Basic elements of an Electrical Drive – Types of Electric Drives – factors influencing the choice of electrical drives – Advantages of electrical drive-heating and cooling curves – Loading conditions and classes of duty cycles – Selection of power rating for drive motors-selection of motor for industrial applications.

UNIT II DRIVE MOTOR CHARACTERISTICS **9**

Working principle of DC and AC motor – Characteristics of DC shunt, series and compound motor –Characteristics of three phase and single phase induction motor –Electrical Braking of DC shunt and series motor – Electrical braking of induction motor.

UNIT III STARTING METHODS **9**

Types of D.C Motor starters: Three point, Four point and Two point Starters – Three phase induction motor starters: stator resistance starter, rotor resistance starter, Auto transformer starter, star delta starter and Direct on line starter-single phase induction motors: Split phase, Capacitor Start, Capacitor start and Capacitor run and Shaded pole induction motor.

UNIT IV CONVENTIONAL SPEED CONTROL OF D.C. AND A.C. DRIVES **9**

Speed control of DC shunt and series motor – Armature and field control method, Ward- Leonard system ofspeed control - Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery schemes.

UNIT V SOLID STATE SPEED CONTROL OF D.C.AND A.C. DRIVES 9

Overview about SCR and Chopper- Speed control Using controlled rectifiers and DC choppers –applications. – Speed control Using inverters and AC voltage regulators – applications**.**

TOTAL: 45 Periods

TEXT BOOKS

1. GopalK. Dubey, "Fundamentals of Electrical drives," Narosa Publishing House, New Delhi,2013.
2. Theraja, B.L., "A Text book of Electrical Technology", Vol. II, S.Chand and Co., New Delhi, Reprint 2011.

REFERENCE BOOKS

1. VedamSubramaniam, "Electric Drives (concepts and applications)",Tata McGraw Hill, 2010
2. BimalK.Bose,"Modern Power Electronics and AC Drives", Pearson Education, Printice Hall, 2006.
3. Pillai.S.K "A first course on Electric drives", New age international, 2nd edition 2007.
4. Nagrath. I. J. & Kothari. D.P, "Electrical Machines", Tata McGraw-Hill, 4th edition, 2010.

OUTCOMES:

Upon Completion of this subject, the students can able to explain different types of electrical drives and their performance. And the conventional and solid-state drives

210101	STRENGTH OF MATERIALS LAB	L	T	P	C
		0	0	3	2

OBJECTIVE

To supplement the theoretical knowledge gained in Mechanics of Solids with practical testing for determining the strength of materials under externally applied loads. This would enable the student to have a clear understanding of the design for strength and stiffness.

LIST OF EXPERIMENTS

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
9. Effect of hardening- Improvement in hardness and impact resistance of steels.
10. Tempering- Improvement Mechanical properties Comparison
    i. Unhardened specimen
    ii. Quenched Specimen and
    iii. Quenched and tempered specimen.
11. Microscopic Examination of
    i. Hardened samples and
    ii. Hardened and tempered samples.

LIST OF EQUIPMENT (for a batch of 30 students)

1. Universal Tensile Testing machine with double 1
2. shear attachment – 40 Ton Capacity
3. Torsion Testing Machine (60 NM Capacity) 1
4. Impact Testing Machine (300 J Capacity) 1
5. Brinnell Hardness Testing Machine 1
6. Rockwell Hardness Testing Machine 1

7. Spring Testing Machine for tensile and compressive loads (2500 N) 1
8. Metallurgical Microscopes 3
9. Muffle Furnace (800^0C)

Total Hours – 45

210102	FLUID MECHANICS & MACHINERY LAB	L	T	P	C
		0	0	3	2

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Rota meter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump / submergible pump.
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

LIST OF EQUIPMENT *(for a batch of 30 students)*

1. Orifice meter setup
2. Venturi meter setup
3. Rota meter setup
4. Pipe Flow analysis setup
5. Centrifugal pump/submergible pump setup
6. Reciprocating pump setup
7. Gear pump setup
8. Pelton wheel setup
9. Francis turbine setup
10. Kaplan turbine setup

Quantity: one each.

209103 **ELECTRICAL ENGINEERING LAB**

L	T	P	C
0	0	3	2

1. Load test on DC Shunt motor
2. Load test on DC Series motor
3. Load test on DC Compound Motor
4. Speed control of DC shunt motor (Armature, Field control)
5. Swinburne's test.
6. Load test on three phase squirrel cage Induction motor
7. Load test on Single - phase Induction Motor.
8. Speed control of three phase squirrel cage Induction Motor
9. Speed control of Single - phase Induction Motor.
10. Characteristics of SCR acting as a rectifier.
11. Characteristics of MOSFET.
12. Characteristics of Chopper circuit.
13. Study of Starters for AC& DC Machine.

TOTAL: 45 Periods

REQUIREMENTS FOR A BATCH OF 30 STUDENTS

S. No.	Description of Equipment	Quantity required
1	D.C. Shunt Motor	3 Nos
2	D.C. Series Motor	1 No
3	D.C. Compound Motor	1 No
4	Three phase Induction Motor (Squirrel cage)	2 Nos.
6	Single phase Induction Motor	2 Nos.
7	Single phase Auto transformer	2 Nos.
8	Three phase Auto transformer	2 No.
9	Moving Coil Ammeter of different ranges	10 Nos.
10	Moving Coil Voltmeter of different ranges	10 Nos.
11	Moving Iron Ammeter of different ranges	10 Nos.
12	Moving Iron voltmeter of different ranges	10 Nos.
13	Wire wound Rheostats of different ratings	10 Nos.

14	Tachometers	10 Nos.
15	Single element watt meters of different ranges UPF / LPF	10 Nos.
17	Digital multi meter	5 Nos.
18	Three point starter, four point starter, DOL starter, manual star / delta starter, semi automatic and fully automatic star / delta starter	1 No each for study experiment.
19	SCR based rectifier module	1No.
20	MOSFET based step up and step down choppers	1each
21	Characteristics of MOSFET kit	1 No

HEAT & MASS TRANSFER **L P T C**

3 1 0 4

OBJECTIVES

To gather adequate knowledge of various modes of heat transfer that occurs in any physical systems, to identify the parameters that characterizes these problems and the methods to solve it in various practical systems and to analyze complex heat and mass transfer problems in any engineering systems.

UNIT I CONDUCTION **9 + 3**

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – General Differential equation of Heat Conduction – Fourier Law of Conduction – Cartesian and Cylindrical Coordinates – One Dimensional Steady State Heat Conduction – Conduction through Plane Wall, Cylinders and Spherical systems – Composite Systems - critical thickness of insulation – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Infinite and Semi Infinite Solids.

UNIT II CONVECTION **9 + 3**

Convection – Introduction, governing equations, boundary layer concept – Dimensional analysis for free and forced convection - free convection - vertical plate, horizontal cylinder and horizontal plate - forced convection – laminar flow, turbulent flow, Reynolds analogy.

UNIT III CONVECTIVE PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS **9 + 3**

Condensation and boiling – Regimes of boiling, correlations, forced convection boiling, laminar film condensation on a vertical plate - heat exchangers – LMTD and NTU analysis, fouling factor, effectiveness.

UNIT IV RADIATION **9 + 3**

Radiation – laws of radiation, black body radiation, shape factor, radiation exchange between gray surfaces, radiosity, and irradiation.

UNIT V MASS TRANSFER **9 + 3**

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

TOTAL: L 45 + T15 = 60 Periods

TEXT BOOK

1. Sachdeva, R.C., Fundamentals of Engineering Heat and Mass Transfer, New Age International, 4th edition, 2010.
2. Kothandaraman, C.P., Fundamentals of Heat and Mass Transfer, New Age International, New Delhi, 3rd edition, 2008.

REFERENCES

1. Yadav, R., Heat and Mass Transfer, Central Publishing House, 1995.
2. Ozisik, M.N., Heat Transfer, McGraw-Hill Book Co., 1994.
3. Nag.P.K. Heat Transfer, Tata McGraw-Hill, New Delhi, 3rd edition, 2011.
4. Holman, J.P., Heat and Mass Transfer, Tata McGraw-Hill, 10th edition, 2011.

LEARNING OUTCOMES:

At the end of this course students will:

- To perform the influence of conduction heat transfer and the thermal analysis based on conduction in various mechanical systems.
- Demonstrate and have the ability to recognize the characteristics of convection heat transfer in external and internal flow.
- To analyze the effect of different boiling regimes and condensation and also through the proper use of modelling can able to choose different heat exchangers for specific applications.
- To perform the impact of radiation heat transfer in different systems that involves heat transfer.
- Gather adequate knowledge regarding the various modes of mass transfer and its analogy with heat transfer.

DESIGN OF MACHINE ELEMENTS **L T P C**

3 0 0 3

OBJECTIVES:

To familiarise the various steps involved in the Design Process, to understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements and to learn to use standard practices and standard data, To learn to use catalogues for standard machine components.

UNIT I INTRODUCTION, SIMPLE STRESSES & TYPES OF LOADS 9

Introduction to the design process – Factors influencing the machine design – Selection of materials based on the physical properties.

Direct, bending and torsional stress equation – Impact and shock loading – Criteria of failure – Stress concentration factor – Size factor – Surface finish factor – Factor of safety – Design stress – Theories of failure.

Variable and cyclic loads – Fatigue strength and limit - S–N Curve – Combined cyclic stress – Soderberg and Goodman's equations.

UNIT II DESIGN OF SPRINGS & BEARINGS 9

Design of helical, leaf, disc and torsional springs under constant and varying loads.

Design of hydrodynamic journal bearings – Selection of antifriction bearings

UNIT III DESIGN OF SHAFTS, KEYS & COUPLINGS 9

Design of solid and hollow shafts based on strength and rigidity – critical speed.

Design of keys, keyways, couplings – Rigid and flexible coupling.

UNIT IV DESIGN OF JOINTS 9

Design of welded joints – Riveted joints – Threaded fasteners – Cotter joints, Knuckle joints and Pipe joints.

UNIT – V DESIGN OF ENGINE PARTS 9

Design of piston, connecting rod, crank shafts and flywheel.

Total: 45 Periods

TEXT BOOK

1. T.V. Sundrarajamoorthy & Shanmugam, Machine Design, Anuradha Publications Reprint 2010.
2. V.B. Bandari., Design of Machine Elements, McGraw-Hill, 3rd edition, 2011

REFERENCES

1. Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
2. Shigley, J.E., and Mischke, C.R., Mechanical Engineering Design, McGraw-Hill International, eighth edition, 2008.
3. Deutschman, D., Michels, W.J., and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
4. Spottes, M.F., Design of Machine Elements, Prentice-Hall India, 1994.
5. R.L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998.

LEARNING OUTCOMES:

At the end of the course the students will be able to:

- This course will familiarize the various steps involved basic design process in the engineering field.
- To understand the principals involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data.
- Identify loading of machine elements and perform stress and deformation calculations to design safe machine parts.
- To learn to use catalogues and to develop standard machine components.

MACHINE TOOLS & MACHINING **L T P C**

3 0 0 3

OBJECTIVE

To understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and broaching To understand the basic concepts of computer numerical control (CNC) machine tool and CNC programming.

UNIT I THEORY OF METAL CUTTING 9

Introduction - Material removal processes, types of machine tools – Theory of metal cutting – Single point tool nomenclature - Chip formation - Orthogonal cutting - Cutting tool materials - Tool wear - Tool life - Surface finish - Cutting fluids.

UNIT II CENTRE LATHE AND SPECIAL PURPOSE LATHES 9

Centre lathe - Constructional features - Various operations: taper turning methods, thread cutting methods - Special attachments - Machining time and power estimation. Capstan and turret lathes –Turret Indexing mechanism, Bar feed mechanism.

UNIT III ABRASIVE PROCESSES 9

Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding – honing, lapping, super finishing, polishing and buffing – Dressing & truing of grinding wheels – Mounting of grinding.

UNIT IV DRILLING & MILLING 9

Hole making: Quill Mechanism, Reaming, Boring, Drilling Machines – Types, tools and operations – Milling: Types, milling cutters, operations - Index head and indexing Mechanism, Simple, compound and differential indexing – angular indexing.

UNIT V GEAR MANUFACTURING, CUTTING & GENERATING PROCESSES AND GEAR FINISHING METHODS 9

Gear Casting - Gear Cutting Methods, Gear Shaper – Gear Hobbing Machine – Gear Broaching – Gear Extrusion – Simple Gear Cutting – Helical Gear Cutting and Bevel Gear Cutting using Indexing Head – Gear Generating Methods - Gear Finishing Process: Gear Honing, Gear lapping, Gear Polishing and Gear Buffing – Super finishing of Gears.

TOTAL: 45 Periods

TEXT BOOKS

1. Hajra Choudry, "Elements of Work Shop Technology – Vol. II", Media Promoters, 2007.
2. HMT – "Production Technology", Tata McGraw-Hill, 2004.

REFERENCE BOOKS

1. Rao, P.N. "Manufacturing Technology", Metal Cutting and Machine Tools, Tata McGraw–Hill, New Delhi, 2009.
2. P.C. Sharma, "A Text Book of Production Engineering", S. Chand and Co. Ltd, IV edition, 2008.
3. P.N.Rao, 'CAD/CAM Principles and Applications', TATA Mc Craw Hill, 2010.
4. M.P.Groover and Zimers Jr., 'CAD/CAM' Prentice Hall of India Ltd., 2008.
5. Rajput R.K, 'A text book of Manufacturing Technology', Lakshmi Publications, 2007.
6. Mikell P. Groover, 'Fundamentals of Modern Manufacturing, Materials, Processes and Systems', John Wiley and Sons, 9th Edition,2010.

LEARNING OUTCOMES:

- Gain an understanding and appreciation of the breadth and depth of the field of manufacturing.
- Understand the concepts and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and broaching.
- Understand the basic concepts of computer numerical control (CNC) machine tool and CNC programming.
- To become familiar with Surface Finishing Processes.

KINEMATICS OF MACHINERY **L T P C**

3 1 0 4

OBJECTIVES:

To understand the concept of machines, mechanisms and related terminologies, to analyze a mechanism for displacement, velocity and acceleration at any point in a moving link, to understand the theory of gears, gear trains and cams and to understand the role of friction in drives and brakes.

UNIT I BASICS OF MECHANISM **9 + 3**

Definitions – Link, Kinematic pair, Kinematic chain, Mechanism, and Machine. – Degree of Freedom – Mobility - Kutzbach criterion (Gruebler's equation) - Grashoff's law- Kinematic Inversions of four-bar chain and slider crank chain - Mechanical Advantage- Transmission angle. Description of common Mechanisms - Offset slider mechanism as quick return mechanisms, Pantograph, Straight line generators (Peaucellier and Watt mechanisms), Steering gear for automobile, Hooke's joint, Toggle mechanism, Ratchets and escapements – Indexing Mechanisms.

UNIT II KINEMATIC ANALYSIS OF LINKAGES **9 + 3**

Analysis of simple mechanisms (Single slider crank mechanism and four bar mechanism) - Graphical Methods for displacement, velocity and acceleration; Shaping machine mechanism - Coincident points – Coriolis acceleration - Analytical method of analysis of slider crank mechanism and four bar mechanism. Approximate analytical expression for displacement, velocity and acceleration of piston of reciprocating engine mechanism.

UNIT III KINEMATICS OF CAMS **9 + 3**

Classifications - Displacement diagrams – Uniform Velocity, Uniform acceleration & retardation, Simple harmonic and Cycloidal motions – Graphical construction of displacement diagrams and layout of plate cam profiles - circular arc and tangent cams - Pressure angle and undercutting.

UNIT IV GEARS **9 + 3**

Classification of gears – Gear tooth terminology - Fundamental Law of toothed gearing and involute gearing – Length of path of contact and contact ratio - Interference and undercutting - Gear trains – Simple, compound and Epicyclic gear trains - Differentials.

UNIT V FRICTION 9 + 3

Dry friction – Pivot and collar friction - Plate clutches - Belt and rope drives - Block brakes, band brakes.

TOTAL: L 45 + T15 = 60 Periods

TEXT BOOK:

1. R.S. Khurmi and J.K. Gupta., Theory of Machines, Chand Publishing Company, New Delhi, updated Edition & Reprint 2010.

REFERENCES:

1. Shigley, J.E., and Uicker, J.J., Theory of Machines and Mechanisms, McGraw-Hill, New Delhi, 1995.
2. Rattan, S.S., Theory of Machines, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 3RD edition, 2009.
3. Thomas Bevan, Theory of Machines, CBS Publishers and Distributors, 3rd Edition, London, 1984.
4. Ghosh, A., and Mallick, A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd., New Delhi, 1988.
5. Rao, J.S., and Dukkipati, R.V., Mechanism and Machine Theory, Wiley-Eastern Ltd., New Delhi, 1992.

Learning outcomes:

At the end of the course the students will be able to:

- Understand the basic concepts of Mechanisms, Machines and their relative motions, then apply it to appropriate environments.
- Carry out kinematic analysis (Displacement, Velocity and Acceleration) of simple mechanisms (Single slider Crank Mechanism and four bar Mechanisms) by graphical and analytical method.
- Construct & Design different CAM profiles for given conditions using graphical & Theoretical methods.

- Understand basic terminologies and apply laws and principles of gears and gear trains.
- Acquire knowledge of friction in various mechanical components and apply it in different situations.

MANUFACTURING TECHNOLOGY LABORATORY **L T P C**

0 0 3 2

OBJECTIVES:

To give practical hands on exposure to students in the various metal cutting operations using commonly used machine tools such as shaper, planner, drilling machine, milling machines, grinding, to know measurements in metal cutting experiments and to have the knowledge in Assembling of Machined Components for different fits.

LIST OF EXERCISES:

1. Studies on the components and working principle of special machines.
2. To make a cube from round block using shaper machine.
3. To make internal keyway using slotter machine.
4. To make a hole in different sizes using drilling machine and apply Reaming and Taping operation on them.
5. To make a spur gear using milling machine.
6. To make a finished surface using surface grinding machine.
7. To do cylindrical grinding operation on a round rod/ square rod.
8. To make any simple component using lathe involving facing, turning and step turning.
9. To make a bush with boring operation using lathe.
10. To make a stud with external thread cut using lathe.

TOTAL: 45 Periods

LIST OF EQUIPMENTS: (For a batch of 30 students)

1. Centre Lathes - 10 Nos.
2. Horizontal Milling Machine - 1 No.
3. Surface Grinding Machine - 1 No.
4. Cylindrical Grinding Machine - 1 No.
5. Shaper - 1 Nos.
6. Slotter - 1 No.
7. Radial Drilling Machine - 1 No.

LEARNING OUTCOMES:

- Students have the practical knowledge in preparing Tapping, Reaming, and Gear Milling, to have skill in Surface grinding, Cylindrical grinding in

an industry and Knowledge to assemble various Machined Components for different fits.

COMPUTER AIDED MACHINE DRAWING LABORATORY **L T P C**

0 0 3 2

OBJECTIVE

To make the students understand and interpret drawings of machine components so as to prepare assembly drawings either manually and using standard CAD packages and to familiarize the students with Indian Standards on drawing practices and standard components

.

DRAWING STANDARDS

Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, and fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc.

2-D DRAWINGS

Limits, Fits – Tolerancing of individual dimensions- Specification of Fits- Manual Preparation of production drawings and reading of part and assembly drawings.

CAD PRACTICE (USING APPLICATION PACKAGES)

Drawing, Editing, Dimensioning, Plotting Commands, Layering Concepts, Hatching, Detailing, Assembly, basic principles of GD&T (geometric dimensioning & Tolerancing)

ASSEMBLY DRAWING (MANUAL & USING APPLICATION PACKAGES)

Manual parts drawing and preparation of assembled views given part details for components followed by practicing the same using CAD packages. Suggested Assemblies: Shaft couplings – Plummer block – Screw jack- Lathe Tailstock – Universal Joint – Machine Vice – Stuffing box- safety Valves - Non-return valves- Connecting rod –Piston and crank shaft- Multi plate clutch- Preparation of Bill of materials and tolerance data sheet

TOTAL: 45 Periods

Use of standard CAD application packages is recommended from the point of view of requirement by industries. However to encourage our national efforts in

indigenous development of software packages with focus on open source, students may be encouraged to work with "CollabCAD Software", developed by: National Informatics Centre (CAD Group), Govt. of India, A-Block, C.G.O. Complex, Lodhi Road, New Delhi 110003, 2003" www.collabcad.com

REFERENCE BOOKS

1. BHATT.N.D. and PANCHAL. V. M., "Machine Drawing", Charotar Publishing House, 388001, 38th Edition, 2003.
2. P.S.G. Design Data Book
3. Luzadder, Warren.J. & Duff, Jon. M. "Fundamentals of Engineering Drawing", Prentice Hall India Pvt. Ltd., Eastern Economy Edition, Eleventh Edition,

List of Equipment (For a Batch of 30 Students)

1. **Computer System 30,** 17" Graphics Terminal, Pentium IV Processor, 80 GB HDD,512 MB RAM, Advanced graphics, accelerator
2. **Laser Printer 01**
3. **Plotter (A2 size) 01**

Software: 30 seats of latest/ recent versions of AutoCAD/ CATIA/ SOLIDWORKS/ SOLID EDGE/NX/PRO-E/COLLABCAD or equivalent software

THERMAL ENGINEERING **L T P C**

3 1 0 4

OBJECTIVE:

To make the student understand the big picture of applied thermodynamics through topics such as Power cycles, IC Engines, Steam nozzles & turbines, air compressors and RAC. This subject enables the students to understand the principle of operation, construction and control of several thermal equipments which find wide applications in a variety of fields like power generation, automobile industry, process industries, food preservation and human comfort. It provides the fundamentals for Power plant Engineering, Automobile Engineering, Turbo machinery, Advanced IC engine design and Refrigeration & Air conditioning (RAC).

UNIT I GAS POWER CYCLES 9+3

Otto, Diesel, Dual & Brayton cycles-Actual and theoretical PV and TS diagrams, Calculation of mean effective pressure, air Standard efficiency, maximum and minimum temperatures, thermal efficiencies, power developed, heat supplied and heat rejected – comparison of Otto, Diesel & dual combustion cycles.

UNIT II INTERNAL COMBUSTION ENGINES 9+3

Classification - Components and their function - Valve timing diagram and port Timing diagram Comparison of two stroke and four stroke engines – Carburettor and ignition system - Diesel pump and injector system - Lubrication system and cooling system. Performance calculation – Performance curves.

UNIT III STEAM NOZZLES AND TURBINES 9+3

Flow of steam through nozzles, shapes of nozzles, nozzle efficiency, critical pressure ratio, super saturated flow - Classifications of steam turbines, Impulse and Reaction principles, velocity diagram for simple and multi-stage turbines, steam turbine governing and control.

UNIT IV AIR COMPRESSOR 9+3

Classification and working principle of various types of compressors, work of compression with and without clearance, Volumetric efficiency, Isothermal

efficiency and Isentropic efficiency of reciprocating compressors, Multistage air compressor and inter cooling –work of multistage air compressor.

UNIT V REFRIGERATION AND AIR CONDITIONING 9+3

Fundamentals of refrigeration – Simple- vapour compression and vapour absorption system – Factor affecting the performance of vapour compression system – Refrigerants – properties - Introduction to air conditioning systems – air conditioning processes.

TOTAL: L 45 +T 15 = 60 Periods

TEXT BOOKS:

1. Rajput. R. K., "Thermal Engineering" Laxmi publications, 9th edition, 2013.
2. Kothandaraman.C.P., Domkundwar.S, Domkundwar.A.V.,"A course in thermal engineering," Dhanpatrai & sons, Fifth edition, 2011

REFERENCES:

1. Arora. C.P, "Refrigeration and Air Conditioning", Tata McGraw-Hill Publishers, 2000.
2. Ganesan. V," Internal Combustion Engines", Third Edition, Tata McGraw-Hill 2007.
3. Rudramoorthy, R, "Thermal Engineering", Tata McGraw-Hill, New Delhi, 2003.
4. Sarkar, B.K, "Thermal Engineering", Tata McGraw-Hill Publishers, 2007

LEARNING OUTCOMEs:

At the end of this course students will:

- Able to do thermodynamic analysis of cycles.
- Understand the construction, operation and performance of different IC engines.
- Analyse and design different steam nozzles/turbines.
- Analyse and design different reciprocating air compressors.
- Analyse and design different RAC systems

DYNAMICS OF MACHINERY **L T P C**

3 0 0 3

OBJECTIVES:

To understand the method of static force analysis and dynamic force analysis of mechanisms, to study the undesirable effects of unbalances in rotors and engines, to understand the concept of vibratory systems and their analysis and to understand the principles of governors and gyroscopes.

UNIT I FORCE ANALYSIS AND FLYWHEELS 9+3

Static force analysis of mechanisms – D ' Alembert's principle - Inertia force and Inertia torque – Dynamic force analysis - Dynamic Analysis in Reciprocating Engines – Gas Forces - Equivalent masses - Bearing loads - Crank shaft Torque– Engine shaking Forces - Turning moment diagrams – Fluctuation of Energy and speed – Energy stored in Flywheel – Mass of Flywheel-– Dimensions of Flywheel

UNIT II BALANCING 9+3

Balancing – Static and Dynamic Balancing of Rotating Masses - Balancing of several masses rotating in same plane and in different planes - Partial Balancing of locomotives – Variation of tractive force - Hammer blow and swaying couple – Balancing of primary and secondary forces in In-line engines.

UNIT III VIBRATIONS 9+3

Basic features of vibratory systems - Basic elements and lumping of parameters -Degrees of freedom - Single degree of freedom - Free vibration - Equations of motion -natural frequency - Types of Damping - Damped free vibration – Whirling of shafts and critical speed - Torsional systems- Forced Vibration - Force transmissibility and amplitude transmissibility -Vibration isolation.

UNIT IV GOVERNORS 9+3

Types of Governors – Terms used in Governors - Centrifugal governors –Watt Governor – Porter Governor – Proell Governor – Hartnell Governor – Wilson Hartnell Governor – Hartung Governor –Hunting – Effort and power of Porter Governor - Controlling Force diagram for Porter Governor – Controlling Force diagram for spring controlled Governor – Sensitivity of Governors – Stability of Governors.

UNIT V GYROSCOPES 9+3

Gyroscopes - Gyroscopic couple – Effect of Gyroscopic couple on an Aeroplane - Effect of Gyroscopic couple on Naval Ship during steering, pitching and Rolling – Stability of four wheel drive moving in a curved path - Stability of two wheel vehicle taking a turn – Effect of Gyroscopic Couple on a disc fixed rigidly at a certain angle to a Rotating Shaft.

TOTAL: 45 + 15 Periods

TEXT BOOKS

1. S S Rattan, "Theory of Machines", Tata Mc Graw Education Pvt, Limited Hill, 2nd Reprint, 2009.
2. R.S. Khurmi and J.K. Gupta., Theory of Machines, Chand Publishing Company, New Delhi, updated Edition & Reprint 2010.

REFERENCE BOOKS

1. Sadhu Singh "Theory of Machines" Pearson Education, 2002.
2. Ashok G. Ambekar, "Mechanism and Machine Theory", PHI Learning Private limited 2009.
3. Singh V.P, "Mechanical Vibrations", 3rd Edition, Dhanpatrai & Co., 2006.
4. Grover G.K, "Mechanical Vibrations", 3rd Edition, Nemchand & Brothers 2006

LEARNING OUTCOMEs:

At the end of the course the students will be able to:

- Understand and conduct static and dynamic force analysis of Mechanisms.
- Apply the concept of balancing and use it for reducing the unbalanced forces in rotating masses and reciprocating engines under operating conditions exposure to IS standards.
- Acquire knowledge on types of vibrations in different systems.
- Apply different damping methods to minimize vibrations using IS standards.
- Understand, apply and analyze the control mechanisms in Governors and Gyroscopes.

ENGINEERING MATERIALS AND METALLURGY **L T P C**

3 0 0 3

OBJECTIVE

To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for various engineering applications.

UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectoid, eutectic, peritectic, and peritectroid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and cast Iron, microstructure, properties and applications.

UNIT II HEAT TREATMENT 9

Definition – Full annealing, stress relief, recrystallisation and spheroidizing – normalising, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on TTT diagram, CCR - Hardenability, Jominy end quench test – Austempering, martempering – case hardening - carburising, nitriding, cyaniding, carbonitriding, flame and induction hardening.

UNIT III FERROUS AND NON FERROUS METALS 9

Effect of alloying elements on steel (Mn, Si, Cr, Mo, V, Ti & W) - stainless and tool steels– HSLA - Maraging steels – Cast Irons - Grey, White malleable, spheroidal – Graphite, Alloy cast irons, Copper and Copper alloys - Brass, Bronze and Cupronickel – Aluminium and Al-Cu alloy – precipitation hardening– Bearing alloys.

UNIT IV NON-METALLIC MATERIALS 9

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE Polymers – Urea and Phenol Formaldehydes – Engineering Ceramics – Introduction to Fibre reinforced plastics.

UNIT V MECHANICAL PROPERTIES AND TESTING 9

Mechanism of plastic deformation, slip and twinning – Types of fracture – Mechanical Properties – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Impact test - Izod and Charpy, Fatigue and creep tests, fracture toughness tests.

Total: 45 Periods

TEXT BOOKS

1. Kenneth G.Budinski and Michael K.Budinski "Engineering Materials" Prentice-Hall of India Private Limited, 4th Indian Reprint 2002.

REFERENCE BOOKS

1. William D Callister "Material Science and Engineering", John Wiley and Sons 2007.
2. Raghavan.V "Materials Science and Engineering", Prentice Hall of India Pvt., Ltd., 2007.
3. Sydney H.Avner "Introduction to Physical Metallurgy" McGraw Hill Book Company, 2007.
4. Dieter G. E., Mechanical Metallurgy, Mc Graw Hill Book Company, 1988.
5. O.P. Khanna, A text book of Materials Science and Metallurgy, Khanna Publishers, 2003.
6. Vijaya. M.S. and G. Rangarajan, Material Science, Tata McGraw-Hill , 2007

LEARNING OUTCOMES:

By studying this subject, students can be able

- To know the microstructure analysis using sophisticated techniques like SEM.
- To have the knowledge in the classification, properties, processing methods and applications for various ferrous and non-ferrous metals, polymers, ceramics and composites.
- To identify the various mechanical properties for the above said materials using sophisticated facilities.
- To have a great exposure in doing heat treatment and their purpose in the engineering applications.

ENGINEERING METROLOGY AND MEASUREMENTS **L T P C**

3 0 0 3

OBJECTIVE:

To impart knowledge on basic principles of instrumentation and metrology, to study the working principle of metrological instruments, to become an expert in the field of measurements and to inculcate the knowledge of various types of measuring instruments and its applications.

UNIT I CONCEPT OF MEASUREMENT 9

General concept – Generalized measurement system-Units and standards-measuring instruments: sensitivity, stability, range, accuracy and precision-static and dynamic response-repeatability-systematic and random errors-correction, calibration - Introduction to Dimensional and Geometric Tolerancing - interchangeability,

UNIT II LINEAR AND ANGULAR MEASUREMENT 9

Definition of metrology-Linear measuring instruments: Vernier, micrometer, Slip gauges and classification, - Tool Makers Microscope - interferometery, optical flats - Comparators: limit gauges Mechanical, pneumatic and electrical comparators, applications. Angular measurements: -Sine bar, Sine center, bevel protractor and angle Decker.

UNIT III FORM MEASUREMENT 9

Measurement of screw threads: Thread gauges, floating carriage micrometer-measurement of gear tooth thickness: constant chord and base tangent method-Gleason gear testing machine – radius measurements-surface finish: equipment and parameters, straightness, flatness and roundness measurements.

UNIT IV ADVANCES IN METROLOGY & MEASUREMENTS 9

Precision instruments based on laser-Principles- laser interferometer-application in measurements and machine tool metrology- Coordinate

measuring machine (CMM): need, construction, types, applications.- computer aided inspection.

UNIT V MEASUREMENT OF MECHANICAL PARAMETERS 9

Force, torque, power:-mechanical, pneumatic, hydraulic and electrical type- Pressure measurement - Flow: Venturi, orifice, rotameter, pitot tube – Temperature: bimetallic strip, thermocouples, pyrometer, electrical resistance thermistor.

TOTAL: 45 Periods

TEXT BOOKS:

1. Alan S. Morris, "The Essence of Measurement", Prentice Hall of India, 2011.
2. Jain R.K., "Engineering Metrology", Khanna Publishers, 2010.

REFERENCES:

1. Gupta S.C, "Engineering Metrology", Dhanpatrai Publications, 2008.
2. Jayal A.K, "Instrumentation and Mechanical Measurements", Galgotia Publications 2005.
3. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education,
   2006.
4. Donald Deckman, "Industrial Instrumentation", Wiley Eastern, 2005.

LEARNING OUTCOME:

- To understand the basic principles of measurements
- To learn the various linear and angular measuring equipments, their principle of operation and applications
- To learn about various methods of measuring Mechanical parameters

THERMAL ENGINEERING, REFRIGERATION & AIR CONDITIONING LAB

L T P C

0 0 3 2

OBJECTIVE:

- To impart knowledge about basic thermal equipments

LIST OF EXPERIMENTS

1. Valve Timing Diagrams
2. Port Timing Diagrams
3. Performance Test on 4-stroke Diesel Engine
4. Determination of Viscosity – Red Wood Viscometer.
5. Determination of Flash Point and Fire Point.
6. Determination of COP of a refrigeration system
7. Experiments on Air-Conditioning system
8. Performance test on two stage reciprocating air compressor.
9. Thermal conductivity measurement on metal bar.
10. Natural convection heat transfer from a vertical cylinder
11. Forced convection inside tube
12. Determination of emissivity of a grey surface.
13. Effectiveness of Parallel/counter flow heat exchanger.
14. Study of Steam Generators and Turbines.

TOTAL: 45 Periods

LIST OF EQUIPMENTS (for a batch of 30 students)

EQUIPMENTS	QUANTITY
I.C Engine – 2 stroke and 4 stroke model	1 set
Red Wood Viscometer	1 No.
Apparatus for Flash and Fire Point	1 No.
4-stroke Diesel Engine with mechanical loading.	1 No.
Steam Boiler with turbine setup	1 No.
Natural convection-vertical cylinder apparatus	1 No.
Forced convection inside tube apparatus	1 No.
Thermal conductivity measurement apparatus	1 No.

Emissivity measurement apparatus	1 No.
Parallel/counter flow heat exchanger apparatus	1 No.
Two stage reciprocating air compressor	1 No.
Refrigeration test rig	1 No.
Air-conditioning test rig	1 No.

DYNAMICS LAB **L T P C**

0 0 3 2

OBJECTIVES:

To supplement the principles learnt in kinematics and Dynamics of Machinery and to understand the measuring devices are used for dynamic testing.

LIST OF EXPERIMENTS

1. Study of gear parameters.
2. Determination of Mass moment of inertia of Fly wheel and Axle system.
3. Motorized gyroscope – Study of gyroscopic effect and couple.
4. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
5. Cams – Cam profile drawing.
6. Cams- Motion curves and study of jump phenomenon.
7. Single degree of freedom Spring Mass System – determination of natural Frequency and verification of Laws of springs – Damping coefficient determination.
8. Vibration of Equivalent Spring mass system – Undamped and damped vibration.
9. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
10. Balancing of rotating masses.
11. Balancing of reciprocating masses.
12. Determination of transmissibility ratio using vibrating table.

Students should be familiar with the use of the following device/Equipments depending upon availability.

Tachometers – Contact and non contact, Dial gauge, Stroboscope, Accelerometers Vibration pickups Displacement meters, Oscilloscope Vibration Shaker, F.F.T. Analyzer, and Dynamic Balancing Machine.

TOTAL:

45 Periods

LEARNING OUTCOMES:

Students will be able to:

Analyze various types of transmission, apply balancing in machine systems, analyze various types of CAMS and gears, analyze the various types of vibration in beams and analyze the kinetics of practical mechanisms.

METROLOGY & MEASUREMENTS LAB **L T P C**

0 0 3 2

OBJECTIVE:

- To impart knowledge about basic Measuring Instruments.

LIST OF EXPERIMENTS

- Calibration of Vernier / Micrometer / Dial Gauge Checking Dimensions of part using slip gauges Measurements of Gear Tooth Dimensions
- Measurement of Angle using sine bar / sine center / tool makers microscope Measurement of straightness and flatness
- Measurement of thread parameters
- Setting up of comparators for inspection (Mechanical / Pneumatic / Electrical) Measurement of Temperature using Thermocouple / Pyrometer Measurement of Displacement
- Measurement of Force Measurement of Torque Measurement of Vibration / Shock

TOTAL: 45 Periods

LIST OF EQUIPMENTS: (For a batch of 30 students)

Micrometer	5
Vernier Caliper	5
Vernier Height Gauge	2
Vernier depth Gauge	2
Slip Gauge Set	1
Gear Tooth Vernier	1
Sine Bar	1
Sine Center	1
Bevel Protractor	1
Floating Carriage Micrometer	1
Profile Projector / Tool Makers Microscope	1
Mechanical / Electrical / Pneumatic	1
Autocollimator	1
Temperature Measuring Setup	1
Displacement Measuring Setup	1
Force Measuring Setup	1
Torque Measuring Setup	1
Vibration / Shock Measuring Setup	1