Shri Guru Gobind Singhji Institute of Engineering and Technology, Nanded

Department of Production Engineering

Syllabus- B.Tech Production Engineering

From 2015-16

Shri Guru Gobind Singhji Institute of Engineering & Technology, Nanded

SY B.Tech (Production)

From Batch 2015-16

Semester III						
Course Code	Course Title	Lectures (L)	Tutorials (T)	Practical (P)	Credits	
					Th.	Pr.
PR 232	Strength of Materials	03	01	02	04	01
PR 233	Thermal Engineering- I	03	01	02	04	01
PR 231	Casting and Welding	04	--	02	04	01
PR 243	Engineering Metallurgy	03	--	02	03	01
PR 245	Machine Drawing and CADD	02	--	02	02	01
HS221	Professional Communication	02	--	02	02	01
	Total	17	02	12	25	
Semester IV						
Course Code	Course Title	Lectures (L)	Tutorials (T)	Practical (P)	Credits	
					Th.	Pr.
MA203	Mathematics III	04	--	--	04	--
PR 242	Theory of Machines	04	--	02	04	01
PR 244	Thermal Engineering- II	03	--	02	03	01
PR 251	Mech. Measurements & Metrology	04	--	02	04	01
PR 234	Machining Processes	03	--	--	03	--
PR 236	Manufacturing Lab. -I	--	--	02	--	01
HS222	Human Values and Professional Ethics	02	--	--	02	--
	Total	20	--	08	24	

STRENGTH OF MATERIALS
(CREDITS THEORY-04, PRACTICAL-01)

Course Code: PR 232 **Contact Hours: Th. 03 T- 01 Pr. 02**

Course Objectives:

- To understand the fundamental concepts.
- To predict behavior of material under different loading conditions.
- To study the factors that affects the design of a mechanical component.
- To utilize fundamental concept and knowledge of the subject in practice.

Evaluation Scheme:

Theory	Mid Term Examination	30 Marks
	End Term Examination	70 Marks
Term work/ Practical	Continuous Evaluation	50 Marks
	External Viva-voce	50 Marks

Course contents:

STRESS AND STRAIN, STRESS-STRAIN RELATIONSHIP AND ELASTIC CONSTANTS, THERMAL STRESSES:

Types of loads, Simple stresses & strains, viz. tensile, compressive, Shear, Crushing, Thermal stresses, Hoop stresses & corresponding strains, Volumetric Strain, Bulk modulus, Hook's law, Young's modulus, Modulus of Rigidity, stress-strain curves for ductile & brittle materials, Poisson's ratio.

MOHR'S CIRCLE FOR PLANE STRESS AND PLANE STRAIN:

Definition of principal plane & principal stresses, Expression for normal and tangential stress, maximum shear stress, Stresses on inclined planes, Position of principal planes & planes of maximum shear, Graphical solution using Mohr's circle

THIN CYLINDERS:

Concept of stresses & strains in thin cylindrical & spherical shells subjected to internal pressure.

SHEAR FORCE AND BENDING MOMENT DIAGRAMS:

Shear force, bending moment & relation between them, Shear force & bending moment diagrams for simply supported beam & cantilevers subjected to point loads & Uniformly distribution load, concept of Uniformly varying load & couples acting on beam, Location of point of contra-flexure.

BENDING AND SHEAR STRESSES:

Theory of simple bending, equation of bending, Assumptions in the theory of bending, moment of resistance, section modulus & neutral axis, Shear stresses – concepts of direct & transverse shear stress , flitch beam

COMBINATION OF BENDING & DIRECT STRESSES:

Axial load, eccentric load, direct stresses, bending stresses maximum & minimum stresses.

Application of the above concepts for machine parts such as offset links, C-clamp, Bench vice, Drilling machine frame, stresses at base of a short column, condition for no tension at extreme fibers, total stress variation diagrams.

DEFLECTION OF BEAMS:

Concepts of Deflection of beams – relation between bending moment & slope, Deflection of simply supported beams and cantilever beams subjected to point load.

TORSION OF CIRCULAR SHAFTS:

Concept of Pure Torsion, Torsion equation for solid and hollow circular shafts, Assumptions in theory of pure Torsion, Comparison between Solid and Hollow Shafts subjected to pure torsion

COLUMNS:

Concepts of Buckling – Rankine's & Euler's formulae for buckling load for columns / shafts under compression, concepts of equivalent length for various end conditions.

STRAIN ENERGY:

Concept, derivation & use of expression for deformation of axially loaded members under gradual, sudden & impact load, Strain energy due to self-weight.

TERM WORK:

The term work shall consist of assignments on the syllabus and the following laboratory tests on the mechanical properties of material.

1. Tension test on ductile material.
2. Bending test on different materials like steel, aluminum.
3. Shear test.
4. Torsion test.
5. Hardness test.
6. Impact test.

Text and Reference Books:

1. R. Ramamrutham, Strength of Materials, 14th Edition, Dhanpat Rai Publications, New Delhi.
2. F. L. Singer and A. Pytel, Strength of Materials, 3rd Ed., Harper & row Publishers, New York.
3. Timoshenko and Young, Engineering Mechanics, Tata McGraw Hill, New Delhi
4. Dr.R.K.Bansal, Strength of Materials, 5th Edition, Laxmi Publications-New Delhi
5. R. L. Mott, Applied Strength of Materials, 4th Ed., Prentice Hall of India, New Delhi
6. E. Popov, Mechanics of Materials, Prentice Hall of India, New Delhi

Course Outcomes:

On successful completion of this course, Students should be able to;

- Define, compute and describe properties of engineering material, their behavior.
- Compute stresses and strains using analytical and graphical methods.
- Gain the knowledge of critical loads, buckling of beams, strain energy concept and torsion of shafts.
- Analyze beams and columns under different loading and supporting conditions.

THERMAL ENGINEERING - I
(CREDITS THEORY-04, PRACTICAL-01)

Course Code: PR 233 **Contact Hours: Th. 03 T – 01 Pr. 02**

Course Objectives:

- To study fundamental laws of thermodynamics, thermodynamics devices and its applications.
- To get conversant with steam engineering.
- To understand the structure and performance of I.C.Engine

Evaluation Scheme:

Theory	Mid Term Examination	30 Marks
	End Term Examination	70 Marks
Term work/ Practical	Continuous Evaluation	50 Marks
	External Viva-voce	50 Marks

Course contents:

1. **Laws Thermodynamics:** Joule's experiment, First law of thermodynamics for a cyclic and non cyclic process, energy, perpetual motion machine of the first kind (PMM-I), energy

balance in steady flow, some steady-flow devices, Limitations of the first law of thermodynamics, thermal reservoir, heat engine, refrigerator, heat pump, statements of the second law of thermodynamics, perpetual motion machine of the second type (PMM-II), reversible process, irreversible processes, actual processes, Carnot cycle or Carnot engine, reversed Carnot cycle.

2. **Entropy:** Clausius' theorem, Clausius inequality, entropy, change of entropy in a reversible process, T-s diagram, the increase of entropy principle, entropy transfer, entropy generation, entropy balance, physical concept of entropy, T-dS relations, third law of thermodynamics.
3. **Steam:** Substance, phases of a pure substance, phase-change phenomenon of a pure substance, terminology of pure substances, property diagrams, P-V-T surface, critical point and triple point, t-s and h-s diagrams, enthalpy changes during formation of steam, wet steam, superheated steam, specific volume of steam, entropy of a pure substance, external work done during evaporation, internal latent heat, internal energy of steam, use of steam tables, Boiler systems, comparison between fire tube and water tube boilers, fire-tube boilers, water tube boilers, some industrial boilers, high-pressure boilers, performance of boilers, boiler mountings and boiler accessories.
4. **Nozzle:** Types of steam nozzles, steam flow through a nozzle and flow through actual nozzles, supersaturated expansion of steam.
5. **Condensers:** Condenser, functions of a condenser, elements of a condensing plant, types of condensers, jet condenser, surface condenser, estimation of cooling water required, condenser efficiency, analysis of condenser operation, air extraction, cooling towers, cooling ponds.
6. **Air Standard Cycle:** Definitions, Air Standard Analysis, Carnot Cycle, Otto Cycle, Diesel Cycle, Dual Cycle.
7. **Internal Combustion Engines :** Classification of IC engines, components of engines, petrol engines, diesel engines, comparison between petrol and diesel engines, comparison between two-stroke and four-stroke engines, advantages and disadvantages of two-stroke cycle engines, air–fuel mixture, carburetion, fuel-injection system, combustion, governing of I.C. engines, ignition systems, firing order, engine-cooling systems, engine lubrication systems, performance of internal combustion engines and heat balance sheet, efficiencies, supercharging.

Term Work:

Part-I: Laboratory work

Conduct of following laboratory experiments

1. Study of Components of IC Engine.
2. Study of Valve timing diagram
3. Trial on Single cylinder Four stroke diesel engine.
4. Trial on four cylinder four stroke petrol engine.
5. Trial on single cylinder two stroke petrol engine.
6. Study of different types of boilers.
7. Study of boiler mountings and accessories.
8. Study of nozzle and diffuser
9. Study of condensers

Part-II: Assignments

1. Numericals based on above syllabus

2. Record of at least three assignments preferably based on latest development in a particular field based on above syllabus.

Practical Examination:

• Practical examination consists of viva-voce/oral by external examiner.

Reference Books:

1. M. M. Rathore, 'Thermal Engineering', Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. B. K. Sarkar, 'Thermal Engineering', Tata McGraw Hill Publishing Company Ltd. New Delhi.
3. P. K. Nag, 'Engineering Thermodynamics', Tata McGraw Hill Publishing Company Ltd. New Delhi.
4. Yunus A. Cengel, Michael A. Boles, "Thermodynamics: An Engineering Approach", Mcgraw-Hill College; 4th edition.
5. R. K. Rajput, 'Thermal Engineering', Laxmi Publications Pvt. Ltd, New Delhi
6. J. Selwin Rajadurai, 'Thermodynamics and Thermal Engineering', New Age InternationalPublishers, New Delhi
7. P. L Ballany, 'Thermal Engineering', Khanna Publishers, New Delhi.

Course Outcomes:

On successful completion of this course, students should be able to;

- Describe fundamentals of thermodynamics, thermodynamic devices and their applications.

- Spectacle the knowledge in the field of steam engineering.
- Evaluate the performance of I.C.Engine.

CASTING AND WELDING
(CREDITS THEORY-04, PRACTICAL-01)

Course Code: PR 231 **Contact Hours: Th. 04 Pr. 02**

Course Objectives:

- To understand the fundamentals and principles of casting, welding
- To understand the various machinery and equipment required to perform the welding operations.
- To understand and apprehend various applications of the casting processes

Evaluation Scheme:

Theory	Mid Term Examination	30 Marks
	End Term Examination	70 Marks
Term work/ Practical	Continuous Evaluation	50 Marks
	External Viva-voce	50 Marks

Course contents:

Casting

INTRODUCTION TO CASTING PROCESSES:

Classification, advantages, limitations, applications of casting, casting terms, sand mold making procedure.

TECHNOLOGY OF PATTERNMAKING, MOULDING AND COREMAKING:

Pattern materials, pattern making tools, types of patterns, pattern allowances, methods of constructing patterns, color coding, Tools and equipment's, types of modeling sands, sand additives, properties of molding sand and testing, molding processes: green sand, dry sand molding: advantages, limitations and applications Core materials, core prints, core boxes, core making, and chaplets.

SPECIAL CASTING PROCESSES:

Shell molding, investment molding, Full molding process, CO2 molding, permanent mold casting, die casting, centrifugal casting and continuous casting, advantages, limitations and applications.

MELTING, POURING AND FEEDING:

Introduction of Furnaces for ferrous and non-ferrous casting E.g. Copula: use, construction, charging and other furnaces.

GATING AND RISERING OF CASTINGS:

Gating system, gates, gating ratio, casting yield, and gating system design. Risering of casting: function, shape, types, location, feeding distance, and its design parameters.

DESIGN CONSIDERATIONS AND INSPECTION OF CASTING:

Designing for economical molding and eliminating defects, Defects in casting, inspection methods: visual, dimensional, mechanical, metallurgical and NDT.

WELDING:

Introduction, weldability, metal properties and its significance in welding, Classification of welding processes, applications and need of welding processes.

METAL ARC WELDING:

Introduction, welding procedure, accessories, power supplies in arc welding, flux, factors of arc welding, electrodes, coding, weld nomenclature, types of joints, positions of welding, weld defects, causes and remedies, design of weld joints, numericals.

TYPES OF ARC WELDING PROCESSES:

Principle, working, advantages, limitations and applications of carbon arc, submerged arc, electro slag, electro-gas, flux-cored arc welding and plasma arc welding, soldering and brazing.

GAS WELDING:

Types of flames, equipment, working, applications of gas welding, MIG, TIG, Oxy-acetylene cutting, arc cutting.

RESISTANCE WELDING:

Introduction, 4-period welding, types like Butt, Spot, Seam, flash, stud, Projection, Percussion, and Thermit welding.

Term Work:

The term work shall consist of a journal record based on above syllabus and one –two jobs on pattern making and welding.

Practical Examination (4hrs):

It shall consist of preparation of one job out of the following:

1. Pattern making.
2. Mould making.
3. Arc welding.
4. Gas welding.

And an oral based on the term work prescribed above and job prepared.

Weightage:

Casting 50%

Welding 50%

Reference Books:

1. Heine R.W, Loper C.R and Rosenthal P.C , "Principles of metal casting", Tata McGraw Hill Publication Co.1998
2. P. L. Jain , "Principles of foundry technology", Tata McGraw Hill Education , New Delhi, 2003
3. PN Rao , "Manufacturing Technology-Foundry, Forming and welding", Tata McGraw Hill, New Delhi , 2006
4. R. Little , "Welding Technology", Tata McGraw Hill Pub. New Delhi
5. Dr. Y.V Deshmukh P.K. Roy , "Welding Manufacturing Process",CBS Publisher and Distributers , New Delhi , 1984

Course Outcomes:

On successful completion of this course, students should be able to:

- Select materials, types and allowances of patterns used in casting and analyze the components of moulds.
- Understand arc, gas, and resistance welding processes.
- Design core, core print and gating system in metal casting processes

ENGINEERING METALLURGY
(CREDITS THEORY-03, PRACTICAL-01)

Course Code: PR 243 **Contact Hours: Th. 03 Pr. 02**

Course Objectives:

- The main objective of this subject is to make student aware of methods of manufacturing Pig Iron from Iron ore and making of steel by Basic oxygen and Electric arc melting processes
- The study of phase diagrams of ferrous and non-ferrous metals alloys help students to understand how to make various engineering alloys and modify their structures and properties by heat treatments to suit a particular application.
- Study of concept of powder metallurgy helps to make use of difficult to melt metals in making and shaping of various component shapes for engineering applications.

- Study of different composite materials and its application in manufacturing processes.
- Study of different nondestructive testing methods for inspecting the components.

Evaluation Scheme:

Theory	Mid Term Examination	30 Marks
	End Term Examination	70 Marks
Term work/ Practical	Continuous Evaluation	50 Marks
	External Viva-voce	50 Marks

Course contents:

INTRODUCTION:

Pig iron Production, Manufacture of steel, by Basic oxygen steel making, Electric Arc steel making, introduction to phase diagram.

STEEL AS AN ENGINEERING ALLOY:

Iron –Iron carbide equilibrium diagram, non-equilibrium cooling of steels, classification and applications of steel, specifications of steel, transformation products of austenite, time Temperature transformation (TTT) diagrams, Austenite and ferritic grain size in steels.

CAST IRONS:

White C.I. Gray C.I. malleable C.I., Nodular cast iron, Alloy cast irons and heat treatment of cast irons.

HEAT TREATMENT OF STEEL:

Conventional annealing, Bright annealing, box annealing, Isothermal (cycle) annealing, Spheroidised annealing, Subcritical annealing, Normalizing, Hardening, Retention of austenite, Effect of retained austenite, elimination of retained austenite, Tempering, Secondary hardening, Temper brittleness, Quench cracks, Hardenability, Carburizing, Selective carburizing, heat treatment after carburizing, Nitriding, Carbonitriding, flame hardening, Induction hardening.

ENGINEERING NON-FERROUS METALS:

Copper and copper alloys, Brasses, Aluminum and Aluminum alloys, Nickel and Nickel alloys, Tin and tin alloys and Bearing materials.

POWDER METALLURGY:

Introduction, characterization and testing of metal powders, powder manufacture, powder conditioning, Oil impregnated bearings, cemented carbide, cermet, advantages and limitations of powder metallurgy.

COMPOSITE MATERIALS AND ITS APPLICATION:

Different composite materials and its application in manufacturing processes.

STUDY OF NON-DESTRUCTIVE METHODS:

Dye penetrant test, Magnetic particle test, Ultrasonic test, Radiography, Eddy current test, significance &comparison of these tests.

TERM WORK

The term - work shall consist of a journal based on the below mentioned laboratory Experiments/study (at least 8).

1. Study of Metallurgical Microscope.
2. Preparation of Specimen for microscopic examination.
3. Heat Treatment of PCS and determine change in percentage of hardness and grain structure.
4. Study of microstructure of plain carbon steels of various compositions.
5. Study of microstructure of various types of C.I.
6. Jominy end-quench test for hardenability.
7. Study of microstructure of various types of alloy steels.
8. Study of microstructure of non – ferrous metals and their alloys.
9. Surface hardening and study of microstructure (study expt.)
10. Study of I.S. codes of steels and selection procedure.
11. Study and demonstration of the NDT processes.

References Books:

1. Guy Albert G.,"Elements of Physical Metallurgy", Oxford & IBH Publishing Co., New Delhi, 1974.
2. Swarup O.,"Elements and Metallurgy",Rastogi Publication,Meerut,1983.
3. Naik S.P.,"Engineering Metallurgy and Material Science",Charotar Publication House,New Delhi, 1985.
4. Jain R.K.,"Production Technology",Khanna Publication,New Delhi, 1986.
5. Higgins Raymond A."Engineering Metallurgy Part-I Metallurgy Process Technology", ELBS,New Delhi, 1987.

6. Kodgire V. D., "Material Science and Metallurgy for Engineers", Everest Publishing House, Pune, 2008, ISBN 81-86314-00-8.
7. Khanna O.P. "Materials Science and Metallurgy", Dhanpat Rai & Sons, New Delhi, 2010, **ISBN**-97-88189-92-831-5.
8. William D. Callister,"Materials Science and Engineering: An Itroduction, 8th Edition, Wiley India (P) Ltd (2010).
9. Raghavan V," Physical metallurgy principles and practice", PHI Learning Privat Limited, New Delhi,2012,ISBN-9788120330122
10. Sidney H. Avner,"Introduction to Physical Metallurgy", Tata McGraw-Hill Education, 2013,ISBN-9780074630068
11. T.V. Rajan, C.P. Sharma," Heat Treatment principles and Techniques", PHI Learning Pvt. Ltd., 1994.

Course Outcomes:

On successful completion of this course, students should be able to:

- Identify the methods of Manufacturing of steel and phase diagram.
- Interpret Iron –Iron carbide equilibrium diagram, time Temperature transformation (TTT) diagrams and their significance.
- Classify the cast irons and their applications and heat treatment processes.
- Select suitable heat-treatment process to achieve desired properties of steel by acquiring the fundamentals of heat treatment.
- Differentiate engineering nonferrous materials and its applications.
- Describe powder metallurgy, its processes and applications.
- Choose the composite materials and its application in manufacturing processes.
- Select the suitable nondestructive testing method for inspecting components.

MACHINE DRAWING AND CADD
(CREDITS THEORY-02, PRACTICAL-01)

Course Code: PR 245 **Contact Hours: Th. 02 Pr. 02**

Course Objectives:

- To learn ISO standards used in machine drawing.
- To learn the conventions displayed on a product drawings.

- To learn drawing and documentation.
- To gain knowledge of various machine parts and their applications.
- To use Sketcher, modeling, assembly and drafting in CAD software like AutoCAD, Solid edge/Solid works/NX/CATIA/Creo for machine drawing.

Evaluation Scheme:

Theory	Mid Term Examination	30 Marks
	End Term Examination	70 Marks
Term work/ Practical	Continuous Evaluation	50 Marks
	External Viva-voce	50 Marks

Course contents:

INTRODUCTION TO MACHINE DRAWING AND CADD:

Machine drawing, CAD concept, software and hardware, CADD, Drawing Standards

BUREAU OF INDIAN STANDARDS (BIS) CONVENTIONS AND CONVENTIONAL REPRESENTATION:

General principles and convention of engineering/machine drawing: Use of Indian and International standards; IS/ISO codes; Surface Finish, Welded Joints, Riveted Joints: Single and Double Riveted Butt and Lap Joints, Engineering curves (Involutes, cycloidal family of curves, helix and spiral); Spur gear, helical gear, Bevel gear and Worm and Worm Wheel and Thread Profiles; Conventions/symbols for process flow, electrical and instrumentation units

COMPUTER AIDED DRAFTING AND DOCUMENTATION:

Introduction to CAD, CAD software and hardware, Study of 2D and 3D modeling software, Sketching in CAD, Commands for geometry creation, editing, viewing, printing; Use of templates and layers; Introduction to solid and assembly modeling; import and export of CAD data; Automated drafting in Solid modeling software;

MACHINE PARTS:

Screwed Fastenings; Pipe Joints, Riveted joints, cotter and knuckle joints, keys, shafts, couplings, valves

PRODUCTION DRAWINGS AND BLUE PRINT READING:

Assembly and detail drawing with complete dimensioning, tolerancing, materials and surface finish, Assembly and part drawings including detailed documentation i. e. dimensioning, tolerancing, materials and surface finish, study and preparation of bill of materials; Blue print reading,

Term Work

The term work shall consist of preparation of drawings related to above syllabus using sketchbook, drawing sheets and CAD tools

Text Books:

1. Machine Drawing -N.D. Bhatt & V.M. Panchal, 46th Edition Charotar Publishing House, 2011
2. Machine Drawing –Siddheswar, Kannaiyah, and Shastry 37th Edition, Tata Mc-graw hill publication New Delhi 2009.
3. Machine Drawing with AutoCAD – G. Pohit and G. Ghosh, Pearson Education, 2005
4. Machine Drawing includes AutoCAD- Ajeet Singh, 2nd Edition Tata Mc-graw hill publication New Delhi 2012.

Reference Books:

1. Machine drawing, K. C. John, PHI
2. James Bethune, Engineering graphics, Pearson Education
3. P.S. Gill, Machine Drawing - S. K. Kataria and Sons, Delhi, 2002
4. Narayana KL, Kannaiah P, Venkata Reddy K, Machine Drawing, 2nd Edition, New Age International, 2009
5. Dhawan R. K, A text book of Machine Drawing, S. Chand & Co, New Delhi, 2005
6. Junnarkar ND, Machine Drawing, Pearson Education, 2005
7. Radhakrishnan, CAD/CAM/CIM, New Age International Publication, 2003

Course Outcomes:

On successful completion of this course, students should be able to:

- Acquire knowledge of various ISO standards used in machine drawing and apply those.
- Read and interpret the conventions displayed on a product drawing.
- Use the important entities like Limits, Fits, Tolerances and Surface Finish, towards their use in the drawing.
- Identify and draw various machine parts.
- Draw/model parts and assemblies using CAD software.\

Course Outcomes:

At the end of the course students will able to:

- Communicate effectively through presentations, discussions and interviews.
- Achieve speaking and writing skills.

MATHEMATICS – III
(CREDITS THEORY-04)

Course Code: MA 203 **Contact Hours: Th. 04**

Course Objectives:

To acquaint student with: the basic concepts of an ordinary differential equations, partial differential equations, Mathematical Modelling in physical problems. Initial and boundary value problems.

Motivate students to use critical thinking skill to solve practical problems.

Evaluation Scheme:

Theory	Mid Term Examination	30 Marks
	End Term Examination	70 Marks

Course contents:

Unit 1

Basic Concepts & Ideas, Geometric Meaning of $y' = f(x, y)$, direction field , exact equations, Integrating factors, Linear differential equation, Bernoulli's equations, orthogonal trajectories, applications to electrical circuits.

Unit 2

Second Order Differential equations, Homogeneous linear differential equation for real & complex roots, Euler Cauchy equation, existence & uniqueness theorem (Without proof) & Wronskian.

Unit 3

Non homogeneous equation, solutions by undetermined coefficients & Variation of parameter methods, modelling, forced oscillation, resonance & electrical circuits, system of differential equations.

Unit 4

Fourier Series, Periodic function, Fourier theorem Euler's formulae for the Fourier coefficients, convergence of Fourier series, change of interval, even & odd function functions, half range Fourier series.

Unit 5

Partial differential equations, Separation of Variables, Vibrations of string, one dimensional equation.

Text/Reference Books:

- Advanced Engineering Mathematics – R.K Jain & S.R.K Iyenger
- Advanced Engineering Mathematics- Erwin Kreyszig
- Elementary Differential Equation(eighth edition) W.E Boyce & R. Diprima (John Wiley 2005)
- Fourier series & boundary Valued Problems., R.V Churchill & JW Brown (Seventh edition) Mc Graw Hill (2006).

Course Outcomes:

At the end of the course the student is expected to understand:

1. Importance of differential equations i.e. ODE and PDE in physical problems
2. Able to solve IVP in electrical and mechanical problems
3. Analyzing physical phenomena in engineering and technology by using this theory

THEORY OF MACHINES
(CREDITS THEORY-04, PRACTICAL-01)

Course Code: PR 242 **Contact Hours: Th. 04 Pr. 02**

Course Objectives:

- To understand commonly used mechanisms for industrial applications.
- To develop competency in drawing velocity and acceleration diagrams for simple and complex mechanisms.
- To understand the concepts of motion transmission elements.

Evaluation Scheme:

Theory	Mid Term Examination	30 Marks
	End Term Examination	70 Marks
Term work/ Practical	Continuous Evaluation	50 Marks
	External Viva-voce	50 Marks

Course contents:

MECHANISMS AND INVERSIONS:

Mechanisms, machines, kinematics pairs, kinematics chains, kinematics inversions.

VELOCITY AND ACCELERATION ANALYSIS:

Instantaneous center, Kennedy's three center theorem, Instantaneous center method and relative velocity method for velocity diagrams, acceleration diagram. Short cut methods for velocity and acceleration diagrams.

BALANCING OF MASSES:

Need for balancing, Balancing of one / several masses rotating in one/different planes, the effect of inertia force of a reciprocating mass on the engine frame, partial primary balance.

TURNING MOMENT AND FLYWHEELS:

Turning moment diagram for an IC engine, fluctuation of energy and speed, flywheel.

GOVERNORS:

Introduction, types of governors, centrifugal governors, watt governor, porter governor, proell governor, spring loaded governors, Hartnell governor, sensitiveness, stability, Isochronisms, Hunting, governor effort and power, controlling force.

CAMS:

Definition, Applications, types of cams, types of followers, Displacement, velocity and acceleration time curves, generation of cam profile, cams with specified contours circular arc cam with flat faced reciprocating follower,

GEARS:

Concept of friction wheel, types of gears, selection of gears, gear terminology, law of gearing, gear profiles, Interference and undercutting, methods of eliminating reducing/ Interference.

The following topics are to be covered in practical classes

VIBRATIONS:

Introduction, spring mass system, natural frequency computations, spring mass, simple pendulum, torsional vibrations and compound pendulum.

GYROSCOPE:

Introduction, gyroscopic couple, gyroscopic stabilization

TERM WORK

It shall consist of a journal prepared by conducting following practicals.

1. Study of at least four inversions of each single slider and double slider crank mechanisms.
2. Drawing of kinematic link diagram for a given mechanisms.

3. At least 4 typical problems of velocity and acceleration analysis to be solved on quarter imperial size drawing sheet.
4. Practical on vibration analysis of spring mass system and compound pendulum etc
5. Practical analysis on Gyroscope.
6. Static and dynamic balancing.
7. Study of generation of involutes tooth profile.
8. 4 sheets on cam profile generation.
9. Practical analysis on Governors
10. Practical analysis on belt tension apparatus

Text Books:

Thomas Bewan , "Theory of Machines" Pearson Education India, 1994

David H. Myszka, "Machine and Mechanisms : Applied Kinematic Analysis", Prentice Hall , 2010

Rattan , "Theory of Machines", Tata McGraw-Hill Education 2005.

R.S. Khurmi, G. K. Gupta , "Theory of Machines", Eurasia Publishing House, 2005

Reference Books :

Shigley , Joseph Edward , "Theory of Machine & Mechanisms", McGraw Hill Inc. 1981

P.L. Ballaney , "Theory of Machines" Khanna Publishers 1987.

Course Outcomes:

On successful completion of this course, students should be able to:

- Understand the principles of kinematic pairs, chains and their classification, DOF, inversions, equivalent chains and planar mechanisms.
- Analyze the planar mechanisms for position, velocity and acceleration.
- Synthesize planar four bar and slider crank mechanisms for specified kinematic conditions.
- Evaluate gear tooth geometry and select appropriate gears for the required applications.
- Design cams and followers for specified motion profiles.

THERMAL ENGINEERING - II
(CREDITS THEORY-03, PRACTICAL-01)

Course Code: PR 244 **Contact Hours: Th. 03 Pr. 02**

Course Objectives:

- To study air compressors and its applications
- To get conversant with vapour cycles and steam turbines.
- To understand the fundamentals and performance of refrigeration and air conditioning systems.

Evaluation Scheme:

Theory	Mid Term Examination	30 Marks
	End Term Examination	70 Marks
Term work/ Practical	Continuous Evaluation	50 Marks
	External Viva-voce	50 Marks

Course contents:

1. **AIR COMPRESSORS:** Uses of compressed air, classification, reciprocating compressor terminology, compressed air systems, reciprocating air compressor, minimizing compression work, clearance volume in a compressor, actual indicator diagram, volumetric efficiency, free air delivery (FAD), limitations of single-stage compression, multistage compression, cylinder dimensions of a multistage compressor, rotary compressors, roots blower compressor, vane-type compressor, centrifugal compressor, axial compressor.
2. **FUELS AND COMBUSTION:** Fuels, characteristic of an ideal fuel, coal, liquid fuels, gaseous fuels, conversion of volumetric analysis to gravimetric analysis, conversion of gravimetric analysis to volumetric analysis, combustion, composition of dry air, amount of air required for combustion, air–fuel ratio, air–fuel ratio from analysis of flue gases, flue gas analysis - Orsat apparatus, heat generated by combustion, calorific value or heating value of fuel, calorimeters.
3. **REFRIGERATION:** Refrigeration, Refrigerators and Heat Pumps, Refrigeration terminology, types of refrigeration systems, gas refrigeration Systems, Brayton refrigeration cycle, Bell Coleman cycle, ideal vapour compression refrigeration cycle, vapour absorption refrigeration cycle, comparison of vapour absorption system with vapour compression system, steam jet refrigeration, heat pump, refrigerants.

4. **PSYCHROMETRY:** Psychrometer, dry, moist and saturated air, properties of moist air, partial pressure of air and vapour, adiabatic saturation temperature, psychrometric chart, air-conditioning processes, adiabatic mixing of two moist air streams, air washer.
5. **AIR CONDITIONING:** Applications of air-conditioning, comfort air-conditioning, effective temperature, air-conditioning cycle, summer air-conditioning system, winter air-conditioning system, year-round air conditioning system, unitary system, central air-conditioning system, classifications of central air-conditioning system, rating of air-conditioning, cooling and heating load calculations, sensible heat factor, ice plant, air coolers, difference between air cooler and air-conditioner.
6. **VAPOUR POWER CYCLES:** Steam power plant, performance parameters of vapour power cycle, Carnot vapour power cycle, Rankine cycle, comparison between Carnot and Rankine cycle, irreversibilities and losses in vapour power cycle, effect of operating variables on Rankine cycle, reheating of steam, super critical Rankine cycle, mean temperature of heat addition, modified Rankine cycle.
7. **INTRODUCTION TO STEAM TURBINES:** Classification of steam turbines, working of impulse steam turbines, reaction steam turbines, velocity diagrams.

Term Work:

Part-I: Laboratory work

Conduct of following laboratory experiments

1. Trial on Refrigeration test rig
2. Trial on Air conditioning test rig.
3. Trial on Ice Plant tutor.
4. Determination of properties of lubricating oil such as flash and fire point of lubricating oil, etc.
5. Trial on reciprocating air compressor.
6. Determination of properties such as calorific value of solid/liquid/gas fuel, etc.
7. Analysis of flue gas (any one flue gas analyzer)

Part-II: Assignments

1. Numericals based on above syllabus

2. Record of at least three assignments preferably based on latest development in a particular field based on above syllabus.

Practical Examination:

• Practical examination consists of viva-voce/oral by external examiner.

Reference Books:

1. M. M. Rathore, 'Thermal Engineering', Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. B. K. Sarkar, 'Thermal Engineering', Tata McGraw Hill Publishing Company Ltd. New Delhi.
3. R. K. Rajput, 'Thermal Engineering', Laxmi Publications Pvt. Ltd, New Delhi
4. J. Selwin Rajadurai, 'Thermodynamics and Thermal Engineering', New Age InternationalPublishers, New Delhi.
5. P. L Ballany, 'Thermal Engineering', Khanna Publishers, New Delhi.

Course Outcomes:

On successful completion of this course, students should be able to;

- Describe fundamentals of air compressors and their applications.
- Design and evaluate refrigeration and air conditioning system.
- Analyze the properties of fuel and flue gases.

METROLOGY AND MEASUREMENTS
(CREDITS: THEORY-04 PRACTICAL-01)

Course Code: PR 251 **Contact Hours: Th. 04 Pr. 02**

Course Objectives:

- To study need of metrology and basic terminology of metrology
- To learn the basics of limit, fit , tolerances and gauge designing
- To study the principles of measurement of various mechanical properties such as geometrical, dimensional, surface finish, pressure, temperature etc.
- To learn the use of various measuring instruments with different setups for accurate measurements.
- To get acquainted with various standards of measurements & the calibration process of instruments.

Evaluation Scheme:

Theory	Mid Term Examination	30 Marks
	End Term Examination	70 Marks
Term work/ Practical	Continuous Evaluation	50Marks
	External Viva-voce	50 Marks

Course contents:

INTRODUCTION:

Need, Precision, Accuracy, Errors, Linearity, Repeatability, Calibration, Sensitivity, Methods of Measurement. Linear Measurement: Vernier Calipers, Height Gauge, Depth Gauges, Feeler Gauges, Micrometer, Slip Gauges. Measurement Standards: Line Standard, End Standard, Wavelength Standard, Classification of Standards.

LIMITS, FITS AND GAUGES:

Tolerances, Interchangeability, Selective Assembly Terminology, Limits Of Size, Allowances, Clearances, Interference, Is 919, Fits, Selection Of Fits, Numerical Problems On Limits of Size And Tolerances, Gauges (Ring, Snap), Taylor's Principle, Gauge Design, Tolerance and Geometry, Geometric Dimensioning and Tolerance.

COMPARATORS:

Definition, Types, Characteristics, Applications,Construction and Working of Different Mechanical, Electrical, Optical, and Pneumatic Comparators.

MEASUREMENTS BY LIGHT WAVE INTERFERENCE:

Basic Principle, Optical Flats, Fringe Patterns and their Interpretation, Testing Of Flat Concave, Convex and Irregular Surfaces, and Checking of Slip Gauges, Michelson Interferometer, NPL Flatness Interferometer.

ANGULAR MEASUREMENT:

Principle and Applications of Measuring Instruments Like Protractor (Optical and Bevel), Sine Bar, Angle Gauges, Spirit Level, Clinometers, Autocollimator, Angle Dekkor, Constant Deviation Prism, and Miscellaneous Measurement of Angle.

MEASUREMENT OF SURFACE FINISH AND SURFACE CHARACTERISTICS:

Definitions, Terminology and Basic Concepts, Methods of Measuring Surface Finish, Analysis of Surface Roughness, Symbols and Values of Surface Roughness, Straightness, flatness, squareness, parallelism etc.

METROLOGY OF SCREW THREADS:

Terminology, Errors and Their Effects, Elements and Their Measurements.

MEASURING MACHINES:

Profile Projector, Toolmaker’s Microscope and CMM.

PRESSURE MEASUREMENT:

Definition of pressure, Units, Types of pressure measurement devices, Manometers, Dead weight tester, Bourdon tube pressure gauge, Diaphragms and bellows, Low pressure measurement, The Mcleod gauge, Pirani thermal conductivity gauge, Knudsen gauge, Ionization gauge, Piezo electric transducer Selection of pressure measuring devices for specific applications , Calibration of pressure measuring devices.

TEMPERATURE MEASUREMENT:

Temperature scales, Ideal gas, Temperature measuring devices, Thermometer, Bi- metallic strip, Electrical resistance thermometer, Thermostats and thermocouples, Laws of thermocouples and their applications, Construction and calibration of thermocouples, Radiation pyrometers, total radiation pyrometers

Term Work:

The term work shall consist of record of following experiments and one to two assignments on every chapter.

1. Use of precision measuring instruments for linear measurements.
2. Experiment on mechanical comparator and study of different types comparators.
3. Experiment on sine bar for measurement of taper angle.
4. Study of auto collimator / angle dekkor.
5. Experiment on pitch errors of screw threads.
7. Assignment on design of gauges.
8. Experiment on profile projector/ Tool maker's Microscope.
9. Experiment on Coordinate Measuring Machine.
10. Experiment on Height master
11. Experiment on pressure and temperature measurement

Text Books:

1. R.K. Jain, "Engineering Metrology", Khanna Publication, New Delhi 1997
2. K.J.Hume, "Engineering Metrology", Kalyani publication ISBN8170290015
3. I. C. Gupta, "A Text book of Engineering Metrology", Dhanpat Rai and Sons.

Reference Books:

1. K.W.B.Sharp, "Practical Engineering Metrology", Pitman Publication

2. Nakra, B.C. and Chaudhry, K.K., "Instrumentation, Measurements and Control", Tata McGraw Hill, 1985 ISBN0074517910

3. Beckwith, T. G. and W.L. Buck: "Mechanical Measurements", 2nd Edition, Addison Wisely Publishing Company, Reading, Mass, 2000 ISBN8131702073

4. D. S. Kumar, "Mechanical Measurement & Control", Metropolitan Book Co. (P) Ltd., ISBN 81-200 0214-8.

5. Metrology by Dobler – Tata McGrawHill Co. New Delhi

Course Outcomes:

On successful completion of the course, students should be able to:

- Use linear and angular measuring instruments.
- Define and describe types of errors
- Define and describe limits and fits and design of gauges for various types of fits
- Identify suitable comparator for different measurements
- Work out for surface integrity parameters
- Measure pressure and temperature by using various mechanical instruments

MACHINING PROCESSES
(CREDITS: THEORY-03)

Course Code: PR 234 **Contact Hours: Th. 03**

Course Objectives:

- The main objective of this subject is to make student aware of tool geometry, tool signature, and mechanics of chip formation, types chip, tool wear, surface finish and need of cutting fluids, machininabilty of the material helps in selection of tool material.
- Study of various features and capabilities of various machine tool types, parts, accessories attachments, and operations performed and time required, assists in selection of proper machine tool for a particular application.
- Study of advances in machine tools and finishing processes helps to take decision for selection of proper machine tool for batch and large size machining applications.

Evaluation Scheme:

Theory	Mid Term Examination	30 Marks
	End Term Examination	70 Marks

Course contents:

INTRODUCTION:

Definition, Principles, Types, Components, Machining Parameters, Drives and Power Requirements.

THEORY OF METAL CUTTING:

Tool Geometry, Tool Signature, Chip Formation, Types of Chip, Tool Wear, Surface Finish, Cutting Fluids and Machinability, Selection of Tool Materials.

MACHINE TOOLS:

Machining Principles, Setting For Typical Products and Operations, Types, Parts, Accessories And Attachments Of Lathe, Drilling, Milling, Shaping, Planning, Slotting, Boring And Broaching Machines. Machining Time Calculations For Lathe, Drilling, Shaping, Planning And Milling Machines.

BATCH PRODUCTION MACHINES:

Capstan and Turret Lathes - Principle, Constructional Details, Parts, Operations and Applications.

GRINDING MACHINES:

Principle, Constructional Details, Components, Types of Grinding Processes, Accessories. Grinding Wheels - Specifications, Shapes, Applications, Dressing and Truing, Mounting, Cutting Fluids Used In Grinding. Selection of Grinding Wheels.

FINISHING PROCESSES:

Lapping, Honing, Super Finishing Operations, Polishing, Buffing, Metal spraying, Galvanizing, Electroplating etc. Tools used For These Operations.

Reference Book:

1. HajraChaudhary, S.K.andHajraChaudharyA.K.,Elements of Workshop Technology, Vol-II, Media Promoters Pub Ltd, Mumbai,1986
2. Rao, P.N., Manufacturing Technology-Metal Cutting and Machine Tools, Tata McGraw Hill, New Delhi,2000

3. B.S. Raghuwanshi,Workshop Technology, Dhanpat Rai Publication, 9th Edition, 1999
4. Serope Kalpakjian, Manufacturing, Engineering Technology, Published by Pearson 4th Edition, 2005.
5. Material & Processes in Manufacturing, E Paul De Garmo, J T Black, PHI.
6. Fundamental of Machining & Machine Tools, Juneja&Sekhon, New Age International 2008.

Course Outcomes:

On successful completion of this module, students should be able to:

- Enlist the different factors affecting on tool life, surface finish and the different types of chips.
- Compute machining times for machining operation on machine tools.
- Describe basic principle operation of lathe, shaper, drilling, milling, and planning, slotting, boring and broaching machines.
- Compare the basic principles of Capstan and Turret lathes.
- Identify different processes for finishing of work pieces.

MANUFACTURING LAB - I
(CREDITS: PRACTICAL-01)

Course Code: PR 236 **Contact Hours: Pr.02**

Course Objectives:

- To gain an understanding and appreciation of the breadth and depth of the field of manufacturing.
- To recognize the strong interrelationships between material properties and manufacturing processes.
- To become familiar with some of the basic metal cutting processes.
- To learn and apply the basic terminology associated with these fields.
- To increase your knowledge and broaden your perspective of the manufacturing world in which many of you will contribute your talents and leadership.

Evaluation Scheme:

Term work/ Practical	Continuous Evaluation	50Marks
	External Viva-voce	50 Marks

Term work:

It shall consist of following study of working, constructional details, various mechanisms, accessories, attachments and different operations of Lathe, Milling M/c, Drilling M/c, Grinding M/c, shaper, planer, slotting M/c, Boring M/c, Broaching M/c and Finishing processes.

Each student will prepare and submit the following jobs.

1. External taper turning - 1 Job
2. Internal taper turning and fitting on (a-above) - 1 job
3. Eccentric turning - 1 Job
4. A simple job on shaper.
5. Estimate machining times for machining operation on machine tool.

The student shall submit the record of term work in the form of journal.

Course Outcomes:

- On successful completion of this module, students should be able to:
- Describe the basics working principle of Lathe, Milling, Drilling, Grinding, Shaper, Planning, Slotting, Boring, Broaching and Finishing processes.
- Compute the machining time for Lathe, Drilling, Grinding, Milling, Shaper, Planning, Slotting, Boring, Broaching processes, through experiments.
- Acquire machining skill by working on lathe, milling machine.
- Write simple NC/ CNC part program for lathe operation.

Human Values & Professional Ethics
(CREDITS THEORY-02)

Course Code: HS 222 **Contact Hours: Th. 02**

Examination Scheme: 30* + 70 marks

*30 marks- The marks can be awarded on the basis of formal Mid term Examination or sessional or assignments as prescribed by the concerned subject teacher(s) and the course co-ordinator for the specific semester/ academic year. As per the schedule of the Institute, end term examination for 70 marks will be held.

Objectives of the course:

1. Making the students aware and sensitive to value system in real life situations.
2. To help the students to discriminate between ephemeral and eternal values

3. To discriminate between essence and form

Unit 1: Course Introduction [5]

Need, Basic Guidelines, Content and Process for Value Education

Understanding the need, basic guidelines, content and process for Value Education. A look at basic aspirations: Self Exploration, Happiness and Prosperity

Fulfillment of human aspirations and harmony

Unit 2: Understanding the Harmony [5]

Thoughtful human being harmony, sentient, attitude and its importance in relationship

Significance of restraint and health (Yama and Niyama)

Human goal settings and life management techniques, existence and co-existence, trust, respect in universal order

Unit 3: Understanding professional Ethics [5]

Harmony at various levels and understanding professional ethics

Creating environmentally aware engineers

Humanistic universal education, natural acceptance of human values, ethical human conduct

Unit 4: Competence of professional ethics [5]

Management models for present technologies, strategies for integrating humans in family and at all levels of existence

Relevance of the above strategies in becoming responsible engineers, technologists and managers

Unit 5: Motivation [2]

Contribution of ancestors in science and technology development to raise self esteem in Indian context.

Suggested Readings / Books:

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Value Education.
2. A Nagraj, 1998, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Purblishers.
5. A.N. Tripathy, 2003, Human Values, New Age International Publishers
6. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.

7. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
8. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
9. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd
10. Subroto Bagchi, The Professional
11. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
12. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008. Scheme and Syllabus Bachelor of Computer.

Course Outcome:

- The students will be able to recognize importance of human values, harmony and ethical behavior in real life situations