SCHEME OF INSTRUCTION AND SYLLABI

of

B.E. V and VI Semesters (III YEAR)

MECHANICAL ENGINEERING

With effect from

2017-2018

DEPARTMENT OF MECHANICAL ENGINEERING

UNIVERSITY COLLEGE OF ENGINEERING

(AUTONOMOUS)

OSMANIA UNIVERSITY,HYDERABAD–500 007

TELANGANA STATE

SCHEME OF INSTRUCTION & EXAMINATION

B.E VSemester (Mechanical Engineering)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P	Contact Hrs/wk	CIE	SEE	
1.	PC501ME	Dynamics of Machines	3	1	-	4	30	70	3
2.	PC502ME	Design of Machine Elements	3	1	-	4	30	70	3
3.	PC503ME	Metal Cutting & Machine Tools	3	-	-	3	30	70	3
4.	PC504ME	Hydraulic Machinery and Systems	3	-	-	3	30	70	3
5.	PC505ME	Metrology & Instrumentation	3	-	-	3	30	70	3
6.	PC506ME	Heat Transfer	3	-	-	3	30	70	3
7	MC901SOC	Gender Sensitization	3	-	-	3	30	70	3 Units
8	PE	Professional Elective -I	3	-	-	3	30	70	3
Practicals									
9.	PW961ME	Engineering Applications with Social Perspective*	-	-	-	-	50	-	1
10.	PC551ME	Manufacturing Processes Lab	-	-	2	2	25	50	1
11.	PC552ME	Dynamics Lab	-	-	2	2	25	50	1
			24	2	4	30	340	660	24

PROFESSIONAL ELECTIVE-I	
PE501ME	Mechanical Vibrations
PE502ME	Powder Metallurgy
PE503ME	Robotic Engineering
PE504ME	Theory of Elasticity

SCHEME OF INSTRUCTION & EXAMINATION
B.E VISemester (Mechanical Engineering)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P	Contact Hrs/wk	CIE	SEE	
1.	PC601ME	Machine Design	3	1		4	30	70	3
2.	PC602ME	Production Drawing	2	-	2	4	30	70	3
3.	PC603ME	Refrigeration and Air Conditioning	3	-	-	3	30	70	3
4.	PC604ME	Production and Operations Management	3	-	-	3	30	70	3
5.	PC605ME	Control Systems Theory	3	-	-	3	30	70	3
6.	PE *	Professional Elective-II	3	-	-	3	30	70	3
7.	OE **	OPEN ELECTIVE-I	3	-	-	3	30	70	3
8.	MC***	Mandatory Course	3	-	-	3	30	70	3 Units
Practicals									
9	PW962ME	Summer Internship	-	-	-	-	-	-	-
10.	PC651ME	Metrology & Machine Tools Lab	-	-	2	2	25	50	1
11.	PC652ME	Hydraulic Machinery Lab	-	-	2	2	25	50	1
			23	01	06	30	290	660	23

Note: **Summer Internship along with credits will be reflected in VII semester memorandum of marks

*PROFESSIONAL ELECTIVE-II	
PE601ME	Energy Systems
PE603ME	Computational Fluids Flows
PE604ME	Nano materials and Technology
PE605ME	Renewable Energy Sources
PE606ME	Operations Research

Mandatory Course***	
MCSS	Science ,Technology, Innovation and Society
MCPA	Indian Polity and Administration
MCBM	Business Ethics and Corporate Governance

**OPEN ELECTIVE-I	
OE601BM	MEMS
OE601CE	Disaster Management
OE602CE	Geospatial Techniques
OE601CS	Operating Systems
OE602CS	OOPS using JAVA
OE601EC	Embedded Systems
OE602EC	Signal analysis and transform techniques
OE601EE	Reliability Engineering
OE601ME	Industrial Robotics
OE602ME	Material Handling
OE601LA	Intellectual Property Rights

Course Code: PC501ME

DYNAMICS OF MACHINES

Credits: 3

Instruction: (3L+1T) per week Duration of SEE: 3 hours

CIE: 30 Marks SEE: 70 Marks

Course Objectives:

- To find static and dynamic forces on planar mechanisms.
- To know the causes and effects of unbalanced forces in machine members.
- To determine natural frequencies of undamped, damped and forced vibrating systems of one, two and multi degree freedom systems.

Course Outcomes:

- Understand various methods of static and dynamic analysis of planar and spatial mechanisms
- Understand and apply the gyroscopic effects in ships, aero planes and road vehicles.
- Analyze balancing problems in rotating and reciprocating machinery
- Apply the concepts of free and forced vibrations of single degree freedom systems in real time systems
- Analyze and design various types of governors like Watt, Porter, Proell, Hartnell governors

Unit-I

Static and Dynamic analysis of planar mechanisms: Graphical and analytical methods, Free body diagrams, Method of superposition, Equivalent offset inertia force, Inertia force in reciprocating engines, Flywheels.

Unit-II

Force analysis of space mechanisms, inertia matrix, Lagrangian and Newton-Euler formulation.
Gyroscopic effect in shafts, aero planes, Naval ships, Two & Four wheel automobiles.

Unit-III

Forces on bearings due to rotating shaft carrying several eccentric rotors, balancing of shafts carrying several rotors, determination of balancing masses from the forces on the bearings shaking forces in a single cylinders engine, partial balancing of reciprocating engine. Balancing of a two cylinder locomotive engine, determination of unbalanced forces and couples.

Unit-IV

The role of a centrifugal governor in speed control, Porter and Hartnell type governors, speed vs lift curves, power and stability.

Undamped free vibration of a single degree of freedom linear system (axial and torsional), determination of natural frequencies, equivalent system of combination of springs, stepped shafts, gears and rotors. Free response of single degree of freedom damped linear systems, damped natural frequencies, relative damping.

Vibration of harmonically forced single degree of freedom systems. Resonance, vibration isolation with coupled damper.

Partial differential equation governing free vibration of a simply supported uniform beam.
Derivation of natural frequencies.

Unit-V

Natural frequencies of two degree freedom linear systems.Nodes in three rotor systems. Modes of vibration, Determining natural frequencies by Holzer's method for multi-rotor systems. Dunkerley's method, Raleigh's method.

Suggested Reading:

1. S.S. Rathan, *Theory of Machines*, Tata-Mc Graw Hill, 1995.
2. Thomas Bevan, Theory of machines, 3rd edition, Pearson Education, 2005
3. A. Ghosh and Mallick, *Theory of mechanisms and machines*, Affiliated to E-W Press, 1988.
4. John.J.Vicker, Gordon R. Pennock, Joseph E. Shigley, *Theory of Machines & Mechanisms*, Oxford University Press, 2003.
5. Robert L. Norton, *Design of Machinery*, Tata Mc Graw Hill, 2005.

Course Code: PC502ME

DESIGN OF MACHINE ELEMENTS

Credits: 3

Instruction: (3L+1T) per week Duration of SEE: 3 hours
CIE: 30 Marks SEE: 70 Marks

Course Objectives:

- To understand the basics of mechanics of materials and design of a machine for static and fatigue strength, rigidity and wear criterions, use of codes and standards.
- To know the principles of ergonomic design.
- To learn the principles to design shafts, keys, belt drives, joints and couplings.

Course Outcomes:

- To select proper material for the machine component based on theories of failure, different fatigue loads.
- Determining size of the machine components for torque transmission, bending and axial loads.
- Identifying the type of joints and fasteners required for a given application and predicting its efficiency

Unit-I

Introduction, Materials used in machine design and their specifications to Indian standards. Important mechanical properties of materials used in design. Codes and standards used in design. Reliability, Principles of good Ergonomic Design, Manufacturing considerations.Preferrednumbers.Value analysis.

Analysis of Stress and Strain : Definition of stress and strain, Types of loading, Direct normal stress, bending stress, Torisonal stress, crushing and bearing stresses, Biaxial stress and Triaxial stress.

Theories of elastic failure, Stress concentration factor, factor of safety, Design of components for static loads, Introduction to thermal stresses.

Unit-II

Design for Fatigue and Impact loads; Importance of fatigue in design, Fluctuating stresses, fatigue strength and endurance limit. Factors affecting fatigue strength. S-N Diagram, Soderberg and Modified Goodman's diagrams for fatigue design. Cumulative fatigue, Miner's rule, Design of components for fatigue. Design of components for impact loading.

Unit-III

Design of keys, shafts – solid hollow stepped shafts and splined shafts under torsion and bending loads.Design of belt drive systems, selection of belts and design of pulleys.

Unit-IV

Design of cotter and knuckle joints, riveted and welded joints under direct and eccentric loading.
Design of couplings – Muff and Split Couplings, Flange, Flexible and Marine type of couplings.

Unit-V

Design of bolts and nuts, locking devices, bolt of uniform strength, design of gasket joints, design of power screws and screw jack.Thick and thin cylinders.

Suggested Reading:

1. V.B. Bhandari, *Machine Design*, Tata Mc Graw Hill Publication, 1991.
2. J.E. Shigley, C.R. Mischne, *Mechanical Engineering Design*, Tata Mc Graw Hill Publications, 2003.
3. Robert C. Juvinall, *Fundamentals of Machine Component Design*, John Wiley & Sons, 2005
4. Robert L. Norton, *Machine Design: An Integrated Approach*,2/e Pearson Education, 2000
5. M.F. Spotts, *Design of Machine Elements*, Prentice Hall of India, 1964.

Course Code: PC503ME

METAL CUTTING AND MACHINE TOOLS

Credits: 3

Instruction: (3L) per week — Duration of SEE: 3 hours

CIE: 30 Marks — SEE: 70 Marks

Course Objectives:

- To learn the tool material, geometry and mechanics of metal cutting for turning, drilling milling.
- To know the heat distribution, tool wear, tool life, various machining processes like lathe, milling, drilling, grinding etc.
- To learn various types of fixtures, conventional and unconventional machining

Course Outcomes: At the end of the course, the student shall be able to:

- Understand the geometry of single and multi-point cutting tools and tool materials
- Develop the relations for chip reduction coefficient, shear angle, shear strain, forces, power, specific energy and temperatures associated with orthogonal cutting
- Understand the practical aspects of tool wear and tool life, and their influence on machinability
- Demonstrate the fundamentals of machining processes and machine tools.
- Understand the principles of various finishing and unconventional machining processes

Unit-I

Basic chip formation process.Cutting tool materials: High carbon steel, HSS, Stellite, Carbides, Coated carbides, Diamond. Tool geometry: Nomenclature of single point cutting tool by ASA and ORS. Geometry of drills, Milling cutters and broaches.Recommended Tool angles. Chip formation: Types of chips, BUE, Chip breakers. Machining: Orthogonal and oblique cutting, Mechanics of metal cutting, Merchant's analysis, Shear angle Solutions of Merchant and Lee & Shafer.

Unit-II

Theoretical estimation of forces in turning, drilling and milling. Thermal aspects of metal cutting: Sources of heat and heat distribution, various methods of measurement of temperature, Cutting fluids and applications. Tool wear, Tool life & Machinability: Types of wear, mechanism of tool wear, Tool life & Machinability. Effects of process parameters on Tool life.Taylor's tool life equation. Economics of machining: Tool life for maximum production, minimum cost. Machining with controlled contact.

Unit-III

Constructional features and specifications of machine tools: Various operations on Lathe, Types of Lathes and special attachments on a Centre Lathe. Drilling, Milling operations.Indexingmethods.Shaper, planer and slotter and their differences. Quick return mechanisms, Automatic feed devices. Jig Boring machines-Differences between horizontal and vertical jig boring machines.

Unit- IV

Grinding machines. Types of grinding, Abrasives and bonds used for grinding wheels. Specification and selection of wheels.Principles of Broaching, Lapping, Honing, Polishing, Buffing, Super finishing and burnishing.

Screws and gear manufacturing: Screw making by tapping, Chasers, Thread rolling, Thread milling, Thread grinding. Gear shaping, Gear hobbing, Gear shaving and grinding.

Unit-V

Jigs and Fixtures: Design principles for location and clamping. Tool holding and work holding devices.Quick clamping devices.Types of Jigs and fixtures.

Unconventional machining: Principles of working and applications of USM, AJM, EDM, ECM,LBM and EBM.

Suggested Reading:

1. David A. Stephenson, Johs S. Agapiou, *Metal Cutting Theory and Practice*, CRC Press, 3rd Edition, March 2016
2. B.L. Juneja ,Shekhon G.S. and Seth Nitin, *Fundamentals of metal cutting & Machine tools*, New Age Publishers, 2003.
3. P.C. Sharma, *A Textbook of Production Engineering*, S. Chand & Company Ltd., 2010, 5th Edition
4. Amitabha Ghosh and Ashok Kumar Mallik, *Manufacturing Science*, Affiliated East-West Press Pvt. Ltd. (2010), 2nd Edition.

Course Code: PC504ME

HYDRAULIC MACHINERY AND SYSTEMS

Credits: 3

Instruction: (3L) per week — Duration of SEE: 3 hours
CIE: 30 Marks — SEE: 70 Marks

Course Objectives:

- The purpose of this course is to learn the Fluid properties and fundamentals of Fluid statics and fluid flow
- To introduce the concepts of flow measurements and flow through pipes
- To introduce the concepts of momentum principles
- To impart the knowledge on pumps and turbines.

Course Outcomes:

- Apply conservation laws to fluid flow problems in engineering applications
- Design and analyze the performance of the reciprocating pumps
- Design, estimate the unit quantities and specific parameter of centrifugal pumps
- Design, working of various types of turbines and could draw the characteristic curves of turbines
- Estimate the performance of various hydraulic equipment and systems and design with Hydraulic power controls and fluidics

Unit-I

Introduction: Classification of Hydraulic machinery. Energy transfer in hydraulic turbines.Positive displacement and Rotodynamic pumps and description of their working principles.
Dynamic action of water: Impact of water jets on flat plates and curved surfaces – single and series, stationary and moving types. Forces on hinged plates and pipe bends. Impulse – momentum equation. Flow over radial and curved vanes.

Unit-II

Reciprocating pumps: Classification, working details, theory and terms used for single and double acting pumps.Effect of acceleration head and friction. Indicator diagrams. Effect of cavitation and limiting suction head on pump speed.Variation of pressure inside pump cylinder during suction and delivery strokes. Work done, power required and efficiency. Functions of air vessels. Work saved and rate of flow from air vessels. Losses and performance curves for reciprocating pumps.Industrial applications.

Unit-III

Centrifugal pumps: Working and constructional details of single stage centrifugal pump. Installation. Priming – significance and methods of priming. Basic classification of CF pumps. Types of impellers, casings and vane shapes used.Simple and multistage pumps and their applications.Series and parallel operation of CF pumps. Theory and terminology used CF pumps. Manometric head and its importance.Manometric efficiency and other efficiencies.Losses in CF pumps. Velocity diagrams. Effect of number of vanes and outlet angle of vane on head developed. Design of radial impellers and volute casing.Origin of cavitation.Limiting suction lift and NPSH.
Principles of similarity: Unit quantities, specific speed, performance prediction from model testing. Performance and characteristic curves. Methods of balancing of end thrust in CF pump installations.

Unit-IV

Hydraulic Turbines: Classification of impulse and reaction turbines and their differences in working. Impulse turbines: Salient features and working details of Pelton wheel installation. Velocity diagrams. Calculation of number of buckets, bucket sizes and power developed. Overall efficiency, speed regulation methods.

Reaction turbines: Constructional details and working of Francis and Kaplan turbines. Draft tube in reaction turbines. Theory, types and efficiency of draft tubes. Velocity diagrams. Blade angles and blade dimensions. Power developed and efficiencies, pressure head at inlet of the runner.

Principles of similarity applied to hydraulic turbines. Unit quantities, specific speed and its significance for turbine selection.Performance prediction from model tests. Performance and characteristic curves for Pelton wheel, Francis and Kaplan turbines. Characteristic diagram.Automatic speed regulation in power plants.Losses in turbine operation. Cavitation effects in reaction turbines and remedial measures. Functions and types of surge tanks.

Unit-V

Hydraulic equipment and system: Working and simple problems on hydraulic ram, hydraulic accumulator and intensifier and hydraulic press. Working details of fluid coupling torque converter. Description of general hydraulic valves in use.

Hydraulic power controls and fluidics: General description of servo-mechanism – Block diagram, types and applications, servo valves. Description of simple valve operated and pump controlled servo mechanisms. Introduction to fluidics. Terms used and Basic concepts of fluidic devices and attachment device. Description of working of amplifiers - Bistable, proportional, Turbulence and Vertex types.

Suggested Reading:

1. Jagdish Lal, *Hydraulic Machines*, Metropolitan Book Co., 1965.
2. Modi, P.N. & Seth, S.M., *A Text book of Fluid Mechanics and Hydraulic Machines*, Standard Book House, New Delhi, 2007.
3. N.S. Govind Rao, *Fluid Flow*, Tata Mc Graw Hill, 1983.
4. R.K. Bansal, *Fluid Mechanics and Hydraulic Machines*, Laxmi Publications (P) Ltd., 2004.
   Subirkar, *Introduction to Fluidics*, Published at Oxford & IBM Publishing Co., Bombay & New Delhi, 1984

Course Code: PC505ME

METROLOGY AND INSTRUMENTATION

Credits: 3

Instruction: (3L) per week — Duration of SEE: 3 hours

CIE: 30 Marks — SEE: 70 Marks

Course Objectives:

- To familiarize with Limits & fits, I.S.O. system and the instruments used to measure these limits.
- To have knowledge of various precision linear and angular measuring instruments.
- To learn the importance of form and how to measure form errors.
- To understand the working principles of various instruments used for the measurement of strain, forces, pressure, temperature and vibrations.

Course Outcomes:

- To understand limits, fits and tolerances and their applications. Linear and angular measurements and measuring instruments.
- To understand the design of limit gauges, evaluate roughness and its measurement.
- To understand basic measuring system, static and dynamic characteristics of instruments
- To understand various principles to measure pressure, temperature, displacemt, force, torque and vibrations.

Unit-I

Limits and Fits, I.S.O. system. Types of interchangeability. Slip gauges and end bars. Height gauges, Abbe's rule, Types of micrometers. Tomlinson gauges, sine bar, autocollimator, calibration of precision polygons and circular scales. Dial indicator, Sigma mechanical comparator. Free flow and back pressure type Pneumatic comparators. Contact & non-contact tooling, Applications of single and multijet gauge heads; computation and match gauging.

Unit-II

Optical projector-measurement by comparison, movement and translation, chart gauge types and microgauge bridge lines. Tool maker's microscope, Floating carriage diameter measuring machine and coordinate measuring machine.Measurement of straightness & flatness using autocollimator.Roundness measurement with intrinsic datum (V-block, Bench centers) and extrinsic datum (TALYROND).

Unit-III

Taylor's principles for plain limit gauges. Usage and limitations of Ring and Snap gauges. Indicating type limit gauges. Position and receiver gauges, principles of thread gauging. Gauge materials and steps in gauge manufacture. General geometrical tests for machine tools. Surface roughness characteristics and its measurement. Elements of instrumentation system. Static characteristics, Systematic and random errors.

Dynamic response of first and second order instruments.

Unit-IV

Strain Measurement: Wire and foil type resistance strain gauges, Evaluation of principal strains with Rosette gauges. Desirable characteristics of gauge material, backing material and adhesive.Ballast and bridge circuits. Lead resistance compensation. Adjacent arm and self temperature compensating methods.Strain gauge calibration. Strain gauge circuits for measuring axial load, bending load and torque. Measurement of displacement with LVDT and Lasers interferometry.

Unit-V

Force Measurement: Proving ring, Strain gauge load cells, Piezo-electric load cell, Ballastic weighing, Pneumatic and hydraulic force meters. Pressure Measurement: Thermocouple vacuum gauge, High and Low pressure measuring devices. Pirani gauge, Bourdon gauge and Bulk modulus gauge, calibration methods.

Vibration measurement, accelerometers, vibration exciters, calibration of vibrometers.
Temperature measurement: Laws of thermo electricity, types of materials and junctions used in thermocouples, lead and extension wires, ambient temperature compensation, protection tubes, series and parallel circuits. RTD.Total radiation and Optical Pyrometers.

Suggested Reading:

1. R.K. Jain, *Engineering Metrology*, Khanna Publications, 1996.
2. I.C. Gupta, *A text book of engineering metrology*, Dhanpat Rai & Sons, 1984.
3. Bechwith, Marangoni, Lienhard, *Mechanical measurement*, LPE; Pearson Education Asia 2000.
4. D.S. Kumar, *Mechanical Measurements*, Metropolitan Book Co., New Delhi, 2001.
   RegaRajendra, Engineering Metrology.

Course Code: PC506ME

HEAT TRANSFER

Credits: 3

Instruction: (3L) per week — Duration of SEE: 3 hours
CIE: 30 Marks — SEE: 70 Marks

Note: During examination, charts necessary for solving problems on unsteady conduction (Heisler charts), heat exchanger charts, tables giving properties of air and water will be supplied.

Course Objectives:

- To understand the basic concepts of heat transfer.
- To study the concepts of conduction, convection, radiation and heat exchangers applicable for commercial and industrial use.
- To study and solve problems on different modes of heat transfer which are related tothermal power plants, refrigeration and air conditioning.

Course Objectives:

- To formulate heat conduction problems in rectangular, cylindrical and spherical coordinate system by transforming the physical system into a mathematical model.
- Familiarize with time dependent heat transfer and compute convective heat transfer coefficients in forced, natural convection.
- To understand radiation heat transfer, heat exchangers and mechanism involved in boiling and condensation.

Unit-I

Basic modes of heat transfer, basic laws of heat transfer, Fourier's law, Newton's law of cooling, Stefen – Boltzmann's law of thermal radiation. Conduction : general conduction equation on Cartesian, & Cylindrical coordinates.

One dimensional steady state conduction through slabs, hollow cylinders and spheres with and without heat generation.

Effect of variable thermal conductivity in heat transfer for one dimensional steady state conduction in plates.Steady state heat transfer through composite plates, cylinders and spheres.Critical radius of insulation.

Two dimensional steady state heat transfer in a plate with prescribed temperatures at the boundary.

Unit-II

FINS: Heat transfer analysis of a body with negligible internal temperature gradients.

Unsteady state conduction:

Lumped parameter analysis of a body with negligible internal temperature gradients. Transient heat transfer analysis of an infinite slab with specified temperature and connective boundary conditions. Use of Grover &Heisler charts for solving problems of infinite slabs, cylinders, spheres.

Unit-III

Convection: Buckingham theorem and use of dimensional analysis in free and forced convection, Physical significance of different dimensionless numbers.

Concept of hydrodynamic and thermal boundary layers.Reynlod's analogy for turbulent flow over flat surfaces.Mixing cup temperature in pipe flows.Calculation of heat transfer for flow over plates, cylinders and in pipes in free and forced convection using empirical formulae.

Unit-IV

Radiation: Absorptivity, reflectivity and transmitivity definitions. Concept of a blackbody and emissivity.Kirchoff's law.Lambert's cosine law, Plank and Wein's laws.Stefen-Boltzmann's law.Monochromatic and total emissive power.Hemispherical emissive power.Radiant exchange power.Radiant exchange between two grey surfaces. Shape factors. Radiant exchange between two infinite parallel plates and between concentric cylinders. Radiation shields.

Unit-V

Heat Exchangers: Classification and applications of heat exchangers in industry. Analysis and design of counter flow and parallel flow heat exchangers (shell and tube type) and condensers. Solving problems for multipass heat exchangers using non dimensional parameter plots.

Change of Phase

Boiling: Pool boiling regimes, nucleate pool boiling.

Condensation: Film condensation, dropwise condensation. Nusselt's analysis to determine condensate film thickness and heat transfer coefficient in film condensation.

Suggested Reading:

1. J.P. Holman, *Heat Transfer*, McGraw Hill Book Company, 1986.
2. S.C. Arora and S. Domkundwar, *A course in Heat and Mass Transfer*, Dhanpatrai& Sons, New Delhi, 2000.
3. D.S. Kumar, *Heat and Mass Transfer*, S.K. Kataria& Sons, New Delhi.
4. Frank. P. Incropera& David P. Dewitt, *Fundamentals of Heat & Mass Transfer*, John willey& Sons, 1990.

Course Code: PC901SOC

GENDER SENSITISATION

3 Units

Instruction: (3L) per week — Duration of SEE: 3 hours

CIE: 30 Marks — SEE: 70 Marks

Course Objectives:

- To develop students' sensibility with regard to issues of gender in contemporary India.
- To provide a critical perspective on the socialization of men and women.
- To introduce students to information about some key biological aspects of genders.
- To help students reflect critically on gender violence.
- To expose students to more egalitarian interactions between men and women.

Course Outcomes:

- Students will have developed a better understanding of important issues related to gender in contemporary India.
- Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film.
- Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
- Students and professionals will be better equipped to work and live together as equals.
- Students will develop a sense of appreciation of women in all walks of life.

UNIT I

UNDERSTANDING GENDER: Why Should We Study It? Socialization: Making Women, Making Men: Introduction-Preparing for Womanhood-Growing up male-First lessons in caste-Different Masculinities; **Just Relationships: Being Together as Equals:** Mary Kom and Onler- Love and acid just do not mix-Love Letters-Mothers and Fathers-Further reading: Rosa Parks-The brave heart.

UNIT II

GENDER AND BIOLOGY: Missing Women: Sex Selection and Its Consequences - Declining sex ratio-.Demographic Consequences; **Gender Spectrum: Beyond the Binary -** Two or many? - Struggles with discrimination; **Our Bodies, Our Health.**

UNIT III

GENDER AND LABOUR: Housework: the Invisible Labour :"My mother doesn't work"- "Share the Load"; **Women's Work: Its Politics and Economics:** Fact and fiction-Unrecognized and unaccounted work- Wages and conditions of work.

UNIT IV

ISSUES OF VIOLENCE: Sexual Harassment: Say No! : Sexual harassment- not eve-teasing- Coping with everyday harassment- "Chupulu"; **Domestic Violence: Speaking Out :** Is home a safe place? When women unite-Rebuilding lives- New forums for justice; **Thinking about Sexual Violence:** Blaming the victim-"I fought for my life." - The caste face of violence.

UNIT V

GENDER STUDIES: Knowledge- Through the Lens of Gender - Point of view- Gender and the structure of knowledge- Unacknowledged women artists of Telangana; **Whose History? Questions for Historians and Others:** Reclaiming a past- Writing other histories- Missing pages from modern Telangana history.

Suggested Reading:

1. A.Suneetha, Uma Bhrugubanda, DuggiralaVasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, GoguShyamala, Deepa Sreenivas and Susie Tharu, "*Towards a World of Equals: A Bilingual Textbook on Gender*" Telugu Akademi, Hyderabad, 1st Edition, 2015.
2. www. halfthesky .cgg.gov.in

Course Code: PE551ME

MANUFACTURING PROCESS LAB.

Credits: 1

Instruction: (2P) per week — Duration of SEE: 3 hours

CIE: 25 Marks — SEE: 50 Marks

Course Objectives:

- To understand the manufacturing processes, preparation of sand mould, casting process
- To learn about electrode composition and different welding processes like arc, gas, spot, TIG, MIG welding.
- To know the forming process.

Course Outcomes:

- Able to test sand properties, make gating system and prepare mould for sand casting.
- Able to join materials using different welding techniques, study of welding properties and defects
- Able to manufacture components using drawing, blanking, piercing, extrusion and sheet metal forming.

Foundry:

1. Study of foundry setup, equipment and the displayed charts with particular attention to moulding machines, sand muller, shell moulding machine & centrifugal casting machine.
2. Mixing and preparation of molding sand samples, Testing of greensand properties.
3. Preparation of molding sand aggregate and simple moulds of greensand complete with sprues, gates and risers.
4. Exercise of melting and casting involving prepared moulds, aluminium metal and crucible furnace. Cleaning of castings, study of the features of the final casting, its features and any visible defects.

Welding:

1. Study of the welding equipment and tools related to Arc, gas and resistance welding & displayed charts.
2. Practice of Arc, Resistance Spot, Resistance Butt and Gas welding. Identification of different types of gas flames.
3. Experimental study of
   (a) Electrode characteristics of SMAW.
   (b) Arc length and welding speed on bead characteristics.
   (c) Welding current on bead penetration.
4. Determination of weld characteristics using DC and AC power sources.
5. TIG and MIG welding process - study and exercises.

Forming:

1. Study of the forming equipment: Different types of mechanical presses and hammers, Metal spinning Lathe.
2. Conventional extrusion of metals.
3. Study of sheet metalworking dies and sheet metal working with existing dies.
4. Testing of metals: Fatigue tests. Testing of sheet metals for formability by using Erichson cupping test.
5. Study of HERF processes. Sheet metal forming with water hammer forming equipment.

Course Code: PE552ME

DYNAMICS LAB.

Credits: 1

Instruction: (2P) per week — Duration of SEE: 3 hours

CIE: 25 Marks — SEE: 50 Marks

Course Objectives:

- To understand the effects and importance of kinematic and dynamic analysis of mechanisms
- To understand effects and analysis of Single degree freedom vibration systems
- To study the gyroscope, governors and cams
- To carry out the static and dynamic analysis of four bar mechanisms and drives

Course Outcomes:

- To find out natural frequencies of various beams with different constraints
- Evaluate static and dynamic balancing of masses
- To find the gyroscopic effect on vehicles
- To find out kinematic and dynamic behavior of mechanisms

Experiments to be conducted:

Study experiment on:

1. Free vibration of Cantilever Beam
2. Free vibration of Simply Supported Beam
3. Free/ Forced vibrations of a SDOF systemto find Moment of Inertia of a connecting rod
4. Modal analysis of a composite beam
5. Modal analysis of a disc
6. Balancing of Rotors
7. Centrifugal governors
8. Mechanical gyroscope
9. Static & Dynamic Balancing m/c
10. Study experiment on cam analysis

MSC ADAMS SOFTWARE

Simulation of kinematic and dynamic analysis of:

11. Grashoff 4 bar mechanism
12. Non Grashoff 4 bar mechanism
13. Slider crank mechanism
14. Double slider mechanisms
15. Gear (spur, helical, bevel) systems
16. Pulley, rope and chain systems
17. Cam drive systems.

Course Code: PE501ME

MECHANICAL VIBRATIONS

Credits: 3

Instruction: (3L) per week Duration of SEE: 3 hours
CIE: 30 Marks SEE: 70 Marks

Course Objectives:

- To gain the knowledge of mathematical modeling of a physical system and applying the principles of Newton's Second Law and conservation of energy to derive the equations of motion.
- To familiarize with linear systems with degrees of freedom.
- To study the response of a vibrating system with periodic excitation and understand the principle of vibration isolation.

Course Outcomes:

- Develop a mathematical model for a physical system and derive the governing differential equations.
- Determine the natural frequencies of single and two degrees of freedom systems.
- Determine and analyze the response of machine members or structures in forced vibration with different excitation frequencies.
- Determine the natural frequencies and mode shapes of bars in elongation and torsion and beams in bending.

UNIT-I

Fundamentals of Vibrations Analysis- Introduction; Elements of vibration; vibration analysis procedure; spring elements-equivalent stiffness; Mass or inertia elements; Damping elements-equivalent damping-Types of damping, Definitions and Terminology, Simple harmonic motion.

Free Vibration Analysis-Single Degree of Freedom Systems Undamped Vibrations: Different methods for equation of motion-Newton's Second Law, D'Alembert's Principle of Virtual displacement, Principle of Conservation of Energy, Rayleigh's method.

Damped Vibrations: Differential equation of motion, critical damping coefficient and damping ratio; Damped natural frequency; Logarithmic decrement; Energy dissipated in viscous damping.

UNIT-II

Forced Vibration Analysis (Single Degree of Freedom System):Response of damped and undamped systems to harmonic excitation; frequency response curve; magnification factor; Harmonic excitation of the base, vibration isolation, transmissibility, force transmission to foundation; response of a damped system under rotating unbalance. Vibration measuring instruments-working principle of Seismic mass, Vibrometer, Accelerometer.

UNIT-III

Damped and Undamped Vibrations: Free and forced vibration analysis of two degree of freedom system-different methods for the formulation of equations of motion, natural frequencies, Principal modes-physical interpretation and orthogonality.

UNIT-IV

Torsional Vibrations: Torsional vibration of one, two and three rotor system, Equivalent shafting, Torsional vibration of a geared system, Coordinate coupling-static and dynamic coupling, whirling of rotating shafts.

UNIT-V

Numerical methods: Characteristic equation, Eigen values, identification of node and mode shapes. Eigen value method, Influence coefficients.

Suggested Readings:

1. G.S. Grover &Nigam ,MechanicalVibrations,Nem Chand & Bros, 6th edn,1998
2. S.S. Rao ,Mechanical vibration, 4th edn, Pearson, 2009
3. Thomson , William T, Theory of Vibration with Application,4th edn, Pearson Education,2007
4. V.P. Singh , Mechanical vibration, Dhanpath Rai &Co.,3rd edn,2006
5. Graham Kelley,S., Mechanical vibration – Schaums Outline Series, TMH
6. F.S. Tse, Morse &Hinkle ,Mechanical vibration, Allyn and Bacon, 1978

Course Code: PE502ME

POWDER METALLURGY

Credits: 3

Instruction: (3L) per week — Duration of SEE: 3 hours

CIE: 30 Marks — SEE: 70 Marks

Course Objectives:

- To understand the importance and advantages of Powder Metallurgy.
- To learn the steps of powder metallurgy-powder properties, mixing, compaction, sintering, post sintering operations, testing.

Course Outcomes:

Unit-I

Introduction, importance and advantages of Powder Metallurgy.

POWDER MANUFACTURE: Comminution, solid state reduction, electrolysis, thermal decomposition, and Atomization (water atomization, oil atomization, gas atomization, centrifugal atomization).

Unit-II

POWDER PROPERTIES, CHARACTERIZATION, AND MIXING: Chemical composition, particle shape, powder density, particle size, size distribution compressibility, green strength. Blending and mixing.

COMPACTION: Compact size, tool materials, design of sintered part, Olivetti process hot pressing, injection moulding, cold iso-static pressing, and hot iso-static pressing.

Unit-III

SINTERING: Theory of sintering. Sintering practice – furnace desing, furnace atmospheres, vacuum sintering, control of shrinkage, liquid phase sintering, activated sintering, and loose powder sintering.

Unit-IV

POST-SINTERING OPERATIONS: Re-press and re-enter, hot re-press, hot forge in a closed die, sizing, coining, HIP, steam treatment, infiltration, and impregnation. Heat treatment, hardening, and tempering, surface hardening, electro-plating, and other coatings. Deburring, machining and joining. Sinter forging.

Unit-V

Testing of sintered parts. Applications: Porous bearings and filters. Magnetic Materials, super alloys, High speed steels, Stainless steels, ODS materials, Production of Near-net shapes, Rapidly solidified powders, and spray forming. Manufacturing of Cutting tools, forming dies using powder metallurgy.

Suggested Reading:

1. E.P. DeGarmo, J.T. Black, R.A. Kohser, Materials and processes in manufacturing – 8th Ed., Prentice Hall, 1997.
2. Roy A. Lindberg, Processes and materials of manufacture – 4th Ed., Prentice Hall of India Pvt. Ltd., New Delhi, 1995.
3. H.H. Hausner – Hand book of powder metallurgy.

Course Code: PE503ME

ROBOTIC ENGINEERING

Credits: 3

Instruction: (3L) per week | Duration of SEE: 3 hours
CIE: 30 Marks | SEE: 70 Marks

Course Objectives:

- To provide student the fundamental knowledge of the various sub-disciplines in serial robots such as kinematics, dynamics, control & manipulation, and computer based acquisition etc.
- To provide adequate background in both analysis and design of serial robots

Course Outcomes:

UNIT-I

Introduction to Robotics Basic structure of Robots.Degree of freedom of Robots. Work envelope. Classification of Robots based on drive Technology, Work-Envelope and motion control methods. Application of Robots in Industry.Specification of requirement of motion and force for different application. Repeatability, Precision and Accuracy as applied to Robots.

UNIT-II

Rotation matrix.Homogeneous transformation matrix.Denavit and Hartenbergrepresentation.Euler angles and RPY representation.Representation of absolute position and orientation in terms of joint parameters, Kinematic equation for manipulators.Inverse kinematics of Robot arm for position and orientation.Redundancy in Robots.

UNIT-III

Jacobian for direct and inverse kinematics.Trajectory planning for Robots.Trajectory control based on incremental inverse kinematics of kinematic equations, Static force analysis, stiffness.

UNIT-IV

Newton - Euler formulation of dynamic equation.Lagrangianformulation.Inertia tensor. Control schemes, individual joint control and disadvantages. Control through computed torques.

UNTT-V

Position and velocity measurement.Optical encoders. Different types of End effectors for industrial Robots. Range and Proximity sensing.Tactilesensors.Force and Torque sensors. Drives used in industrial Robots. Introduction to techniques used in Robot vision. Image acquisition and processing.Introduction to Robot programming.

Suggested Reading:

1. Fu. K.S., GonZalez R.C., Lee C.S.G. "Robotics, Control-sensing vision and Intelligence", McGraw Hill, Int. Ed., 1987.
2. Asada and Sllotine , ‘robot analysis and intelligence’ BS Publications , India.
3. Spong and Vidyasagar, "Robot Dynamics & Control", John Wiley and Sons, Ed.,1990.
4. Groover M P, "Industrial Robotics", McGraw Hill Publications, 1999.
5. Mittal and Nagrath, "Industrial Robotics", Tata McGraw Hill Publications, 2004.
   Saha&Subirkumarsaha, ‘robotics’, tmh, india.

Course Code: PE504ME

THEORY OF ELASTICITY

Credits: 3

Instruction: (3L) per week — Duration of SEE: 3 hours

CIE: 30 Marks — SEE: 70 Marks

Course Objectives:

- To familiarize stress and strain.
- To understand problems on bending, torsion, thin wall, thick wall and columns

Course Outcomes:

Unit-I

Analysis of Stress: Stress tensor, Equilibrium equations in Cartesian coordinates, Two dimensional stress at a point and principal stresses. Three dimensional stress at a point and principal stresses. Stresses on an oblique plane in terms of principal stresses.

Unit-II

Analysis of Strain: Strains in terms of displacements in Cartesian coordinates, Equations of compatibility, Generalised Hook's Law and Lame's constants, Strain energy, Dilational and distortional energy, St. Venant's principle.

Unit-III

Two dimensional problems: Plane stress, Plane strain problems: Stress function, Bi-harmonic equation, Equilibrium equations, Strain displacement relations and compatibility equations in polar coordinates, Stress concentration.

Unit-IV

Bending of straight beams and curved beams. Torsion of shafts, Membrane analogy.Bending of plates.

Unit-V

Axi-symmetric problems, Thick walled cylinders subjected to internal and external pressures, Stresses in composite tubes, Rotating disks of uniform and variable thickness. General treatment of column stability problems.

Suggested Reading:

1. L.S. Srinath, *Advanced Mechanics of Solids*, Tat Mc Graw Hill Publ. Co., 1970.
2. S. Timeshenko& J.N. Goodier, *Theory of Elasticity*, Mc Graw Hill, 1970.
3. A.C. Uguaral, *Advanced Strength and Theory of Elasticity*, Elsevier Publication, 1965.
4. S. Singh, *Theory of Elasticity*, Khanna Publishers, 1979.