Semester V						
S.No	Course Code	Course Name	L	T	P	C
1	ME 223	Manufacturing Processes - II	2	1	0	6
2	ME 324	Design of Machine Elements	3	0	0	6
3	ME 302	Applied Thermodynamics	3	0	0	6
4	ME 314	Heat Transfer Laboratory	0	0	3	3
5	ME 312	Solid Mechanics Laboratory	0	0	3	3
6	ME 311	Mechanical Measurements Laboratory	0	0	3	3
7	EE 227	Data Analysis (2nd Half)	3	0	0	3
8		Elective 1	3	0	0	6
		Total Credits				36

1	**Title of the course** (L-T-P-C)	**Manufacturing Processes II** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	--
3	**Course content**	Material Removal Processes: Mechanics of Machining, tool geometry and materials, chip formation, tool temperature, tool wear, tool life, surface finish, machinability. Optimization of machining processes. Machine Tools: Generation of surfaces by machining, basic operations on shaping, slotting and planning machines, lathe, drilling and boring machines and grinding machines. Process Parameters and setups. Production Machines: Capstan and turret lathes, automats, broaching machines, centreless grinding machines. Special purpose machines for thread cutting and gear cutting (hobbing and shaping). Finishing processes honing, laping burnishing and deburring. Introduction to modern machining processes: EDM, ECM, LASER, Jigs and fixtures, principles of location and clamping, synthesis of simple jigs and fixtures. Principles of assembly engineering, theory of dimensional chains, fully interchangeable and selective assembly. Introduction to Numerical Control.
4	**Texts/References**	1. G. Boothroyd and W. A. Knight, Fundamentals of Machining and Machine Tools, Marcel Dekker, 1989. 2. A. Ghosh and A. K. Mallik, Manufacturing Science, Affiliated East West Press, 1985. HMT, Production Technology, Tata McGraw Hill, 1980. 3. J. Mcgeough, Advanced Methods of Machining, Chapman and Hall, 1988. 4. M. F. Spotts, Dimensioning and Tolerancing for Quality Productions, Prentice Hall, 1983..

1	**Title of the course** (L-T-P-C)	**Design of Machine Elements** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	**Fundamentals of Mechanical Engineering Design**: Mechanical engineering design, Phases of design process, Design considerations, Engineering Materials and their Mechanical properties, Standards and Codes, Factor of safety, Material selection, Static Stresses: Static loads. Normal, Bending, Shear and Combined stresses, Stress concentration factor **Design for Impact and Fatigue Loads**: Impact stress, Fatigue failure: Endurance limit, S-N Diagram, Stress concentration effects, Notch sensitivity, fluctuating stresses, Goodman & Soderberg relationship, cumulative fatigue damage.Curved Beams: Stresses in curved beams of standard cross sections used in crane hook, punching presses & clamps, closed rings and links **Threaded Fasteners & Power Screws:** Stresses in threaded fasteners, effect of initial tension, design of threaded fasteners under static loads, eccentrically loaded bolted joints, types of power screws, efficiency & self-locking, design of power screw, screw jack: (complete design) **Riveted Joints & Weld Joints:** Rivet types, rivet materials, failures of riveted joints, efficiency, boiler joints, Lozanze joints, riveted brackets, eccentrically loaded joints, types of welded joints, strength of butt, fillet welds, Welded brackets with transverse & parallel fillet welds, eccentrically loaded welded joints **Design of Shafts, Joints, Couplings and Keys:** Torsion of shafts, design for strength and rigidity with steady loading, ASME codes for power transmission shafting, shafts under combined loads. Rigid and flexible couplings, Flange coupling, Bush and Pin type coupling and Oldham's coupling, Design of Cotter and Knuckle joints, Design of keys- square, saddle, flat and feather **Mechanical Springs & Flexible mechanical Elements:** Types of springs, spring materials, stresses in helical coil springs of circular & non-circular cross sections. Tension & compression springs, concentric springs; springs under fluctuating loads Belts: Materials of construction of flat & V belts, power rating of belts,concept of slip and creep, initial tension, effect of centrifugal tension, maximum power condition, Selection of flat & V belts, length & cross section from manufacturers' catalogues. Construction & application of timing belts, Wire ropes: Construction of wire ropes, stresses, selection of wire ropes. Chain drive: Types of power transmission chains, modes of failure for chain, & lubrication of chains **Gear drives, Clutches & Brakes:** Classification of gears, materials for gears, standard systems of gear tooth, gear tooth failure modes and lubrication of gears, Spur Gears, Design of Clutches, Design of Brakes **Bearing Design:** Lubricants, their properties, bearing materials, properties; mechanisms of lubrication, hydrodynamic lubrication, Numerical examples on hydrodynamic journal & thrust bearing design, static, dynamic load carrying capacities, equivalent bearing load, load life relationship; probability of survival
4	**Texts/References**	**TEXTBOOKS:** 1. **Mechanical Engineering Design**, Joseph E Shigley and Charles R. Mischke. McGraw Hill International edition, 6th Edition, 2009. **REFERENCES:** 2. **Machine Design, Robert L. Norton, Pearson Education Asia, 2001. DATA HANDBOOK: Design Data Hand Book**, K. Lingaiah, McGraw Hill, 2nd Ed.

1	**Title of the course** (L-T-P-C)	**Applied Thermodynamics** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	Introduction to the Course, General Scheme of things, Energy Resources, Heat Engines. Recap of I law for Closed and Open Systems. Classification of cycles as Open/Closed, Refrigeration/Power, Multi-component/ Single- component, Internal combustion/ external combustion, etc. Performance parameters: Network, thermal efficiency, heat rate, specific fuel consumption, work ratio, specific output, mean effective pressure, volumetric efficiency, COP, refrigeration effect. Carnot vs. other cycles. General stoichiometry and definition of terms (rich mixture, lean mixtures). Heat of formation, Heat of reaction, Calorific Value of fuel, Estimation methods for Calorific values, Exhaust Gas Analysis, Orsat Apparatus. Otto Cycles, Diesel Cycles, Air-standard cycles and Actual cycles, Dual cycle, p-theta diagram. Combustion and knocking in SI engine. Combustion and knocking in CI engine. Carburetion. Brayton cycle with explanation of various terms Modifications of Brayton cycle. Rankine cycle. Modifications to Rankine cycle. Feed Water Heaters and analysis. Moisture separators/ application of Rankine to Nuclear power plants. Vapour Compression and Reverse Brayton Cycles Vapour Absorption Cycles. Psychrometry. Reciprocating, rotary and centrifugal Compressors. Gas Power Cycles: Simple gas turbine cycle - single and twin shaft arrangements, intercooling, reheating, regeneration, closed cycles, optimal performance of various cycles, Ideal vs Real cycles; Jet Propulsion: turbojet, turboprop, turbofan, ramjet, thrust and propulsive efficiency; Rocket Propulsion; Direct Energy Conversion: thermionic and thermoelectric converters, photovoltaic generators, MHD generators, fuel cells.
4	**Texts/References**	1. Moran M. J. and H. N. Shapiro., Fundamentals of Engineering Thermodynamics, Third Edition, Wiley, New York, 1995. 2. Cengel Y. A. and Boles M. A., Thermodynamics: An Engineering Approach, McGraw Hill, 3rd Ed., 1998 3. Dossat R. J. and Horan T. J., Principles of Refrigeration, Pearson Education, 4th Indian Reprint, 2004. 4. Arora C. P., Refrigeration and Air-conditioning, Tata McGraw Hill, 2nd Ed., 2003. 5. H I H Saravana muttoo, G F C Rogers and H. Cohen, Gas Turbine Theory 4e, Pearson, 2003

1	**Title of the course** (L-T-P-C)	**Heat Transfer lab** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	1. Measurement of thermal conductivity of a composite material 2. Measurement of convective heat transfer coefficient 3. Transient heat conduction 4. Heat transfer through fins 5. Jet impinging 6. Boiling and Condensation 7. Critical heat flux measurement 8. Emissivity measurement 9. Heat flux meter calibration 10. Heat transfer in the tubular heat exchanger 11. Heat transfer by radiation
4	**Texts/References**	1. Incropera F. P. and Dewitt D. P., Fundamentals of Heat and Mass Transfer, 5th Ed., Wiley and Sons, New York, 2002. 2. Gayler J. F. W. and C. R Shotbolt, Metrology for Engineers, ELBS, 1990.

1	**Title of the course** (L-T-P-C)	**Solid Mechanics Lab** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	**List of Experiments:** • Calibration of photoelastic material using a disk under diametral compression, a beam under four-point bending and an uni-axial tensile specimen; and SCF evaluation in a circular ring, acrane hook and a plate with hole. • Stresses in thin pressure vessels using strain gauges; • Deflection of curved beams – a ring, a semi-circular ring, a quadrant and an angular davit • Stability of columns – To evaluate the buckling load for different materials (Steel, Copper,Aluminium and Brass) under different end conditions (Hinge-Hinge and Hinge-fixed condition) • Hardness test – Rockwell, Vickers and Brinell Hardness test • Impact testing machine: Izod and Charpy test • Torsion testing machine Tests of UTM: Tension (Ductile and Brittle), compression (brittle and ductile),bending ofbeam, leaf spring characteristics
4	**Texts/References**	1. S. Crandall, N. Dahl, S. Lardner, An Introduction to Mechanics of Solids, Tata MG Hill, 2012. 2. E.P. Popov, Engineering Mechanics of Solids, Prentice Hall, 2012. 3. Gere abd Goodno, Mechanics of Materials, 7th ed., Cengage Learning India, 2012.Gere and Timoshenko, Mechanical of Materials, CBS Publishers,1986.

1	**Title of the course** (L-T-P-C)	**Mechanical Measurements Lab** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	Exposure to Mechanical Measurements
3	**Course content**	**List of experiments:** • Study of the output characteristics of RC circuit for various inputs (Sine wave, square wave and step input) • Study of the output characteristics of LRC circuit for various inputs (Sine wave, square wave and step input) • Study of the working of orifice meter, venturi meter and rotameter • Steady state and transient calibration of temperature sensors (thermocouple and RTD) • Steady state and transient calibration of pressure sensors • Measurement of rotational speed by encoder, infrared sensor and stroboscope • Measurement of stress/strain through strain gage rosettes • Utility of operational amplifiers for generation of square wave, differentiator and integrator Study of Analog to digital converter and digital to analog converter
4	**Texts/References**	1. E.O. Doebelin, Measurement systems: Application and Design, Fourth Ed., 1990, McGrawHill. 2. Richard S. Figliola, Donald E. Beasley, Theory and Design for Mechanical Measurements, John Wiley and Sons.

1	**Title of the course** (L-T-P-C)	**Data Analysis** **(3-0-0-3)**
2	**Pre-requisite courses(s)**	Introduction to Probability
3	**Course content**	The role of statistics. Graphical and numerical methods for describing and summarizing data. Sampling variability and sampling distributions, Estimation using a single sample, Hypothesis testing using a single sample, Comparing two populations or treatments, Simple linear regression and correlation, and Case studies.
4	**Texts/References**	Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists," Elsevier, New Delhi, 3rd edition (Indian), 1987. Papoulis and Pillai, "Probability, Random Variables and Stochastic processes," 4th Edition, Tata McGraw Hill, 1991. William Feller , "An Introduction to Probability Theory and Its Applications," Vol. 1, 3rd edition, John Wiley International, 1968.