Shri Shamrao Patil (Yadravkar) Educational & Charitable Trust's
Sharad Institute of Technology College of Engineering
(An Autonomous Institute)
Yadrav (Ichalkaranji)-416121, Dist. – Kolhapur

Teaching and Evaluation Scheme for T Y B. Tech.

Semester: V and VI

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Department: Mechanical Engineering **Rev:** MECH Course Structure/00/2020-21

Class: T. Y. B. Tech. **Semester:** V

Course Code	Course Type	Course	Teaching Scheme				Evaluation Scheme					Credits
			L	T	P	Total Hrs	CA1	CA2	MSE	ESE	Total	
ME501	PCC	Heat Transfer	3	-	-	3	10	10	30	50	100	3
ME502	PCC	Machine Design-I	3	-	-	3	10	10	30	50	100	3
ME503	PCC	Metrology and Quality Control	3	-	-	3	10	10	30	50	100	3
ME504	PEC	Elective-II	3	-	-	3	10	10	30	50	100	3
OEXXX	OEC	Open Elective-I	3	-	-	3	10	10	30	50	100	3
ME505	PCC	Heat Transfer Laboratory	-	-	2	2	15	15	-	20	50	1
ME506	PCC	Machine Design-I Laboratory	-	-	2	2	25	25	-	-	50	1
ME507	PCC	Metrology and Quality Control Laboratory	-	-	2	2	15	15	-	20	50	1
ME508	PCC	Turbo-machinery Laboratory	-	-	2	2	15	15	-	20	50	1
ME509	PCC	Automobile Engineering Laboratory	-	-	2	2	25	25	-	-	50	1
ME510	MC	Account and Finance Management	2	-	-	2	25	25	-	-	50	Audit
PROJ04	PROJ	Mini Project-IV	-	-	2	2	25	25	-	-	50	1
ME511	MC	Industrial Safety	2			2	25	25	-	-	50	Audit
HMS05	HSMC	Aptitude Skills-III	1	-	-	1	25	25	-	-	50	1
HMS06	HSMC	Language Skills-III	-	-	2	2	25	25	-	-	50	Audit
			20	**-**	**14**	**34**	**270**	**270**	**150**	**310**	**1000**	**22**

Elective II

ME504A: Turbo Machinery
ME504B: Dynamics of Machinery and Synthesis of Mechanism
ME504C: Additive Manufacturing
ME504D: Experimental Stress Analysis
ME504E: Quantitative Techniques for Project Management

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Sharad Institute of Technology College of Engineering

(An Autonomous Institute)

Yadrav (Ichalkaranji)-416121, Dist. – Kolhapur

Department: Mechanical Engineering **Rev:** MECH Course Structure/00/2020-21

Class: T. Y. B. Tech. **Semester:** VI

Course Code	Course Type	Course	Teaching Scheme				Evaluation Scheme					Credits
			L	T	P	Total Hrs	CA 1	CA2	MSE	ESE	Total	
ME601	PCC	Internal Combustion Engines and Hybrid Vehicles	3	-	-	3	10	10	30	50	100	3
ME602	PCC	Machine Design-II	3	-	-	3	10	10	30	50	100	3
ME603	PCC	Advanced Manufacturing Processes	3	-	-	3	10	10	30	50	100	3
ME604	PEC	Elective-III	3	-	-	3	10	10	30	50	100	3
OEXXX	OEC	Open Elective-II	3	-	-	3	10	10	30	50	100	3
ME605	PCC	Internal Combustion Engines and Hybrid Vehicles Laboratory	-	-	2	2	15	15		20	50	1
ME606	PCC	Machine Design-II Laboratory	-	-	2	2	25	25			50	1
ME607	PCC	Advanced Manufacturing Processes Laboratory	-	-	2	2	25	25			50	1
ME608	PCC	CAD/CAM/ CAE Laboratory	-	-	2	2	15	15		20	50	1
ME609	PCC	Sensor and Instrumentation Laboratory	-	-	2	2	25	25			50	1
PROJ05	PROJ	Capstone Project Phase-I	-	-	4	4	25	25		50	100	2
IFT02	PROJ	Industrial Training/ Field Training	-	-	-	-	-	-		50	50	Audit
HMS07	HSMC	Aptitude Skills-IV	1	-	-	1	25	25	-	-	50	Audit
HMS08	HSMC	Language Skills-IV	-	-	2	2	25	25	-	-	50	1
			16	**-**	**16**	**32**	**230**	**230**	**150**	**390**	**1000**	**23**

Elective III

ME604A: Power Plant Engineering
ME604B: Process Planning and Cost Estimation
ME604C: Finite Element Analysis
ME604D: Industrial Automation and Robotics

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Semester-V
Heat Transfer

ME501	PCC	Heat Transfer	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment 1: 10 Marks Continuous Assessment 2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Thermal Engineering, Fluid Mechanics

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain the basic laws of heat transfer, various modes of heat and mass transfer.
CO2	Formulate and evaluate solution for one dimensional steady state heat conduction and unsteady state heat conduction problems
CO3	Explain use of fins and evaluate effectiveness and efficiency if fin in heat transfer problems
CO4	Calculate heat transfer coefficient for free and forced convection heat transfer.
CO5	Formulate and solve the Heat Exchanger Rating and Sizing problems.
CO6	Evaluate radiation view factors and solve radiation heat transfer problems.

Course Contents:

Unit 1: Introduction to Heat and Mass Transfer Modes of heat transfer, basic laws of heat transfer, Thermal conductivity and its variation with temperature for various engineering materials, Derivation of generalized differential equation of heat conduction, **Introduction to mass transfer**: Modes of mass transfer, Analogy between heat, mass and momentum transfer, Fick's law of diffusion. (Description only) Concept of Nano-fluids and introduction to CFD analysis (Description only)	[6]
Unit 2: Heat Conduction without and with Heat Generation and Unsteady State Heat Conduction One dimensional steady state heat conduction without heat generation: heat conduction through plane wall, cylinder, sphere, Electrical analogy; concept of thermal resistance and	[6]

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conductance, Composite slab, composite cylinder and composite sphere, Critical radius of insulation for cylinder and sphere, the economic thickness of insulation (Numerical Treatment). One dimensional steady state heat conduction with uniform heat generation, heat conduction for plane wall, cylinder and sphere (Numerical Treatment). Unsteady state heat conduction: Lumped heat capacity analysis, Biot and Fourier number and their significance Numerical Treatment), use of Hiesler and Grober charts (Description only)	
Unit 3: Heat Transfer through Extended Surfaces Boundary and Initial Conditions, Types and applications of fins, Heat transfer from rectangular and pin fins, Fin effectiveness and efficiency, Numerical treatment on fins, Error estimation in temperature measurement in thermos-well (Numerical Treatment)	[6]
Unit 4: Fundamentals of Convection Concept of the hydrodynamic and thermal boundary layer, Local and average convective coefficient for laminar and turbulent flow for flat plate and pipe, Dimensional analysis in free and forced convection, physical significance of the dimensionless numbers related to free and forced convection, empirical correlations for free convection and forced convection for heat transfer in laminar and turbulent flow over a flat plate and through a duct, Numerical treatment on free and forced convection.	[6]
Unit 5: Heat Exchangers and Phase Change Phenomenon Classification and types of heat exchangers, fouling factor, and overall heat transfer coefficient, heat exchanger analysis using LMTD and NTU methods for parallel and counter flow, design consideration of heat exchangers and introduction to design standards like TEMA, compact heat exchangers (Numerical Treatment on LMTD and NTU methods) **Nucleate and film boiling phenomenon**: drop wise and film wise condensation, Nusselt's theory of condensation nature of heat transfer in such phenomenon, Heat pipe component and working principle. (Description only)	[6]
Unit 6: Radiation Fundamental concepts, Black body radiation, Planck's distribution law, Wien's displacement law and the Stefan-Boltzmann law, Surface emission, radiative properties of a surface, The grey, black and real surface, Radiation shape factor, use of shape factor charts, Kirchhoff's law, Lambert's cosine law, Heat exchange between non-black bodies, heat exchange between two infinitely parallel planes and cylinders, Radiation shields, heat exchange by radiation, between two finite black/gray surfaces, Gas radiation, Solar radiation, irradiation, radiation potential, electrical network method of solving radiation problems.	[6]
Text Books: 1. "Engineering Heat and Mass Transfer", Mahesh M. Rathore, Laxmi Publications Pvt	

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Limited, 2006N. P. Bali, A Text Book of Engineering Mathematics, Laxmi Publications, New Delhi.
2. "A Text Book on Heat Transfer", Dr. S. P. Sukhatme, Orient Longman, Hyderabad (2005)
3. P.K. Nag, "Heat Transfer", Tata McGraw Hill Publishing, 5th edition, 2008
4. Incropera and Dewitt, "Fundamentals of Heat and Mass Transfer", Wiley publications, 2nd edition, 2007
5. "Fundamentals of Heat and Mass Transfer", R. C. Sachdeva, Willey Eastern Ltd., 2012
6. "Heat and Mass Transfer", S. C. Arora and S. Domkoundwar, Dhanpat Rai and Sons, Delhi (2012)

Reference Books:

1. Yunus A. Cengel, "Heat Transfer: A Practical Approach", McGraw-Hill Higher Education, 2002.
2. J.P. Holman: "Heat Transfer"; McGraw-Hill, 1996
3. Latif M. Jiji, "Heat Conduction", Springer, 3rd edition, 2009.
4. H. Schlichting, K. Gersten, "Boundary Layer Theory" Springer, 8th edition, 2000.

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Machine Design – I

ME502	PCC	Machine Design – I	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment 1: 10 Marks Continuous Assessment 2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic mechanical Engineering, Strength of Materials, Theory of Machines

Course Outcomes: At the end of the course, students will be able to:

CO1	Extend the knowledge of types of stresses, types of load, theories of failure and factor of safety for the design of machine elements.
CO2	Determine the dimensions of simple machine elements for given load.
CO3	Determine the dimensions of shaft, keys and couplings for given power.
CO4	Determine the wire diameter and coil diameter of spring for the given load.
CO5	Determine the dimensions of power screw and nut for the given load.
CO6	Explain the selection procedure of flat and V-belt form manufacturer's catalogue.

Course Contents:

Unit 1: Introduction and Role of Materials Introduction, General design procedures, Types of loads, types of stresses and use of design data book. Stress analysis, material selection, factor of safety, calculation of allowable stresses, theories of failure: Introduction of stress concentration, effect of stress concentration, how to minimize stress concentration	[6]
Unit 2: Design of Simple Machine Elements Design of knuckle joint, Turn-buckle and bell crank lever	[6]
Unit 3: Design of shaft, Keys and Couplings Strength and deflection– ASME code for transmission shafting including axial loads (Problems not involving more than 2 transmitting elements.) Selection of keys, check for stresses. Introduction, classification, advantages, and applications of Couplings, design of Rigid and flexible coupling, Design of flexible coupling continued Bush and Pin type coupling Oldham's coupling.	[6]
Unit 4: Design of Springs Terminology, materials and specifications-Classification and Applications of Springs, Stresses in springs, Wahl's correction factor, Deflection of springs-Design of Helical compression springs subjected to uniform applied loads like I.C. engine valves, weighing	[6]

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balance, railway buffers and governor springs, Problems on helical compression springs; Construction and application of Leaf springs.	
Unit 5: Design of Power Screws Power Screws: Types of threads used for power screw and their applications, torque analysis for square and trapezoidal threads, efficiency of screw, collar friction, overall efficiency, self- locking in power screws, stresses in the power screw, design of screw and nut, differential and compound screw, re-circulating ball screw. Design of screw jack: (Complete Design).	[6]
Unit 6: Design of Belt and Chain Drives Flat and V belts, Geometric relationship, analysis of belt tensions, condition for maximum power, Design and selection of flat belt, V-belt and timing belt and chain drives from manufacturer's catalogue, Adjustment of belt tensions.	[6]

Text Books:

1. V. B. Bhandari, "Design of Machine Elements", Tata McGraw Hill Publications, New Delhi, 2008.
2. R. L. Nortan, " Machine Design: An Integrated Approach", Pearson Education Singapore, 2001
3. A Machine Design R.S. Khurmi and J. K. Gupta S. Chand publication.
4. Machine design S G Kulkarni McGraw Hill Education Publications
5. Introduction to Machine design V B Bhandari McGraw Hill Education Publications.
6. Design Of Machine Elements Vol I, Vol II J.B.K. Das , P.L. Srinivas Murthy Sapna publication
7. Machine Component Design William Orthwein Jaico publication

Reference Books:

1. R. C. Juvinall, K. M. Marshek, " Fundamental of machine component design", John Wiley and Sons Inc., New York, 3rd edition, 2002.
2. J. Hamrock, B. Jacobson and Schmid Sr., " Fundamentals of Machine Elements", International Edition, New York, 2nd edition, 1999.
3. S. Hall, A. R. Holowenko, H. G .Langhlin, "Theory and Problems of Machine Design", Schaum's Outline Series, Tata McGraw Hill book Company, New York, 1982.
4. J. E. Shigley and C. Mischke, "Mechanical Engineering Design", Tata McGraw Hill Publications, 7th edition, 2004.
5. M. F. Spotts, "Design of Machine Elements", Prentice Hall of India, New Delhi.
6. Machine Design by Robert L.Norton, Tata Mc- Graw Hill Publication
7. Fundamentals of Machine Component Design by Junvinall Wiley India
8. Mechanical System Design by Anurag Dixit SCITECH publication
9. Design of Machine Element/Machine Design by Kannaiah SCITECH publication
10. Design of Machine Element by Spotts/Shoup/Hornberger/Jayram/Venketesh Pierson Education
11. Machine Design by T H Wentzell Cengage Learning

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Design Data Handbook:

1. Design Data Hand Book , K. Lingaiah, McGraw Hill, 2nd Ed.
2. Data Hand Book, K. Mahadevan and Balaveera Reddy, CBS Publication
3. Design Data Hand Book, H.G. Patil, I. K. International Publisher, 2010.
4. Design data PSG College of Technology Coimbatore

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Metrology and Quality Control

ME503	PCC	Metrology and Quality Control	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment 1: 10 Marks Continuous Assessment 2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Machine drawing lab

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain and justify the knowledge associated with various standards of measurement, system of limits, fits, tolerances and design of gauges.
CO2	Describe the knowledge associated with comparators and angle measuring instruments.
CO3	Explain the methods used for measurement of straightness, flatness and surface roughness of given component.
CO4	Illustrate the methods used for the measurement of screw threads and gear parameters
CO5	Collect measurement data, investigate and analyze problems related to quality
CO6	Select appropriate control tool, evaluate results and devise and communicate the corrective action.

Course Contents:

Unit 1: Linear Measurements, Tolerances and Gauging International standards of length, Line and End and Wavelength measurement, Errors in measurement, Slip gauges, linear measuring instruments, limit gauges. Importance of limits system in mass production, conventional diagram of limit, fit, Tolerances, IS specifications of limits, Hole and Shaft Basis systems. Types of Fits, Numerical on limit system, Taylor's Principle of gauge design, Design and types of plug and ring gauges.	[6]
Unit 2: Comparators and Angle Measurement Principle and characteristics of a comparator, Mechanical, Optical Electrical, Pneumatic comparators, Dial gauges, Mechanical and pneumatic types of comparators and their uses in inspection, Different angle measuring instruments-applications, Introduction to Co-ordinate Measuring Machine (CMM)	[6]
Unit 3: Interferometry and surface roughness Principle of Interferometry and Optical flat principle, Application for checking flatness and angle, Surface patterns, Concept and need of straightness and flatness, Surface roughness terminology, Direction of lay, textures, symbols, Numerical assessment of surface roughness, Instruments used in surface roughness assessment	[6]

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Unit 4: Measurement of Screw Threads and Gears Different errors in screw threads, Measurement of forms of thread with profile projector, Pitch measurement, Measurement of thread diameters with standard wire, screw thread micrometer, Errors in gears, Measurement of Spur Gears Run out Checking, Pitch measurement, Profile checking, Backlash checking, Tooth thickness measurement, checking of composite errors.	[6]
Unit 5: Quality Control: Concept of Quality, Quality dimensions, Quality control and quality assurance, Specification of quality, Factors controlling quality of design and conformance, Cost of quality and cost reduction, Balance between cost and quality and value of quality, seven quality tools.	[6]
Unit 6: Statistical Quality Control and Acceptance Sampling Importance of statistical method in quality control, ND curve, Different types of control charts (X Bar, R, p, np, C and U charts), their constructions, Interpretation and applications, Basic concept of sampling inspection, Operating characteristic curves, Producer risk, Consumer risk, Single, double and multiple sampling plans.	[6]

Text Books:

1. "Engineering Metrology", I. C. Gupta, Dhanpat Rai Publications.
2. "Engineering Metrology", R. K. Jain, Khanna Publisher.
3. "Engineering Metrology", M. Mahajan, Dhanpat Rai and Sons.
4. "Engineering Metrology and Measurements", N. V. Raghvendra and L. Krishnamurthy Oxford University Press.

Reference Books:

1. "Metrology and Measurement", Anand K. Bewoor, Vinay A. Kulkarni, McGraw Hill Publication, New Delhi
2. "Practical Engineering Metrology", Sharp K.W.B. Pitman, London
3. "Statistical Quality Control", A.L. Grant, Tata McGraw Hill International, New York. 6th Edition.
4. "Statistical Quality Control", R. C. Gupta,9th Edition

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Elective-II

Turbo Machinery

ME504A	PCC	Turbo Machinery	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment 1: 10 Marks Continuous Assessment 2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering Physics, Engineering Chemistry, Thermal engineering, Fluid mechanics

Course Outcomes: At the end of the course, students will be able to:

CO1	Outline the introduction of turbo machines and its applications
CO2	Explain construction and working of pelton wheel
CO3	Explain construction and working of reaction turbine
CO4	Explain construction and working of fans and blower
CO5	Evaluate the performance of centrifugal pump
CO6	Explain the contraction and working of air compressor and gas turbine

Course Contents:

Unit 1: Introduction to Turbo Machinery Turbo machines (Hydraulic and Thermal), Classification of Turbo machines, Applications of fluid and turbo machines, Impulse momentum principle and its applications, Force excreted on fixed plate, moving flat plate and curved vanes, series of plates, velocity triangles and their analysis, work done equations , efficiency.	[6]
Unit 2: Impulse Water Turbines Classification of water turbines, Impulse Water Turbines Pelton wheel- construction, principle of working, velocity diagrams and analysis, design aspects, governing and performance characteristics, specific speed, selection of turbines, Numerical Treatment on efficiency and work done.	[6]
Unit 3: Reaction Water Turbines Classifications of reaction turbine, construction features, velocity diagrams and analysis, degree of reaction, performance characteristics. Draft tubes: types and analysis, causes and remedies for cavitation phenomenon Governing of turbines, Similitude and dimensional analysis of hydraulic turbines,	[6]
Unit 4: Theory of Fans and Blowers Classification of blowers and fan, Eulers characteristics, velocity triangles and operating	[6]

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pressure conditions, Equations for blowers and fans, Losses and hydraulic efficiency, Numerical treatment on performance, Flow through impeller casing, inlet nozzle, Volute, diffusers, leakage, mechanical losses, Surge and stall, Applications of blowers and fans	
Unit 5: Centrifugal Pump Classification of pumps, components of centrifugal pump, types of heads, velocity triangles and their analysis, effect of outlet blade angle, cavitation, NPSH, priming of pumps, specific speed, performance characteristics of centrifugal pump, series and parallel operation of pumps, efficiency calculations, selection of pumps	[6]
Unit 6: Air compressors and Gas Turbines **Introduction of compressor-** Classification and applications. Construction and working of reciprocating, rotary and axial flow compressor, Volumetric, Isothermal and Mechanical efficiency of reciprocating compressor, Advantages of multi staging, Inter-cooling and after cooling. **Instruction of gas turbine-** Classification and applications of gas turbine, Open cycle, closed cycles, cycle modifications of gas turbine, Introduction of ram jet, pulse jet, turbo prop and rocket engine.	[6]

Textbook:

1. Turbomachines, B. U. Pai, Wiley India.
2. S. M. Yahya Turbine, Compressors and Fans, Tata Mc-Graw Hill Publishing Company, 1996.
3. R. K. Rajput, Fluid Mechanics and Hydraulic Machines S. Chand.
4. Fluid mechanics and hydraulic machines by Modi and Seth.
5. Steam and gas Turbines by V. Ganeshan
6. R. Yadav, Steam and Gas Turbines and Power Plant Engineering, VII edition, Central Publ. house

Reference Book:

1. Shepherd, D.G., Principles of Turbomachinery, Macmillan, 1969
2. Fluid Mechanics and Hydraulic Machines S.C. Gupta 1e Pearson Education.
3. Hydraulic Machines by V.P. Vasantdani
4. Fluid flow machines by N.S. Govindrao
5. William W. Perg, Fundamentals of Turbomachinery, John Wiley and Sons

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Dynamics of Machinery and Synthesis of Mechanism

ME504B	PEC	Dynamics of Machinery and Synthesis of Mechanism	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment 1: 10 Marks Continuous Assessment 2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Applied Mechanics, Kinematics of Machines

Course Outcomes: At the end of the course, students will be able to:

CO1	Analyze the gyroscopic couple effect and friction of mechanical components
CO2	Explain working principles of governor
CO3	Estimate the balancing of rotary and reciprocating masses
CO4	Ability to understand position generation problems
CO5	Ability to understand function generation problems
CO6	Ability to understand path generation problems

Course Contents:

Unit 1: Angular Motion Gyroscopes – effect of precession – motion on the stability of moving vehicles such as motorcycle – motorcar – aero planes and ships. Static and Dynamic Force, Analysis of planar mechanisms.	[6]
Unit 2: Governors Watt, porter, spring loaded governors – Hartnell with auxiliary springs. sensitiveness, isochronism and hunting.	[6]
Unit 3: Balancing Balancing of rotating masses single and multiple – single and different planes, use analytical and graphical methods. Primary, secondary, and higher balancing of reciprocating masses. analytical and graphical methods, unbalanced forces and couples, examination of "V" multi cylinder in line and radial engines for primary and secondary balancing	[6]
Unit 4: position generation Introduction to position generation problem, concept of pole, two and three position generation synthesis, poletriangle, Relationship between moving and fixed pivots, Four position generation, opposite pole quadrilateral, center point and circle point curve, Burmester's point	[6]

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Unit 5: function generation Introduction to function generation problem, co-ordination of input-output link motion, relative pole technique, inversion technique, overlay technique, graphical synthesis of quick return mechanisms for optimum transmission angle. Types of errors, accuracy points, chebyshev's spacing, Frudenstein's equation.	[6]
Unit 6: path generation Introduction to path generation problem, synthesis for path generation with and without prescribed timing using graphical method. Coupler curves, cognate linkages, Robert's law of cognate linkages.	[6]

Text Books:

1. Advanced Mechanism Design: Analysis and synthesis Volume-II, G.N. Sandor and A.G. Erdman.
2. Theory of Machines and Mechanisms: Uicker and Shigley, Tata McGraw Hill.
3. Theory of Machines: S. S. Rattan, Tata McGraw Hill.

Reference Books:

1. Applied Linkage Synthesis by Tao D.C.
2. Kinematics and Dynamics of Machinery: Wilson and Sadler, Harper Collins Publishers.

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Additive Manufacturing

ME504C	PEC	Additive Manufacturing	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment 1: 10 Marks Continuous Assessment 2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Analysis of Mechanical Elements

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain Importance of RP in Manufacturing
CO2	Choose suitable materials for RP
CO3	Identify Different RP Technologies
CO4	Apply Different methods for Post-processing of RP parts
CO5	Develop proper "Design for manufacture" for RP and
CO6	Apply RP in Automobile, Aerospace, and Bio-medical.

Course Contents:

Unit 1: Introduction to Rapid prototyping: Introduction to Rapid prototyping ,RP evolution, Overview of RP, Introduction to reverse engineering Traditional manufacturing vs RP, Computer aided design (CAD) and manufacturing (CAM), Different RP processes Advantages of RP, Benefits	[6]
Unit 2: Materials science for RP Different materials used in RP, multi-functional and graded materials in RP, Role of solidification rate Evolution of non-equilibrium structure, Structure property relationship, Use of multiple materials, Grain structure and microstructure	[6]
Unit 3: Different RP Technologies Powder-based AM processes involving sintering (selective laser sintering, shaping,), melting (electron beam melting. involvement).Printing processes (drop!et based 3D, Solid-based RP processes, extrusion based fused deposition modeling, Laser powder forming, Stereolithography Laminated objectmanufacturing, Micro- and nano-additive	[6]
Unit 4: Methods for Post-processing of AM parts Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using thermal techniques and non-thermal techniques, Part Cleaning and finishing, Process Strength and limitations.	[6]

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Unit 5: Design for manufacture for RP and Process Analysis Motivation DFMA concepts and objectives., RP unique capabilities, Exploring design freedoms, Design tools for RP, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts, Other Manufacturing Constraining Features.	[6]
Unit 6: RP Applications Ergonomic Studies Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models, Rapid tooling, new materials development, Bi-metallic parts, Application examples for Aerospace, defense, automobile	[6]
Text Books: 1. Rapid Prototyping and Engineering Applications, Frank W. Liou, CRC Press 2. Introduction to Rapid Prototyping, Amitav Ghosh, North West Publication, New Delhi.	
Reference Books: 1. Rapid Manufacturing, Flham D.T and Dinjoy S.S Verlog London 2001. 2. Rapid Prototyping Materials, Gurumurthi, IISc Bangalore 3. Rapid Automated, Lament wood. Indus press New York. 4. Stereo Lithography and other RP and M Technologies, Paul F. Jacobs: SME, NY 1996. 5. Rapid Prototyping, Terry Wohlers Wohler's Report 2000" Wohler's Association 2000.	

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Experimental Stress Analysis

ME504D	PEC	Experimental Stress Analysis	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment 1: 10 Marks Continuous Assessment 2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering Mechanics, Strength of Materials, Control Engineering, Engineering Physics

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain basic concepts of dynamic measurements.
CO2	Describe stress strain analysis of mechanical systems using electrical resistance strain gauges.
CO3	Illustrate different strain analysis methods.
CO4	Explain photoelasticity concept and comapre with 2D photoelasticity.
CO5	Illustrate different photoelastic coatings.
CO6	Illustrate different brittle coatings

Course Contents:

Unit 1: Introduction Definition of terms, Calibration, Standards, Dimension and units generalized measurement system. Basic concepts in dynamic measurements, system response, distortion, impedance matching, Analysis of experimental data, cause and types of experimental errors. General consideration in data analysis.	[6]
Unit 2: Electrical Resistance Strain Gauges Strain sensitivity in metallic alloys, Gauge construction, Adhesives and mounting techniques, Gauge sensitivity and gauge factor, Performance Characteristics, Environmental effects, Strain Gage circuits. Potentiometer, Whetstone's bridges, Constant current circuits.	[6]
Unit 3: Strain Analysis Methods Two element, three element rectangular and delta rosettes, Correction for transverse strain effects, Stress gauge, Plane shear gauge, stress intensity factor. **Force, Torque and strain measurements**: Mass balance measurement, Elastic element for force measurements, torque measurement.	[6]
Unit 4: Photoelasticity: Nature of light, Wave theory of light - optical interference, Stress optic law–effect of	

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stressed model in plane and circular polariscopes, Isoclinic's and Isochromatics, Fringe order determination Fringe multiplication techniques , Calibration photoelastic model materials. Two Dimensional Photoelasticity: Separation methods: Shear difference method, Analytical separation methods, Model to prototype scaling, Properties of 2D photoelastic model materials, Materials for 2D photoelasticity	[6]
Unit 5: Photoelastic (Birefringent) Coatings: Birefringence coating stresses, Effects of coating thickness: Reinforcing effects, Poisson's, Stress separation techniques: Oblique incidence.	[6]
Unit 6: Brittle Coatings: Coatings stresses, Crack patterns, Refrigeration techniques, Load relaxation techniques, Crack detection methods, Types of brittle coatings, Calibration of coating. Advantages and brittle coating applications.	[6]

Text Books:

1. Photoelasticity Vol I and Vol II, M.M.Frocht, John Wiley and sons.
2. Strain Gauge Primer, Perry and Lissner.
3. Photo Elastic Stress Analysis, Kuske, Albrecht and Robertson John Wiley and Sons.
4. Motion Measurement and Stress Analysis, Dave and Adams.
5. Holman, Experimental Methods for Engineers, Tata McGraw-Hill Companies, 7th Edition, New York, 2007.
6. B. C. Nakra and K. K. Chaudhry, Instrumentation, Measurement and Analysis, Tata McGraw-Hill Companies, Inc, New York, 7th Edition, 2006.
7. Ramesh K., e-Book on "Experimental Stress Analysis", IIT Madras, 2009.
8. W.N. Sharpe (Ed.), Springer Handbook of Experimental Solid Mechanics", Springer, 2008.

Reference Books:

1. Experimental stress analysis – Dally and Riley.-McGraw Hill.
2. Experimental stress analysis – Dr. Sadhu Singh., Khanna Publications.
3. Experimental stress analysis – L. S. Srinath., Tata McGraw Hill.
4. Experimental stress analysis – Dove and Adams.
5. The strain gauge primer – Perry Listner.
6. Moiré fringes – Theocoris. Pergamon press limited.

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Quantitative Techniques in Project Management

ME504E	PEC	Quantitative Techniques in Project Management	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment 1: 10 Marks Continuous Assessment 2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Engineering Mathematics-I/II/III

Course Outcomes: At the end of the course, students will be able to:

CO1	Define and formulate research models to solve real life problems for allocating limited resources by linear programming.
CO2	Apply transportation and assignment models to real life situations.
CO3	Apply queuing theory for performance evaluation of engineering and management
CO4	Apply the mathematical tool for decision making regarding replacement of items in real life..
CO5	Determine the EOQ, ROP and safety stock for different inventory models.
CO6	Construct a project network and apply CPM and PERT method

Course Contents:

Unit 1: Introduction Introduction to Operations Research, Stages of Development of Operations Research, Applications of Operations Research, Limitations of Operations Research Linear programming problem, Formulation, graphical method, Simplex method, artificial variable techniques.	[6]
Unit 2: Assignment and Transportation Models Transportation Problem, North west corner method, Least cost method, VAM, Optimality check methods, Stepping stone, MODI method, Assignment Problem, Unbalanced assignment problems, Travelling salesman problem.	[6]
Unit 3: Waiting Line Models and Replacement Analysis Queuing Theory: Classification of queuing models, Model I (Birth and Death model) M/M/1 (∞, FCFS), Model II - M/M/1 (N/FCFS). **Replacement Theory**, Economic Life of an Asset, Replacement of item that deteriorate with time, Replacement of items that failed suddenly.	[6]
Unit 4: Inventory Models Inventory Control, Introduction to Inventory Management, Basic Deterministic Models,	

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Purchase Models and Manufacturing Models without Shortages and with Shortages, Reorder level and optimum buffer stock, EOQ problems with price breaks.	[6]
Unit 5: Project Management Techniques Difference between project and other manufacturing systems. Defining scope of a project, Necessity of different planning techniques for project managements, Use of Networks for planning of a project, CPM and PERT.	[6]
Unit 6: Time and Cost Analysis Time and Cost Estimates: Crashing the project duration and its relationship with cost of project, probabilistic treatment of project completion, Resource allocation and Resource leveling.	[6]

Text Books:

1. P. K. Gupta, D. S. Hira, "Operations Research", S. Chand and Company Ltd., New Delhi,1996.
2. L. C. Jhamb, "Quantitative Techniques for managerial Decisions", Vol. I and II, Everest Publishing House, Pune, 1994.
3. N. D. Vohra, "Operations Research", Tata McGraw Hill Co., New Delhi.

Reference Books:

1. H. Taha, "Operations Research–An Introduction", Maxwell Macmillan, New York.
2. J. K. Sharma, "Operations Research–An Introduction", Maxwell Macmillan, New Delhi.
3. Harvey M. Wagner, "Principles of Operations Research with Applications to Managerial Decisions", Prentice Hall of India Pvt. Ltd., New Delhi, 2nd edition, 2005.
4. Rubin and Lewin, "Quantitative Techniques for Managers", Prentice Hall of India Pvt. Ltd., New Delhi.

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Heat Transfer Laboratory

ME505	PCC	Heat Transfer Laboratory	0-0-2	1 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: - Practical: 2 hrs./week	Continuous Assessment 1: 15 Marks Continuous Assessment 2: 15 Marks Practical and Oral Exam: 20 Marks

Pre-Requisites: Thermodynamics, Fluid Mechanics

Course Outcomes: At the end of the course, students will be able to:

CO1	Analyze various modes of heat transfer.
CO2	Analyze heat exchangers.
CO3	Demonstrate heat pipe, condensation and boiling phenomena.
CO4	Demonstrate thermal analysis process using software.

The Heat Transfer Lab consists of Any 8 experiments (from No 1 to No 10) and No 11] {Total 8 experiments}:

1. Determination of thermal conductivity of insulating powder/ Metal rod.
2. Determination of thermal conductivity of material in Composite wall / Lagged pipe.
3. Determination of local and average heat transfer coefficient in Natural convection heat transfer from a vertical cylinder.
4. Determination of Heat Transfer Coefficient under forced convection to air from a heated pipe.
5. Determination of emissivity of a Nonblack surface.
6. Determination of Stefan Boltzmann Constant.
7. Determination of Critical Heat Flux.
8. Determination of overall heat transfer coefficient and effectiveness in a Heat Exchanger.
9. Study and Demonstration of Heat Pipe
10. Performance analysis of extended surfaces
11. Thermal analysis of any two experiments from above list using any analysis software like ANSYS, FUSION360, etc.

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Machine Design-I Laboratory

ME506	PCC	Machine Design-I Laboratory	0-0-2	1 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: - Practical: 2 hrs./week	Continuous Assessment 1: 25 Marks Continuous Assessment 2: 25 Marks

Pre-Requisites: Basic Mechanical Engineering, Strength of Materials, Theory of Machines

Course Outcomes: At the end of the course, students will be able to:

CO1	Select suitable material from design data book for the given component.
CO2	Design simple machine elements and create 3D model of the same.
CO3	Design of shaft, keys and couplings.
CO4	Design of helical compression springs.
CO5	Design of screw jack and create 3D model of the same.
CO6	Select flat and V-belt form manufacturer's catalogue.

The Machine Design-I Laboratory Lab consists of list of experiment as follows

1. The term work shall consist of two design projects based on Industrial/application. Each design project draft through CAD software, consist of assembly drawings with a part list and overall dimensions and other drawings of individual components. Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified, wherever necessary, so as to make it working drawing
2. Four assignments based on topics of syllabus of Machine Design I

Text Books:

1. V. B. Bhandari, "Design of Machine Elements", Tata McGraw Hill Publications, New Delhi, 2008.
2. R. L. Nortan, "Machine Design: An Integrated Approach", Pearson Education Singapore, 2001.
3. A Machine Design R.S. Khurmi and J.K.Gupta S. Chand publication
4. Machine design S G Kulkarni McGraw Hill Education Publications
5. Introduction to Machine design V B Bhandari McGraw Hill Education Publications
6. Design Of Machine Elements Vol I, Vol II J.B.K. Das , P.L. Srinivas Murthy Sapna publication
7. Machine Component Design William OrthweinJaico publication

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Reference Books:

1. R. C. Juvinall, K. M. Marshek, " Fundamental of machine component design", John Wiley and Sons Inc., New York, 3rd edition, 2002.
2. B. J. Hamrock, B. Jacobson and Schmid Sr., " Fundamentals of Machine Elements", International Edition, New York, 2nd edition, 1999.
3. A. S. Hall, A. R. Holowenko, H. G .Langhlin, "Theory and Problems of Machine Design", Schaum's Outline Series, Tata McGraw Hill book Company, New York, 1982.
4. J. E. Shigley and C. Mischke, "Mechanical Engineering Design", Tata McGraw Hill Publications, 7th edition, 2004.
5. M. F. Spotts, "Design of Machine Elements", Prentice Hall of India, New Delhi.
6. Machine Design by Robert L. Norton, Tata Mc- Graw Hill Publication
7. Fundamentals of Machine Component Design by Junvinall Wiley India
8. Mechanical System Design by Anurag Dixit SCITECH publication
9. Design of Machine Element/Machine Design by Kannaiah SCITECH publication
10. Design of Machine Element by Spotts/Shoup/Hornberger/Jayram/Venketesh Pierson Education
11. Machine Design by T H Wentzell Cengage Learning.

Design Data Handbook:

1. Design Data Hand Book, K. Lingaiah, McGraw Hill, 2nd Ed.
2. Data Hand Book, K. Mahadevan and Balaveera Reddy, CBS Publication
3. Design Data Hand Book, H.G. Patil, I. K. International Publisher, 2010.
Design data PSG College of Technology Coimbatore

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Metrology and Quality Control Laboratory

ME507	PCC	Metrology and Quality Control Laboratory	0-0-2	1 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: - Practical: 2 hrs./week	Continuous Assessment 1: 15 Marks Continuous Assessment 2: 15 Marks Practical and Oral Exam: 20 Marks

Pre-Requisites: Machine drawing lab

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain and justify the knowledge associated with various linear and angle measuring instruments.
CO2	Illustrate the methods used for the measurement of screw threads, gear parameters and flatness of given component.
CO3	Collect measurement data, investigate and analyse problems related to quality, select appropriate control tool, evaluate results and devise and communicate corrective action.

The MQC Lab consists of any 8 experiments to be conducted from the list where minimum two experiments should be related to quality

1. Study and use of Linear Measuring Instruments
2. Study and use of Comparators
3. Study and use of Angle Measuring Instruments
4. Screw Thread Measurement
5. Study and Measurement of Thread parameters using Profile Projector.
6. Spur Gear Measurement
7. Study and use of Optical Flat
8. Study of Normal Distribution Curve
9. Study and Use of Control Charts
10. Study of Operating Characteristics Curves

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Turbo machinery Laboratory

ME508	PCC	Turbo machinery Laboratory	0-0-2	1 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: - Practical: 2 hrs./week	Continuous Assessment 1: 15 Marks Continuous Assessment 2: 15 Marks Practical and Oral Exam: 20 Marks

Pre-Requisites: Engineering Mechanics, Thermodynamics, Engineering Physics, Fluid machines

Course Outcomes: At the end of the course, students will be able to:

CO1	Test for different turbo machinery.
CO2	Experiment with different types of pumps.
CO3	Explain different hydraulic devices and working of hydroelectric power plant.

The Turbomachinary Lab consists of 8 experiments

1. Study and Trial on Pelton wheel turbine
2. Study and Trial on Francis wheel turbine
3. Study and Trial on Centrifugal Pump
4. Study and Trial on Reciprocating Pump
5. Study and Trial on Reciprocating compressor
6. Study and Trial on blower
7. Study and demonstration of Hydraulic Devices
8. Industrial Visit at Hydro-Electric Power plant/ Pump Manufacturing Unit

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Automobile Engineering Laboratory

ME509	PCC	Automobile Engineering Laboratory	0-0-2	1 Credits

Teaching Scheme:	Examination Scheme:
Lecture: - Practical: 2 hrs./week	Continuous Assessment 1: 25 Marks Continuous Assessment 2: 25 Marks

Pre-Requisites: Basic Mechanical Engineering, Strength of Materials, Theory of Machines

Course Outcomes: At the end of the course, students will be able to:

CO1	Demonstrate various automobile systems like Chassis, single plate clutch, synchromesh gearbox final drive.
CO2	Demonstrate various automobile systems like Final drive differential, front wheel steering geometry and steering mechanism.
CO3	Demonstrate various electrical systems like battery charging, hydraulic braking, suspension system, wheel balancing and alignment and its construction and working principle.
CO4	Summarize the visit report to service station or industry.

The Automobile Engineering Laboratory Lab consists of list of experiment as follows

Note: Conduct any 8 Experiments in Group A

Group A

1. Study and demonstration of four wheeler chassis layout and vehicle body parts and its materials.
2. Study and Demonstration of working of single plate automobile clutch and clutch plate lining materials.
3. Study and demonstration of synchromesh gearbox. (necessity, interlocking mechanism, gear shifting mechanism (Troubleshooting)
4. Study and demonstration of final drive and differential. (Types of final drive gear, Troubleshooting)
5. Study and demonstration of front wheel steering geometry and steering mechanism. (Troubleshooting)
6. Study and demonstration of suspension system of a four-wheeler. (Any one suspension system from conventional or independent, troubleshooting)

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7. Study and demonstration of working Hydraulic braking system. (Air bleeding of hydraulic brake, Troubleshooting)
8. Study and demonstration of Lead acid Battery. (Troubleshooting)
9. Study and demonstration of electrical charging system. (Troubleshooting)
10. Study of automobile air conditioning system.
11. Study and demonstration of electrical starting system.(Troubleshooting)

Group B

1. Experiment on wheel balancing and front wheel alignment.
2. Visit to servicing station for study of vehicle maintenance, repairs and report.

OR

2. Visit to Automobile manufacturing industry.

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Account and Finance Management

ME510	MC	Account and Finance Management	2-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment 1: 25 Marks Continuous Assessment 2: 25 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand and define basic terminology used in finance and accounts
CO2	Prepare and appraise Financial Statements and evaluate company in the light of different
CO3	Analyze the risk and return of alternative sources of financing.
CO4	Estimate cash flows from a project, including operating, net working capital, and capital spending
CO5	To estimate the required return on projects of differing risk ,to estimate the cash flows from an investment project, calculate the appropriate discount rate, determine the value added from the project, and make a recommendation to accept or reject the project
CO6	To describe and illustrate the important elements in project finance Using financial calculator and Excel in a variety of problems.

Course Contents:

Unit 1: Introduction to Financial Accounting, Book keeping and Recording Meaning, Scope and importance of Financial Accounting. Financial Accounting - concepts and conventions, classification of accounts, Rules and principles governing Double Entry Book-keeping system, Meaning, Preparation of Journal, Ledger , Cash book and Trial balance. (Practical application on tally)	[4]
Unit 2: Financial Statement Preparation, analysis and Interpretation Preparation of financial statement and Profit and Loss Account, Balance Sheet, Ratio Analysis -classification of various ratios. (Calculation on Excel)	[4]
Unit 3: Introduction To Financial Management Concept of business finance, Goals and objectives of financial management, Sources of financing - LONG TERM: shares, debentures, term loans, lease and hire purchase, retained earnings, public deposits, bonds (Types, features and utility), SHORT TERM: bank finance, commercial paper, trade credit and bills discounting, INTERNAL: Retained earnings	[4]
Unit 4: Working Capital Management Concept of working Capital, significance, types. Adequacy of working capital, Factors affecting working capital needs, Financing approaches for working capital, Methods of	[4]

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forecasting working capital requirements, meaning and importance of accounts receivable.(Excel)	
Unit 5: Time Value of Money and Capital Budgeting Concept of time value of money, Compounding and discounting; Future value of single amount and annuity, present value of single amount and annuity; Practical application of time value technique. Capital budgeting - Nature and significance, techniques of capital budgeting –Pay Back Method, Accounting rate of return, Internal Rate of Return, DCF, Net Present Value and profitability index. (Application on Excel)	[4]
Unit 6: Project Financing [2] Details of the company, its promoters, and project finances required, profitability etc., Loan documentation-Appraisal of terms loans by financial institutions. Basic components of project finance.(Excel Based)	[4]
Text Books: 1. Financial, Cost and Management Accounting by Dr. P. Pariasamy, HH Publication. 2. Financial Management by Khan and Jain, Tata McGraw Hill. 3. Financial Management by Dr. P. C. Tulsian, S.Chand. 4. Financial Management by Ravi Kishore,Taxmann	

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Mini Project-IV

PROJ04	PROJ	Mini Project-IV	0-0-2	1 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: - Practical: 2 hrs./week	Continuous Assessment 1: 25 Marks Continuous Assessment 2: 25 Marks

Pre-Requisites:

Course Outcomes: At the end of the course, students will be able to:

CO1	Select the appropriate method for solving the problem
CO2	Make use of various engineering techniques and tools to give a solution
CO3	Justify the method/tools used to develop the solution.
CO4	Demonstrate tangible solutions to the problem
CO5	Describe the solution with the help of a project report and presentation.

About Hackathon

The project is a part of addressing societal and industrial needs. Hackathon is one of the platforms that students will use to solve real-world challenges. This course focuses on the selection of methods/engineering tools/analytical techniques for problem-solving. Through this course, students gain a thorough understanding of engineering basics and ideas, gain practical experience, have the opportunity to display their skills and learn about teamwork, financial management, communication skills, and responsibility.

Guidelines

1. Every student shall undertake the Hackathon activity for semester V.
2. Minimum three and maximum of five students should work together in Hackathon
3. The students have to work on different approaches and finalize the best methodology to solve the problem in consultation with the project guide.
4. The students should use different tools /Techniques for the development of the solution to the problem.

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5. While developing solutions, the student can take care of effective use of resources, follow ethical practices, finance management,
6. The solution should be optimal, affordable, user-friendly and environment friendly.
7. Critically analysis and testing of the solution provided.
8. By using IPR, students should reserve their rights of innovations as well as communicate new findings to society with the help of research papers.

The committee of senior faculty members and a project guide will be appointed to monitor the progress and continuous evaluation of each project. The assessment shall be done jointly by the guide and committee members.

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Industrial Safety

ME511	MC	Industrial Safety	2-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: -2 hrs./week Practical:	Continuous Assessment 1: 25 Marks Continuous Assessment 2: 25 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Illustrate the history of safety moments.
CO2	Make use of safety techniques at industrial work environment.
CO3	Construct an ergonomic interventions in repetitive works.
CO4	Estimate rules and regulations for health, safety and environment.
CO5	Illustrate rules and principles of safety in Engineering industries.
CO6	Illustrate importance of safety education and training.

Course Contents:

Unit 1: Introduction to Industrial safety History of Safety movement –Evolution of modern safety concept- general concepts of management –Safety policy - Safety Organization - line and staff functions for safety, budgeting for safety.	[4]
Unit 2: Safety Techniques Incident Recall Technique (IRT), Job Safety Analysis (JSA), Components of safety audit, types of audit, audit methodology, non-conformity reporting (NCR), audit checklist and report – review of inspection safety survey, safety inspection, safety sampling, Safety Audit.)	[4]
Unit 3: Human Factors Engineering Applications of human factors engineering, man as a sensor, man as information processor, man as controller – Man vs Machine. Ergonomics interventions in Repetitive works, training prevention of manual handling injuries in the work place, postural stability, Personal protective equipment's	[4]
Unit 4: Regulations for Health, Safety and Environment Safety committee and function, Role and responsibilities of safety officer, Role of safety department, Factories act and rules -. Indian explosive act - - Indian petroleum act and rules. Environmental pollution act Manufacture, Indian Electricity act and rules.	[4]
Unit 5: Safety in Engineering Industry General safety rules, principles, maintenance, Inspections of turning machines, boring	[4]

machines, milling machine, grinding machines, CNC machines, , types, safety principles, electrical guards, work area, material handling, inspection, hazards	
Unit 6: Safety Education and Training Importance of training- -training methods –conferences, competitions – method of promoting safe practice - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.	[4]

Text Books:

1. "Industrial safety management", L M Deshmukh, TATA McGraw Hill, 2010.
2. "Safety Management in Industry" Krishnan N.V. Jaico Publishing House, Bombay, 1997.

Reference Books:

1. "Industrial Accident Prevention" Heinrich H.W. McGraw-Hill Company, New York, 1980.
2. "Industrial Safety" Roland P. Blake, Prentice Hall, Inc., New Jersey, 1973
3. "Safety Management by John V. Grimaldi and Rollin H. Simonds, All India Travelers Book seller, New Delhi, 1989.
4. The Factories Act 1948, Madras Book Agency, Chennai, 2000.
5. Explosive Act, 1884 and Explosive rules, 1883 (India), (2002), Eastern Book company, Lucknow, 10th Edition
6. Human factors in engineering and design, MARK S.SANDERS

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Aptitude Skill III

HMS05	HSMC	Aptitude Skill III	1-0-0	1 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 1hrs/week Tutorial: NA Practical: NA	Continuous Assessment 1:-25 Marks Continuous Assessment 2:-25 Marks Practical and Oral Examination: NA

Pre-Requisites: Communication Skills, Aptitude Skills I, II

Group A

Aptitude (12Hrs) (Compulsory)

Course Outcomes: At the end of the course, students will be able to:

CO1	Solve the problems on system of equation
CO2	Solve the problems on seating arrangement
CO3	Solve the logical reasoning problems
CO4	Solve the critical analysis problems
CO5	Solve the problems of Data interpretation
CO6	Solve the problems of permutations and Combinations

Course Contents:

Unit 1: Parts of Speech Word Family (Using the same word as different Parts of Speech), Punctuation	[2]
Unit 2: Analogy Letter Writing (Formal), E-Mail Writing, CV Writing	[2]
Unit 3: Reading Comprehension Reading Comprehension, Paragraph Jumbles	[2]
Unit 4: Spotting Errors (in different parts of sentence) Spotting Errors (in different parts of sentence), Subject-Verb Agreement, Sentence Correction, Sentence Completion	[2]
Unit 5: One Word Substitution One Word Substitution, Narrating Events/ReportsSummary/Precis Writing	[2]
Unit 6: Dialogue Writing Dialogue Writing, Group Discussion, Interview Skills (Using formal notations and gestures etc.)	[2]

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Text Books:

1. Raymond Murphy, Essential English Grammar with Answers, Murphy.
2. Objective General English by R.S. Aggarwal, S Chand Publishing; Revised edition (15 March 2017).

Reference Books:

1. Rao N, D, V, Prasada, Wren and amp; Martin High School English Grammar and Composition Book, S Chand Publishing, 2017
2. Murphy, Intermediate English Grammar with Answers, Cambridge University Press; Second edition

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Language Skill- III

HMS06	HSMC	Language Skill- III	0-0-2	Audit

Teaching Scheme:	**Examination Scheme:**
Practical : 02 hrs week	Continuous Assessment 1:-25 Marks Continuous Assessment 2:-25 Marks Practical and Oral Examination: NA

Pre-Requisites: Language Skills-I, II

Languages (Any One)
Python (Technical Language) (24Hrs)
Syllabus for Python

Course Objectives:
This course provides an opportunity to enhance acquisition of the fundamental elements of the Python language. Emphasis is on the progressive development of basic programming syntaxes and essentials used in Python.

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain essentials and fundamentals of Python Programming.
CO2	Illustrate data types and variables.
CO3	Illustrate Operators and Expressions.
CO4	Make a use of Decision making and Looping statements.

Unit 1: Introduction What is Python, what can python do, why python, how to use Python, Python indentation, python comments, basic syntax of program ,first program of python	[6]
Unit 2: Variable and data types Creating variable, casting, variable name, global variable, local variable, built in datatypes, string, constructor, function of data type, type conversion	[6]
Unit 3 :Operators in Python Unary Operator ,Binary operator -:(arithmetic operator, logical operator ,assignment operator, ,membership operator ,identity operator ,bitwise operator) , ternary operator	[6]
Unit 4: Statements and loops Input and Output Statements ,Conditional Statements ,Simple if Statement ,If-else statement ,Else-if Ladder, Nested if statement, ,while loop ,for loop ,break ,continue ,pass statements	[6]

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Semester-VI

Internal Combustion Engines and Hybrid Vehicles

ME601	PCC	Internal Combustion Engines and Hybrid Vehicles	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment 1: 10 Marks Continuous Assessment 2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Thermal Enginering, Fluid Mechanics

Course Outcomes: At the end of the course, students will be able to:

CO1	Classify I C Engine and identify its components.
CO2	Explain various factors affecting SI and CI combustion.
CO3	Explain various engine systems and elaborate governing systems.
CO4	Evaluate various performance parameters and discuss SI and CI engine emissions.
CO5	Apply concepts of different alternate fuels used for SI and CI engines.
CO6	Outline different configurations of Hybrid Vehicles.

Course Contents:

Unit 1: Fundamentals of IC Engines Applications, nomenclature, engine components, Engine classification, two and four stroke cycle engines; fundamental difference between SI and CI engines; valve timing diagrams. Power Cycles: Air standard Otto, Diesel and Dual cycles; Valve timing diagrams, Fuel-Air cycles and deviation of actual cycles from ideal cycles.	**[6]**
Unit 2: Combustion Introduction, important qualities and ratings of SI Engines fuels; qualities and ratings of CI Engine fuels. Combustion in S.I. Engines, flame speed, ignition delay, normal and abnormal combustion, effect of engine variables on flame propagation and ignition delay, Combustion in C.I. Engines, combustion of a fuel drop, stages of combustion, ignition delay, combustion knock; types of SI and CI Engine combustion chambers.	**[6]**

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Unit 3: Various Engine Systems Starting systems, fuel supply systems, engine cooling system, ignition system, engine friction and lubrication systems, governing systems.	[6]
Unit 4: Engine Testing and Performance of SI and CI Engines Parameters, Type of tests and characteristic curves. Super charging in IC Engine: Effect of attitude on power output, types of supercharging. **Engine Emissions and control**: Pollutants from SI and CI engines and their control, emission regulations such as Bharat and Euro.	[6]
Unit 5: Alternate fuels Need for alternative fuels, applications, various alternate fuels etc Gaseous Fuels, Alcohols, Biodiesels, vegetable oil extraction, Trans-esterification process, properties of alternative fuels and fuel blends. **Fuel Cell Technology**: Operating principles, Types, construction, working, application, advantages and limitations	[6]
Unit 6: Layout of Electric vehicle and Hybrid vehicles Advantages and drawbacks of electric and hybrid vehicles, System components, Electronic control system – Different configurations of Hybrid vehicles, Power split device. High energy and power density batteries.	[6]

Text Books:

1. V. Ganeshan, "Internal Combustion Engines", Tata McGraw Hill Publications, New Delhi, 3rd edition.
2. J. B. Heywood, "Internal Combustion Engine Fundamentals", Tata McGraw Hill Publications, New York, International Edition, 1988
3. "Alternative Fuels", Dr. S. S. Thipse, Jaico publications.
4. "IC Engines", Dr. S. S. Thipse, Jaico publications.

Reference Books:

1. "Engine Emissions, pollutant formation", G. S. Springer and D.J. Patterson, Plenum Press.
2. ARAI vehicle emission test manual.
3. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, "The Biodiesel Handbook", AOCS Press.
4. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers.
5. Transactions of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.).

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Machine Design – II

ME602	PCC	Machine Design – II	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment 1: 10 Marks Continuous Assessment 2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic mechanical Engineering, Strength of Materials, Kinematics of Machines, Machine Design-I

Course Outcomes: At the end of the course, students will be able to:

1	Design against fluctuating loads.
2	Design of pressure vessel
3	Design of spur gear and helical gear
4	Design of bevel and worm and worm wheel
5	Design of flywheel
6	Selection of bearing for different applications

Course Contents:

Unit 1: Design against Fluctuating Loads Stress concentration, stress concentration factors, fluctuating stresses, fatigue failure, endurance limit, notch sensitivity, approximate estimation of endurance limit, design for finite life and finite life under reversed stresses, cumulative damage in fatigue, Soderberg and Goodman diagrams, fatigue design under combined stresses.	[6]
Unit 2: Rolling contact Bearings Types, Static and dynamic load carrying capacities, Stribeck's Equation, Equivalent load, load and life relationship, selection of bearing life, Load factor, selection of bearing from manufacturer's catalogue, Cyclic loads and speeds, Design for probability of survival other than 90% Lubrication and mountings of rolling contact bearings.	[6]
Unit 3: Sliding Contact Bearings Methods of lubrication, Viscosity and its measurement, Effect of temperature, viscous flow through rectangular slot, Hydrostatic step bearing, Load capacity and energy losses, Reynolds equation, Raimondi and Boyd method, temperature rise, Lubrication oils, Additives and greases, Comparison of rolling and sliding contact bearings.	[6]
Unit 4: Spur Gears and Helical Gears: **Spur Gear:** Definitions, Nomenclature, stresses in gear tooth: Lewis equation and form factor, Design for strength Dynamic load and wear load, Design for strength under wear load on gear Efficiency of gear drives.	[6]

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Helical Gear: Nomenclature, stresses in gear tooth: Lewis equation and form factor, Design for strength, Dynamic load and wear load, Design for strength under wear load on gear Efficiency of gear drives.	
Unit 5: Bevel and Worm Gears **Bevel Gears:** Definitions, formative number of teeth. Design based on strength, dynamic and wears loads, Efficiency of gear drives. **Worm Gears:** Definitions, formative number of teeth. Design based on strength, dynamic and wears loads, Efficiency of worm gear drives, Applications of worm and worm wheel	[6]
Unit 6: Design of Flywheel Introduction, Types of Flywheels, stresses in disc and armed flywheel. Fluctuation of energy and speed, turning moment diagram, estimating inertia of flywheel for reciprocating prime movers and machines, Weight of the flywheel, flywheel for punches, rim constructions, stresses in rims and arms, Construction of flywheel.	[6]

Text Books:

1. V. B. Bhandari, "Design of Machine Elements", Tata McGraw Hill Publications, New Delhi, 2008.
2. R. L. Nortan, " Machine Design: An Integrated Approach", Pearson Education Singapore, 2001
3. A Machine Design R.S. KhurmiandJ.K.Gupta S. Chand publication.
4. Machine design S G Kulkarni McGraw Hill Education Publications.
5. Introduction to Machine design V B Bhandari McGraw Hill Education Publications.
6. Design of Machine Elements Vol I, Vol II J.B.K. Das, P.L. Srinivas Murthy Sapna publication.
7. Machine Component Design William OrthweinJaico publication.
8. Design Data Hand Book for Mechanical Engineers K Mahadevanand K Balaveera Reddy CBS publications

Reference Books:

1. R. C. Juvinall, K. M. Marshek, " Fundamental of machine component design", John Wiley and Sons Inc., New York, 3rd edition, 2002.
2. B. J. Hamrock, B. Jacobson and Schmid Sr., " Fundamentals of Machine Elements", International Edition, New York, 2nd edition, 1999.
3. A. S. Hall, A. R. Holowenko, H. G .Langhlin, "Theory and Problems of Machine Design", Schaum's Outline Series, Tata McGraw Hill book Company, New York, 1982.
4. J. E. Shigley and C. Mischke, "Mechanical Engineering Design", Tata McGraw Hill Publications, 7th edition, 2004.
5. M. F. Spotts, "Design of Machine Elements", Prentice Hall of India, New Delhi.
6. Machine Design by Robert L.Norton, Tata Mc- Graw Hill Publication
7. Fundamentals of Machine Component Design by Junvinall Wiley India
8. Mechanical System Design by Anurag Dixit SCITECH publication
9. Design of Machine Element/Machine Design by Kannaiah SCITECH publication
10. Design of Machine Element by Spotts/Shoup/Hornberger/Jayram/Venketesh Pierson Education
11. Machine Design by T H WentzellCengage Learning.

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Design Data Handbook:

1. Design Data Hand Book, K. Lingaiah, McGraw Hill, 2nd Ed.
2. Data Hand Book, K. Mahadevan and Balaveera Reddy, CBSPublication
3. Design Data Hand Book, H.G. Patil, I. K. International Publisher, 2010.
4. Design data PSG College of Technology Coimbatore

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Advanced Manufacturing Process

ME603	PCC	Advanced Manufacturing Process	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment 1: 10 Marks Continuous Assessment 2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Analysis of Mechanical Elements

Course Outcomes: At the end of the course, students will be able to:

CO1	Compare different non-conventional machining methods.
CO2	Explain basics of CNC machines.
CO3	Apply geometric dimensioning and tolerancing used on production drawing.
CO4	Explain various rapid prototyping methods.
CO5	Choose various gear manufacturing methods.
CO6	Explain an automation and robotics system used for manufacturing environment.

Course Contents:

Unit 1: Fundamentals of Non-conventional methods Needs and types of non-conventional methods. EDM process, WEDM process, ECM process, AJM process, EBM process, LBM process.	[6]
Unit 2: CNC Machines Introduce NC, CNC and DNC, Constructional features – Drives and control systems, ISO specification – Machining center – Turning center, Introduction to CNC Programming, Introduction to CAM	[6]
Unit 3: Geometric Dimensioning and Tolerancing Tolerance Zone Conversions – Surfaces, Features, Features of Size, Features – Datum Oddly Configured, Curved Surfaces as Datum Features, Equalizing Datum's – Datum Feature of Representation.	[6]
Unit 4: Rapid Prototyping Techniques of rapid manufacturing, Stereo Lithography process, Laser Sintering process, Fused Deposition Method, Applications and Limitations, Rapid tooling.	[6]
Unit 5: Gear Manufacturing Methods	

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Function and types of gears, gear manufacturing methods, Gear hobbing – working principle, advantages, limitations. Gear shapping – Gear shapping by pinion cutter, gear shaping by rack cutter, comparison of gear hobbing and gear shaping, Gear finishing methods – Need of gear finishing, gear shaving, gear grinding, gear lapping.	[6]
Unit 6: Automation and Robotics Types of automations, Comparison of types of automations, Flexible manufacturing system, Introduction to Robotics, Components of Robotics - sensors, controller, processor and software	[6]
Text Books: 1. V. K. Jain, "Advanced machining processes", Allied publishers Pvt. Ltd., New Delhi, 2002. 2. G. F. Benedict, "Nontraditional Manufacturing Processes", Marcel Dekker Inc., 1987.	
Reference Books: 1. M. C. Geough, "Advanced methods machining", Chapman and Hall, 1998. 2. G. E. Thyer, "Computer numerical control of machine tools", BH Newners, 1991. 3. P. C. Pandey, H. S. Shan "Modern machining processes", Tata McGraw-Hill, 1980.	

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Elective-II

Power Plant Engineering

ME604 A	PEC	Power Plant Engineering	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment 1: 10 Marks Continuous Assessment 2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Fluid Mechanics, Thermal Engineering, Heat Transfer

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain various equipment/systems utilized in power plants.
CO2	Demonstrate site selection methodology, construction and operation of Hydro Electric Power Plants.
CO3	Discuss working, site selection, advantages, and disadvantages of steam power plants.
CO4	Discuss operation of Combined Cycle Power Plants.
CO5	Discuss types of reactors, waste disposal issues in nuclear power plants.
CO6	Illustrate power plant economics.

Course Contents:

Unit 1: Introduction Introduction: Energy resources and their availability, types of power plants, selection of the plants, review of basic thermodynamic cycles used in power plants	[6]
Unit 2: Hydro Electric Power Plants Hydro Electric Power Plants : Rainfall and run-off measurements and plotting of various curves for estimating stream flow and size of reservoir, power plants design, construction and operation of different components of hydro-electric power plants, site selection, comparison with other types of power plants.	[6]
Unit 3: Steam Power Plants Steam Power Plants: Flow sheet and working of modern-thermal power plants, super critical pressure steam stations, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized fuel, ash handling systems, dust collection-mechanical dust collector and electrostatic precipitator	[6]
Unit 4: Combined Cycles Combined Cycles: Constant pressure gas turbine power plants, Arrangements of combined plants (steam and gas turbine power plants), re-powering systems with gas production from coal, using PFBC systems, with organic fluids, parameters affecting thermodynamic	[6]

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efficiency of combined cycles, Problems.	
Unit 5: Nuclear Power Plants Nuclear Power Plants: Principles of nuclear energy, basic nuclear reactions, nuclear reactors-PWR, BWR, CANDU, Sodium graphite, fast breeder, homogeneous; gas cooled, Advantages and limitations, nuclear power station, waste disposal.	[6]
Unit 6: Power Plant Economics Power Plant Economics: Load curve, different terms and definitions, cost of electrical energy, tariffs methods of electrical energy, performance and operating characteristics of power plants- incremental rate theory, input-output curves, efficiency, heat rate, economic load sharing, Problems.	[6]

Text Books:

1. A Text Book of Power Plant Engineering, R.K. Rajput, Laxmi Publications.
2. Power Plant Engineering, P.C. Sharma, S.K. Katariaand Sons.
3. Power Plant Engineering, G.R. Nagpal, Khanna Publishers.
4. Power station Engineering and Economy by Bernhardt G.A. Skrotzki and William A. Vopat, TMH.
5. Power Plant Engineering, P.K. Nag, 2nd Edition, TMH, New Delhi.

Reference Books:

1. Power Plant Engineering, A K Raja, Amit Praksh Shrivastava, Manish Dwivedi, New Age International Publishers.
2. Power Plant Familiarization, Manual of Central Training Resources Unit of NTPC India, 1991.
3. Nuclear Power Plant Engineering, James Rust, Haralson Publishing Company.
4. Nuclear Power Plants, Edited by Soon Heung Chang, InTech Publishers

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Process Planning and Cost Estimation

ME604B	PEC	Process planning and cost estimation	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment 1: 10 Marks Continuous Assessment 2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Production Planning and control

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain Production equipment and tooling selection for process planning
CO2	Illustrate Process Selection for various production processes
CO3	Explain importance of machining time for various processes
CO4	Evaluate machining time for various processes
CO5	Explain importance of cost estimation of Different Types of Jobs
CO6	Explain cost estimation of Different Types of Jobs

Course Contents:

Unit 1: Process Planning Introduction to methods of Manufacturing process and Production equipments , Tooling selection, Drawing Interpretation, Material Evaluation, Manual process planning, Computer-aided process planning (CAPP),Retrieval ,Generative .	[6]
Unit 2: Process Selection Process selection - Technological choice , specific component choice, Process flow choice, Factors affecting process selection - Machine capacity, Analysis of machine capacity, Process and equipment selection procedure - Determination of man, machine and material Requirements, Factors influencing choice of machinery, Selection of machinery, Preparation of operation planning sheet for simple components.	[6]
Unit 3: Importance Of Machining Time Importance of Machine Time Calculation .Allowances, Concept of normal time and standard time, Estimation of Machining time, Different Techniques of estimation of machining time.	[6]
Unit 4: Machining Time Calculation Calculation of Machining Time for Turning Operations on CNC machine, Calculation of Machining Time for Drilling Operations, Calculation of Machining Time for Boring Operations, Calculation of Machining Time for Milling Operations, Calculation of	[6]

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Machining Time for Grinding Operations.	
Unit 5: Introduction To Cost Estimation Importance of costing and estimation, Classification of cost, Elements of cost , Estimation of cost elements , Methods of Estimating, Data requirements for cost estimation, Steps in making cost estimate, Calculation of depreciation cost	[6]
Unit 6: Production Cost Estimation Cost Estimation of Turning job,Cost Estimation of Milling job, Cost Estimation of Grinding job, Cost Estimation of Forging Job	[6]
Text Books: 1. Process Planning and Cost Estimation by Dr.V.Jayakumar. 2. Peterscalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2002. 3. Sinha B.P, "Mechanical estimating and Costing", Tata-McGraw Hill publishing co, 1995.	
Reference Books: 1. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9th Edition, John Wiley, 1998. 2. Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2003. 3. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.	

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Finite Element Analysis

ME604C	PEC	Finite Element Analysis	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment 1: 10 Marks Continuous Assessment 2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: A basic understanding of vectors, matrices and partial differential equations for thermal and mechanical problems

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain fundamental concepts, equations of equilibrium, stress-strain relations and the Potential Energy principal and Approximations of Differential equations.
CO2	Apply different methods of Finite Element formulations for one dimensional problem.
CO3	Make use of Constant strain triangle Element for two dimensional plane stress and plane.
CO4	Solve the Axisymmetric Solid and plane truss problems by using different methods of Finite Element Formulations.
CO5	Utilize 1D and 2D element formulations for Scalar field problems.
CO6	Illustrate the Computer Implementation of the Finite Element Method.

Course Contents:

Unit 1 Fundamental Concepts Introduction, Past, present and future of FEA, stresses and Equilibrium, boundary conditions, strain-displacement relations, stress-strain relations, Temperature effects, Potential energy and equilibrium; the Rayleigh-Ritz method, Galerkins method, Saint-Venant's principle, Von-Mises stress, Gauss elimination method.	[6]
Unit 2 One Dimensional Problem Introduction, Finite element modeling (element division, numbering scheme), coordinates and shape functions, the potential energy approach (element stiffness matrix, force terms), Galerkin approach (element stiffness matrix, force terms), Assembly of the global stiffness matrix and load vector, properties of K, the finite element equations; treatment of boundary conditions (types of boundary conditions, elimination approach, penalty approach (Theoretical concept only), multipoint constraints, Quadratic shape functions.	[6]
Unit 3 Two-Dimensional Problems using Constant Strain Triangles Introduction, finite element modelling, Constant Strain Triangle (CST), Iso-parametric representation, potential-energy approach, element stiffness, force terms, Galerkin approach, stress calculations, Problem modelling and boundary conditions	[6]

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Unit 4 Axisymmetric solids subjected to axisymmetric loading and Analysis of Trusses Introduction, Axisymmetric formulation, Finite element modelling, Triangular element, potential energy approach, body force term, rotating flywheel, pressure vessel, Galerkin approach, stress calculations. **Trusses:-**Plane trusses, Local and Global coordinate systems, formulas for calculating L and M, element stiffness matrix, Stress Calculations, Assembly of global stiffness matrix.	[6]
Unit 5 Scalar Field Problems Introduction, steady state heat transfer, One dimensional heat conduction, One dimensional heat transfer in thin fins, Two dimensional steady state heat conduction, two dimensional fins.	[6]
Unit 6 Computer Implementation of the Finite Element Method: **Pre-processing**: Model definition – nodal coordinates element connectivity, material and element type and property definitions, type of analysis (static/modal), loading and boundary conditions. Meshing techniques- free and mapped meshing, Quality checks – aspect ratio, warp angle, skew, distortion, stretch, included angle, taper **Processing**: Element level calculations, Equation assembly, Equation solver (sparse solvers, factorization, numerical/computational issues) **Post Processing**: Strain and stress recovery (integration and nodal points), interpretation of results (results validation and data interpretation) and design modification	[6]

Text Books:

1. "Introduction to Finite Elements in Engineering", Chandrapatala, Belgundu, Prentice Hall of India, 3rd Edition.
2. "Finite Element Method with Application in Engineering", Y. M. Desai, T. I. Eldho, A. H. Shah, Pearson Education.
3. "Textbook of Finite Elements Analysis", P. Sheshu, Prentice-Hall of India Private Limited, New Delhi, 5th Edition.
4. "An Introduction to Finite Element Method",J. N. Reddy; Tata McGraw Hill International Editions, ISBN 0-07-112799-2, 2nd Edition.
5. "Finite Element Methods for Engineers", U.S. Dixit, Cengage Learning, 1st Edition.
6. "Finite Element Analysis – Theory and Practice", M.J. Fagan, Longman Scientific and Technical

Reference Books:

1. "The Finite Element Method – Basic Concepts and Linear Applications" O. C, Zienkiewicz; Tata McGraw Hill International Editions; ISBN 0-07-084175-6.
2. "Practical Finite Element Analysis", N.S. Gokhale, S.S. Deshpande, S.V. Bedekar, A.N.Thite, Finite to Infinite Publication.
3. "Concepts of Finite Element Methods", Manicka Selvam, SCITECH publication.
4. "A First Course in the Finite Element Analysis" ,D.L.Logan, Cengage Learning.
5. "Finite Elements Analysis – Theory and Application with ANSYS", Sawed Moveni. Prentice-Hall of India, 2nd Edition.
6. "Applied Finite Elements Analysis", Larry J. Segerlind, BSP Books Pvt Ltd.

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Industrial Automation and Robotics

ME604 D	PEC	Industrial Automation and Robotics	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment 1: 10 Marks Continuous Assessment 2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: None.

Course Outcomes: At the end of the course, students will be able to:

1	Explain basic concepts of Automation.
2	Explain industrial control and analyze transfer line.
3	Explain fundamental knowledge of assembly automation.
4	Explain fundamental concepts of Industrial Robot.
5	Classify different types of end effectors and sensors required for applications.
6	Illustrate robot teaching.

Course Contents:

Unit 1 Introduction to Automation Automated manufacturing systems, fixed /programmable/ flexible, Automation, Need of automation, Basic elements of automated systems- Power, program and control. Low cost automation, Economic and social aspects of automation, advanced automation functions, Levels of automation.	[6]
Unit 2 Industrial Control and Transfer Line A. Industrial control systems in process and discrete manufacturing industries, Continuous and discrete control; Computer process control. B. Fundamentals of transfer lines, Configurations, Transfer mechanisms, Storage buffers, Control, Applications; Analysis of transfer lines with and without storage buffers.	[6]
Unit 3 Assembly Automation Assembly Automation: Types and configurations, Parts delivery at workstations, Various vibratory and non-vibratory devices for feeding and orientation, Product design for automated assembly, Quantitative analysis of assembly system.	[6]
Unit 4 Fundamentals of Industrial Robots Specifications and Characteristics, Criteria for selection, Robotic Control Systems: Drives, Robot Motions, Actuators, Power transmission systems, Robot controllers, Dynamic properties of robots-stability, Control resolution, Spatial resolution, Accuracy, Repeatability, Compliance, Work cell control, Interlocks.	[6]

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Unit 5 Robotic End Effectors and Sensors Transducers and sensors- Sensors in robotics and their classification, Touch (Tactile) sensors, Proximity and range sensors, Force and torque sensing, End Effectors- Types, grippers, Various process tools as end effectors; Robot End effector interface, Active and passive compliance, Gripper selection and design, Transformation, Relative transformation, Direct and inverse kinematics solutions, DH representation and displacement matrices for standard configuration (theoretical treatment).	[6]
Unit 6 Robot Teaching Introduction, Various teaching method, Task programming, Survey of Robot level programming languages, A Robot program as a Path in space, Motion interpolation, WAIT, SIGNAL and DELAY commands, Branching, Robot language structure, Various textual robot, Languages such as VAL II, RAIL, AML and their features, Typical programming examples such as palletizing, Loading a machine etc., Application of Robot.	[6]

Text Books:

1. "Automation, Production Systems and Computer Integrated Manufacturing", Groover, M.P., Pearson Education, ISBN: 81-7808-511-9 2nd Edition (2004).
2. "Industrial Robotics, Technology, Programming and Applications", Groover, M.P.; Weiss, M.; Nagel, R.N. and Odrey, N.G. , McGraw Hill Intl. Edition.,ISBN: 0-07-024989- X.
3. "Introduction to Robotics, Analysis, Control and Applications", Niku, Saeed B., Willey Publication, ISBN 9788126533121, 2nd Edition.
4. "Robotics-Control, Sensing, Vision and Intelligence", Fu, K.S.; Gonzalez, R.C. and Lee, C.S.G., McGraw Hill Intl. Ed., ISBN:0-07-100421-1.

Reference Books:

1. "Robot Technology Fundamentals", Keramas, James G, Thomson Learning –Delmar ISBN: 981-240-621-2, (1998).
2. "Handbook of Robotics", Noff, Shimon Y., John Wiley and Sons.
3. "Introduction to Robotics, Analysis, Systems and Applications", Niku, Saeed B. (2002), Prentice Hall of India.
4. "Robotics for Engineers", Koren, Yoram, Tata McGraw Hill., (2003).
5. "Fundamentals of Robotics, Analysis and Control", Schilling, Robert J, Prentice Hall of India, ISBN: 81-203-1047-0, (2004).
6. "Introduction to Robotics Mechanics and Control" J. J. Craig, Pearson Education, 3rd Edition.
7. "Applied Robotics Volume I and II", Edwin Wise, Cengage Learning

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Industrial Hydraulics and Pneumatics

ME604 E	PEC	Industrial Hydraulics and Pneumatics	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment 1: 10 Marks Continuous Assessment 2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Fluid Mechanics, Metrology and Quality Control.

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain various components of fluid power elements.
CO2	Explain Hydraulic system elements
CO3	Explain control of fluid power elements
CO4	Explain Pneumatic system elements
CO5	Illustrate circuits of fluid power systems
CO6	Illustrate applications of fluid power systems

Course Contents:

Unit 1: Introduction to Fluid Power Classification, general features, Applications in various fields of engineering, Merits and Demerits of fluid power systems, Components of fluid power, Hydraulic fluids: Fluid properties, SAE grades and ISO symbols, selection of fluid, sources of fluids and additives, effect of temperature on fluids, Introduction and Application of pneumatics, Physical properties, Principles, basic requirement of pneumatic system, comparison with hydraulic system.	[6]
Unit 2: Hydraulic System Elements Classification, types of seals, sealing material, pipes, hoses, compatibility of seal with fluids. a) Pumps-types-Gear, lobe, screw, vane, piston, selection of pumps, theoretical flow rate, pump performance – efficiencies b) Hydraulic Cylinders- Types, single acting, double acting, telescopic and tandem, cylinder force, velocity and power, acceleration and deceleration of cylinder loads, load calculations for vertical, horizontal and inclined cylinders,c) Hydraulic Motors-Types, gear, vane and piston, semi-rotary actuators, analysis of a semi-rotary single-vane motor, performance of hydraulic motors- efficiencies	[6]
Unit 3: Fluid Power Control Valves Hydraulic Systems-Direction control valves – Types, check valves, two way, three way,	[6]

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four way, shuttle valves, methods of actuation, Pressure control valves – Types, pressure relief, pressure reducing, unloading, counterbalance, pressure – sequence flow control valves – types, needle, non-pressure compensated, pressure compensated Principle of pressure control valves, directly operated and pilot operated pressure Pneumatic Systems Direction control valves (two way, three way, four way), check valves, flow control valves, pressure control valves, speed regulators, quick exhaust valves, time delay valve, shuttle valve and twin pressure valve, Solenoid operated, pilot operated valve	
Unit 4: Fluid Power Systems Accessories **Hydraulic Systems-**Seals- Classification, reservoirs-types and sizing, Accumulators-types, selection, sizing accumulators, applications, fluid conditioners, filters and strainers, heat exchangers, hydraulic lines-sizing, burst and working pressure **Pneumatic Systems-**Compressors- Types, piston, screw and vane, air capacity rating of compressors, power required to drive compressors, sizing of air receivers, Fluid conditioners- air filters, air pressure regulators, air lubricators, FRL unit, air dryers.	[6]
Unit 5: Basic Fluid Power Circuits Study of Circuits and its Application- 1. Meter In circuit 2. Meter Out circuit 3. Regenerative circuit 4. Counterbalance circuit 5. Hydraulic cylinder sequencing circuits 6. Cylinder synchronizing circuits 7. Pneumatic circuit with time delay 8. Impulse operation circuit	[6]
Unit 6: Hydraulic Circuit Design and Analysis Design of hydraulic system for industrial applications includes following 1. Load, Pressure and flow calculations 2. Sizing and selection of components 3.Circuit preparation	[6]
Text Books: 1. "Anthony Esposito, "Fluid Power with Applications", Pearson Education 2005 2. Majumdar S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw-Hill, 2001.	

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Internal Combustion Engines and Hybrid Vehicles Laboratory

ME605	PCC	Internal Combustion Engines and Hybrid Vehicles Laboratory	0-0-2	1 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: - Practical: 2 hrs./week	Continuous Assessment 1: 15 Marks Continuous Assessment 2: 15 Marks Practical and Oral Exam: 20 Marks

Pre-Requisites: Thermal Engineering, Fluid Mechanics, Thermal Engineering Lab

Course Outcomes: At the end of the course, students will be able to:

CO1	Identify various components of I C Engine by dismantling and assembly.
CO2	Test for various engine performance parameters.
CO3	Illustrate different engine components through industrial visit.

The I. C. Engine Lab consists of following experiments

Study Group
1. Demonstrate Constructional detail of I.C. engines by dismantling and assembly.
2. Study of Carburetor and Petrol injection system
3. Study of fuel injection system of diesel engine

Test Group (Any Five)
1. Test on four stroke Diesel Engine.
2. Test on four stroke Petrol Engine.
3. Morse Test on multi cylinder Engine
4. Visit to a engine manufacturing company / repairing unit
5. Test on computer controlled I.C. Engine
6. Measurement of exhaust emissions of SI / CI engines.
7. Test on variable compression ratio engine
8. Market Survey on Hybrid Vehicles

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Machine Design-II Laboratory

ME606	PCC	Machine Design-II Laboratory	0-0-2	1 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: - Practical: 2 hrs./week	Continuous Assessment 1: 25 Marks Continuous Assessment 2: 25 Marks

Pre-Requisites: Basic mechanical Engineering, Strength of Materials, Kinematic of Machines, Machine Design-I

Course Outcomes: At the end of the course, students will be able to:

CO1	Design against fluctuating loads.
CO2	Design of pressure vessel and gear box design and drafting (2D/3D) using CAD
CO3	Design of flywheel.
CO4	Selection of bearing for different applications using the manufacturer's catalogue

The Machine Design-II Laboratory consists of following experiments

1. The term work shall consist of two design projects based Industrial application. Each design project shall draft through CAD software, consist of assembly drawings with a part list and overall dimensions and other drawings of individual components. Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified, wherever necessary, so as to make it working drawing.
2. Four assignments based on topics of syllabus of Machine Design II.
3. Industrial visit based on topics of syllabus of Machine Design II.

Text Books:

1. V. B. Bhandari, "Design of Machine Elements", Tata McGraw Hill Publications, New Delhi, 2008.
2. R. L. Nortan, "Machine Design: An Integrated Approach", Pearson Education Singapore, 2001.
3. A Machine Design R.S. KhurmiandJ.K.Gupta S. Chand publication
4. Machine design S G Kulkarni McGraw Hill Education Publications
5. Introduction to Machine design V B Bhandari McGraw Hill Education Publications
6. Design Of Machine Elements Vol I, Vol II J.B.K. Das, P.L. Srinivas Murthy Sapna publication
7. Machine Component Design William OrthweinJaico publication

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8. Design Data Hand Book for Mechanical Engineers K Mahadevanand K Balaveera Reddy CBS publications.

Reference Books:

1. R. C. Juvinall, K. M. Marshek, " Fundamental of machine component design", John Wiley and Sons Inc., New York, 3rd edition, 2002.
2. J. Hamrock, B. Jacobson and Schmid Sr., " Fundamentals of Machine Elements", International Edition, New York, 2nd edition, 1999.
3. A. S. Hall, A. R. Holowenko, H. G .Langhlin, "Theory and Problems of Machine Design", Schaum's Outline Series, Tata McGraw Hill book Company, New York, 1982.
4. J. E. Shigley and C. Mischke, "Mechanical Engineering Design", Tata McGraw Hill Publications, 7th edition, 2004.
5. M. F. Spotts, "Design of Machine Elements", Prentice Hall of India, New Delhi.
6. Machine Design by Robert L.Norton, Tata Mc- Graw Hill Publication
7. Fundamentals of Machine Component Design by Junvinall Wiley India
8. Mechanical System Design by Anurag Dixit SCITECH publication
9. Design of Machine Element/Machine Design by Kannaiah SCITECH publication
10. Design of Machine Element by Spotts/Shoup/Hornberger/Jayram/Venketesh PiersonEducation
11. Machine Design by T H WentzellCengage Learning

Design Data Handbook:

1. Design Data Hand Book, K. Lingaiah, McGraw Hill, 2nd Ed.
2. Data Hand Book, K. Mahadevan and Balaveera Reddy, CBSPublication
3. Design Data Hand Book, H.G. Patil, I. K. International Publisher,2010.
4. Design data PSG College of Technology Coimbatore

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Advanced Manufacturing Process Laboratory

ME607	PCC	Advanced Manufacturing Process Laboratory	0-0-2	1 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: - Practical: 2 hrs./week	Continuous Assessment 1: 25 Marks Continuous Assessment 2: 25 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Show nontraditional machining process in an industry
CO2	Develop spur gear by using simple indexing method
CO3	Develop part containing surface grinding / cylindrical grinding operation
CO4	Show flexible manufacturing system in an industry
CO5	Show Robotics system in an industry

The Advanced Manufacturing Process Laboratory consists of Any 8 experiments

1. Industrial visit to study at least one nontraditional machining process
2. One job of gear cutting (spur gear) by using simple indexing method (max. four students per job).
3. One job containing surface grinding / cylindrical grinding operation. (max. four students per job).
4. Industrial visit to study at flexible manufacturing system.
5. Industrial visit to study Robotics system.

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CAD/CAM/CAE Laboratory

ME608	PCC	CAD/CAM/CAE Laboratory	0-0-2	1 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: - Practical: 2 hrs./week	Continuous Assessment 1: 15 Marks Continuous Assessment 2: 15 Marks Practical and Oral Exam: 20 Marks

Pre-Requisites: Engineering Graphics

Course Outcomes: At the end of the course, students will be able to:

CO1	Construct CAD part models, assembly model and drafting of machine elements using CAD software.
CO2	Write NC programs for turning and milling.
CO3	Evaluate stresses in components subjected to simple structural loading using FE software.

The CAD/CAM/CAE Laboratory consists of following experiments

1. Part modeling of machine elements using any one of the CAD software 2. Assembly modeling of assembly or sub-assembly of engineering products using any one of the CAD software. 3. Drafting of Parts and Assembly of engineering assembly using any one of the CAD software 4. Minimum 2 Jobs (Programs) on CNC Turning operations 5. Minimum 2 Jobs (programs) on CNC Milling operation 6. Minimum 4 structural analysis problems to be solved using a CAE software.	

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Sensor and Instrumentation Laboratory

ME609	PCC	Sensor and Instrumentation Laboratory	0-0-2	1 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: - Practical: 2 hrs./week	Continuous Assessment 1: 25 Marks Continuous Assessment 2: 25 Marks

Pre-Requisites: Basic knowledge of Semiconductor Physics and Basic Electronics

Course Outcomes: At the end of the course, students will be able to:

CO1	Select different types of transducers and sensors and explain with applications
CO2	Illustrate Signal Conditioning and Data Acquisition Systems.
CO3	Explain the instrumentation techniques.
CO4	Explain measurement system and measuring instruments.
CO5	Sketch, explain and illustrate different oscilloscopes and display devices.
CO6	Sketch, explain and design different types of bridges.

The Sensor and Instrumentation Laboratory consists of following experiments

1. Introduction to Instrumentation 2. Measurement of strain using strain gauge 3. Characteristics of temperature sensors 4. Study of Characteristics of LVDT 5. Measurement of Natural frequency and damping ratio of the given system 6. Loading effects of Potentiometer and Characteristics of Opto-coupler 7. Level Measurement using proximity sensors 8. Effect of Modifying and Interfering input for the given measurement system 9. Characteristics of Hall effect sensor 10. Accelerometer sensor	

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Capstone Project Phase-I

PROJ05	PROJ	Capstone Project Phase-I	0-0-4	2 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: - Practical:	Continuous Assessment 1: 25 Marks Continuous Assessment 2: 25 Marks End Semester Examination: 50 Marks

Pre-Requisites: All courses

Course Outcomes: At the end of the course, students will be able to:

CO1	State the exact title of the project and problem definition.
CO2	Explain the motivation, objectives and scope of the project.
CO3	Review the literature related to the selected topic of the project.
CO4	Design the mechanism, components of the system and prepare detailed drawings.
CO5	Evaluate the cost considering different materials/manufacturing processes.

It is expected that the students should complete at least 50% of the total project work in VI Semester. The objective is to prepare the students to examine any design or process or

The students in a group of not more than FOUR will work under the guidance of the faculty member on the project work undertaken by them. The completion of work, the submission of the report and assessment should be done at the end of VII Sem.

The project work should consist of any of the following or appropriate combination:

1. A comprehensive and up-to-date survey of literature related to study of a phenomenon or product.
2. Design of any equipment and / or its fabrication and testing.
3. Critical Analysis of any design or process for optimizing the same.
4. Experimental verification of principles used in applications related to various specializations related to Mechanical Engineering.
5. Software development for particular applications.
6. A combination of the above.

phenomenon from all angles, to encourage the process of independent thinking and working and to expose them to industry. The students may preferably select the project works from their opted

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elective subjects. The students should submit the report in a prescribed format, before the end of VII semester. The report shall be comprehensive and presented typed on A4 size sheets and bound. Number of copies to be submitted is number of students plus two. The assessment would be carried out by the panel of examiners for both, term work and oral examinations.

Industrial Training/Field Training

IFT02	PROJ	Industrial Training/Field Training	0-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: - Practical:	End Semester Examination : 50 Marks

Pre-Requisites: Basic knowledge of all courses

Course Outcomes: At the end of the course, students will be able to:

Course Description:-Internship / Training is educational and career development opportunity, providing practical experience in a field or discipline. At the end of the **Fourth and Fifth semester**, every student should undergo practical training in an industry / professional organization / Research laboratory with the prior approval of the HoD/TPO/Principal of the college and submit the report along with the completion certification from the Industry/ Organization. The report will be evaluated during the **Sixth** semester by the department.
Course Learning Outcomes:-
After successful completion of the course, students will be able to
CO1. Verify the Technical knowledge in real industrial situations. CO2. Develop interpersonal communication skills. CO3. Discuss activities and functions of the industry in which the Internship/training has done. CO4. Write the technical report.
Prerequisite: - Basics of Mechanical Engineering, Good written and Oral Communication.
Guideline for Students:-
1. Arrive at work as per schedule, ready to work and stay for the agreed upon time.
2. Present yourself in a professional manner at all times, including being appropriately dressed at workplace.
3. Communicate any concerns with your supervisor and the internship/Training coordinator in a timely manner and respectfully.

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4. Demonstrate enthusiasm and interest in what you are doing, ask questions and take the initiative as appropriate.
5. Complete and submit assigned tasks by designated timelines. Meet all deadlines.
Student's Diary/ Daily Log
The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily training diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches and drawings related to the observations made by the students.
The daily training diary should be signed after every day by the supervisor/ in charge of the section where the student has been working. The diary should also be shown to the Faculty Mentor.
Student's Diary and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the SITCOE immediately after the completion of the training. It will be evaluated on the basis of the following criteria:
• Regularity in maintenance of the diary.
• Adequacy and quality of information recorded.
• Drawings, sketches and data recorded.
• Thought process and recording techniques used.
• Organization of the information.
Internship Report
After completing the internship, the student should prepare a comprehensive report to indicate what he/she has observed and learned in the training period. Daily diary will also help to a great extent in writing the industrial report since much of the information has already been incorporated by the student into the daily diary. The competent authority should sign the training report. The Internship report should be evaluated on the basis of following criteria:
i. Originality. ii. Adequacy and purposeful write-up. iii. Organization, format, drawings, sketches, style, language etc. iv. Variety and relevance of learning experience. v. Practical applications, relationships with basic theory and concepts taught in the course.

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Evaluation of Internship/Training

The student should be evaluated based on his training report and presentation, before an expert committee constituted by the concerned department as per norms. The evaluation will be based on the following criteria:

- Quality of content presented.
- Proper planning for presentation.
- Effectiveness of presentation.
- Depth of knowledge and skills.
- Attendance record, daily diary, departmental reports shall also be analyzed along with the Internship Report.

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Aptitude Skills-IV

HMS07	HSMC	Aptitude Skills- IV	1-0-0	Audit

Teaching Scheme:	Examination Scheme:
Lecture: 01/week	Continuous Assessment 1:-25 Marks Continuous Assessment 2:-25 Marks Practical and Oral Examination: NA

Pre-Requisites: Communication Skills, Aptitude Skills I, II

Aptitude (12Hrs) (Compulsory)

Course Outcomes: At the end of the course, students will be able to:

CO1	Solve the problems on system of equation
CO2	Solve the problems on seating arrangement
CO3	Solve the logical reasoning problems
CO4	Solve the critical analysis problems
CO5	Solve the problems of Data interpretation
CO6	Solve the problems mensurations

Unit 1: System of equations Quadratic equations, Surds and indices, solution of equations, Ages.	[2]
Unit 2: Seating Arrangment Linear seating Arrangement, Circular seating arrangement, Complex seating arrangement	[2]
Unit 3: Logical Reasoning Numerical based on sense of direction, Blood relations, Odd man Out	[2]
Unit 4: Critical analysis Clocks and Calendar based problems, Cryptarithmetic, heights and distances	[2]
Unit 5: Data Interpretation Table form, Bar form, Line for Pi chart form	[2]
Unit 6: Permutations and Combinations Numbers and Words Repetition allowed and Repetition not allowed	[2]

Text Books:

1. RS Aggarwal, "Quantitative Aptitude for Competitive Examinations", S. Chand Publisher; 2016 edition

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2. Quantitative Aptitude for CAT TMH Publications
3. Vedic Maths Made Easy By Dhaval Bhatiya Jaico Publication House.

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Language Skill- IV

HMS08	HSMC	Language Skill- III	0-0-2	1 Credit

Teaching Scheme:	**Examination Scheme:**
Practical : 02 hrs week	Continuous Assessment 1:-25 Marks Continuous Assessment 2:-25 Marks Practical and Oral Examination: NA

Pre-Requisites: Language Skills I, II

Languages (Any One)
Python (Technical Language) (24Hrs)
Syllabus for Python

Course Objectives:
This course provides an opportunity to enhance acquisition of the fundamental elements of the Python language. Emphasis is on the progressive development of basic programming syntaxes and essentials used in Python.

Course Outcomes: At the end of the course, students will be able to:

CO 1	Explain essentials and fundamentals of Python Programming.
CO 2	Illustrate data types and variables.
CO 3	Illustrate Operators and Expressions.
CO 4	Make a use of Decision making and Looping statements.

Unit 1: Function Why we Need Function ,Categories of Functions-Predefined ,User-define ,Parts of Functions Arguments, Return Value ,Definition of Function ,Function Calling ,Lambda(Introduction)	[6]
Unit 2: Python Collections List, tuple, set, dictionary—-> constructor ,check, change ,remove item ,list comprehension , **Sort, Loop through ,joining**	[6]
Unit 3 : Class and Object OOP Characteristics ,creating class ,__init__() method, creating Object ,accessing methods and Variables of class, constructor and destructor ,inheritance ,super(),function overloading	[6]
Unit 4: File handling Path and Directory Settings-Absolute,Relative,File Modes(r,w,a,etc),Open and Close file Reading File using Python--Read Line By Line readline() function,Read Word,Read character (offset),Writing Text File using Python--Write Mode,Append Mode, Exception handling	[6]

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Text Books : 1. Python Projects (Author: Laura Cassell, Alan Gauld) Wrox publication 2. Murach's Python Programming. Author.:Michael Urban, Joel Murach, murach's Publication. 3. Fundamentals of Python (First Program) Cengage MINDTAP Publication 2nd Edition. Author: K.A. Kambert	

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