SGGS INSTITUTE OF ENGINEERING & TECHNOLOGY, NANDED

(An Autonomous Institute of Government of Maharashtra)

T.Y. B. Tech. (Mechanical) Curriculum Structure

Academic year 2017-18 onwards

Semester V						
Course Code	Course Title	Lectures (L)	Tutorials (T)	Practical (P)	Credits	
					Th.	Pr.
ME301	Machine Design – I	03	01	02	04	01
ME302	Dynamics of Machines	03	01	02	04	01
ME303	Heat Transfer	03	01	02	04	01
Student have to opt for any one from MA302A to MA302C as Elective 1		04	--	--	04	--
MA302A	Mathematics-IV (Complex Analysis)					
MA302B	Mathematics-IV (Statistics and Probability)					
MA302C	Mathematics-IV (Numerical Analysis)					
ME309 to ME314	Elective-II	03	01	02	04	01
	Total	**16**	**04**	**08**	**20**	**04**
				Total Credits	**24**	
Semester VI						
Course Code	Course Title	Lectures (L)	Tutorials (T)	Practical (P)	Credits	
					Th.	Pr.
ME306	Machine Design – II	03	01	02	04	01
ME307	Internal Combustion Engines	03	01	02	04	01
ME308	Refrigeration and Air Conditioning	03	01	02	04	01
ME304	Tool Design	03	01	02	04	01
ME315 to ME319	Elective-III	03	01	02	04	01
	Total	**15**	**05**	**10**	**20**	**05**
				Total Credits	**25**	
				Total	**49**	

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List Electives for Third Year B. Tech Mechanical Engineering.

Elective-I (Choose any one from the following)

MA302A: Complex Analysis

MA302B: Statistics and Probability

MA302C: Numerical Analysis

Elective-II (Choose any one from the following)

ME309: Computer Aided Design

ME310: Steam and Gas Turbines

ME311: Advanced Machining Techniques

ME312: Mechatronics-I

ME313: Production Planning and Control

ME 314:Industrial Fluid Power

Elective-III (Choose any one from the following)

ME315: Finite Elements Analysis

ME316: Mechatronics-II

ME317: Productivity Improvement Techniques

ME318: Computational Fluid Dynamics

ME319: Elements of PLM

Open Elective(s): Offered by other departments in the Institute

MACHINE DESIGN-I

(CREDITS THEORY: 04, PRACTICAL: 01)

Course code: ME301 **Contact Hours/Week:** Th. 03, Tu. 01, Pr. 02

Course Objective:

a. To develop an ability to understand the designing process for mechanical component.
b. To demonstrate different types of loadings to which mechanical component are subjected and apprehend the associated design principles.
c. To comprehend design principles for designing various types of joints involved in assembling machine components.
d. To demonstrate the application of design principles to certain torque transmitting and torque absorbing elements.

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 70 Marks	Practical Examination: 50%

Course Content:

Introduction: Steps of design, Basic requirements of machine element, Design of machine elements, Selection of materials, Designation of material as per ISI, Various codes and standards.

Design against static load: Static Load, Modes of failure, Failure of ductile materials, Failure of brittle materials, Stress due to bending moment, Stress due to torsional moment, Eccentric axial loading, Design of machine parts subjected to combined direct and bending stress.

Design against fluctuating load: Definition, Stress concentration, Fluctuating stress, Fatigue failure, Endurance limit, S-N curve, Low cycle and High cycle fatigue.

Endurance Limit: Approximate estimation, Reversed stresses- Design for finite and infinite life, Cumulative damage in fatigue, Soderberg and Goodman lines, Modified Goodman diagrams, Gerber equation, Fatigue design under combined stresses.

Design of shafts, Keys & Couplings: Shaft design on strength basis, Shaft design on torsional rigidity basis.Keys: Definition, Types of keys and their design, Splines and their design. Couplings: Definition, Muff coupling, Rigid flange coupling, Bushed pin flexible coupling, Design for lateral rigidity, Castigliano's theorem, Area moment method, Critical speed of shaft.
Threaded, Riveted and Welded Joints: Introduction, Basic types of screw fastening, Bolt of uniform strength, Eccentrically loaded bolted joints in shear, Bolted joint under fluctuating load, Bolted joints with combined stresses. Riveted Joint: Methods of riveting, Types of rivet heads, Types of riveted joints, Strength of joint, Eccentric loaded riveted joint. Welded Joint:

Introduction, Types, Stresses in Butt and fillet joints, Strength of welded joints, Eccentrically loaded joints.

Clutches: Type of clutches, Friction materials, Torque transmitting capacity, Single-disc, Multi-disc, Cone and Centrifugal clutches, Energy equation, Thermal considerations.

Brakes and Dynamometer: Introduction, Energy absorbed by brake, Heat to be dissipated during braking, Materials for brake lining, Types of brake, Shoe brake, Band brake, Band and block brake, Internal expanding brake. Dynamometer: Introduction, Types of dynamometers.

Term Work:

Full imperial size sheets with the design problems on

1. Cotter joint or Knuckle joint.
2. Design of screw and nut or Design of screw jack.
3. Rigid or Flexible flange coupling.
4. Threaded, Riveted and welded joint.
5. Clutch and Brake.

Practical Examination:

It shall consist of oral/practical examination based on above syllabus.

Reference Books:

1. Joseph E. Shigley and Charles R. Mischke, "Mechanical Engineering Design," Tata McGraw Hill Publication, 6th Edition,2005
2. V.B.Bhandari, "Design of Machine Element," Tata McGraw Hill Publications, 4th Edition, 1997
3. C.S Sharma & Kamlesh Purohit, "Design of Machine Elements," Prentice Hall of India publications, New-Delhi, Eastern Economy 3rd Edition, 2003.
4. Spott's M.F. and Shoup T.E. – "Design of Machine elements," Prentice Hall International.
5. Black P.H. and O. Eugene Adams, "Machine Design," McGraw Hill Book Co. Ltd.

Design Data Book:

1. Design Data Book for Mechanical Engineers, K. Mahadevanan & K. Balaveera Reddy, CBS Publishers & Distributor Delhi, 4th Edition 2008
2. Design Data Book – B. D. Shiwalkar, Central Techno Publication Nagpur, 2nd Edition 2007.

Course Outcomes:

1. Students understand the need, steps of machine design, and consideration for manufacturing.
2. Student will be able to evaluate life of machine components against static loads and fluctuating loads.
3. Student demonstrates skill of designing various temporary and permanent joints.
4. Students will design the transmission shafts, key and coupling.

DYNAMICS OF MACHINES

(CREDITS THEORY: 04, PRACTICAL: 01)

Course code: ME302 **Contact Hours/Week:** Th. 03, Tu. 01, Pr. 02

Course Objective:

a. To expand student's background in kinematic synthesis and analysis.
b. To introduce the students to static & dynamic forces exerting on basic machine parts and their effects on it.
c. To demonstrate need of balancing and methods used to balance the working parts in kinetics.
d. To inculcate the principles of vibrations, its types and control measures.

Evaluation Scheme:

Theory	Practical
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 70 Marks	Practical Examination: 50%

Course Content:

Static force analysis: Constraint and applied forces, Static equilibrium, Equilibrium of two and three force members, Equilibrium of four forces and torque, Force convention and free body diagrams, Principle of virtual work, Static force analysis considering friction.

Dynamic Force Analysis: D-Alembert's Principle, Dynamic analysis of Four link mechanism and slider-crank mechanism, Velocity & acceleration of piston and connecting rod, Engine force analysis, Inertia of connecting rod, Inertia force in reciprocating engines (Graphical method).

Turning Moment: Turning moment diagram for reciprocating engines, Speed fluctuation, Power smoothening by flywheels.

Balancing: Static balancing, Dynamic balancing, balancing of several masses in different planes, Force balancing of linkages, balancing of reciprocating mass, balancing of locomotives, Effect of partial balancing in locomotives, balancing of inline engines, Balancing of V engines, Balancing of radial engines, Balancing machines, Field balancing.

Vibration: Definitions, Types of vibration, Basic features of vibrating system, Degree of freedom, Free longitudinal vibration, Displacement, Velocity and Acceleration, Inertia effect of the mass of spring, Damped vibration, Logarithmic decrement, Forced vibration, Forced damped vibration, Dynamic magnifier, Transmissibility, Vibration isolation, Transverse vibration, Whirling of shaft & critical speeds, Free torsional vibration, Single rotor systems, Inertia effect of mass of shaft, Multifilar system, Two rotor system, Three rotor system, Geared systems.

Term Work:

1. Full imperial size sheets/Assignments on Static, Dynamic force analysis and balancing.
2. Assignment on each unit.

List of Experiments: (Any eight)

1. To determine the oscillations of simple pendulum.
2. To determine the radius of gyration of given compound pendulum.
3. To determine the radius of gyration of given bar by using Bi-Filar suspension.
4. To study the longitudinal vibrations of helical spring and to determine the frequency of vibration theoretically and experimentally.
5. To study the un-damped free vibration of equivalent spring mass system.
6. To study the forced vibrations of equivalent spring mass system.
7. To study the torsional vibration (un-damped) of single rotor shaft system.
8. To study the free vibration of two rotor system and to determine the natural frequency of vibration theoretically and experimentally.
9. To study the damped torsional oscillations and to determine the damping coefficient Ct.
10. To verify the Dunkerley's Rule experimentally.
11. To study the forced lateral vibrations of the beam for different damping.

Practical Examination:
It shall consist of oral/practical examination based on above syllabus.

Reference Books:

1. S. S. Rattan, "Theory of Machines," Tata McGraw Hill Publishing Co Ltd., New Delhi 2nd Edition, 2005.
2. P.L. Ballaney, "Theory of Machines & Mechanism," Khanna Publishers, New Delhi, 21st Edition, 2005.
3. Thomas Bevan, "The Theory of Machines," CBS Publishers and Distributors, New Delhi, 1st Edition, Reprint 2005.
4. J. E. Shigley, J. J. Uicker, "Theory of Machines & Mechanism," McGraw HillPublication– New Delhi, 2nd Edition.

Course Outcomes:

1. Student demonstrates and analyzes different mechanisms used in various machines.
2. Student exhibit skills towards application of static force analysis and synthesis of mechanisms.
3. Student exhibits need, design and applications of balancing machine parts.
4. Student exhibits solutions to issues related to vibration, their effect and its control measures.

HEAT TRANSFER

(CREDITS THEORY: 04, PRACTICAL:01)

Course code: ME303 **Contact Hours:** Th. 03, Tu.01, Pr.02

Course Objective:

a. To demonstrate the fundamentals of heat transfer along with material and medium properties.
b. To inculcate steady state behavior of heat transfer by different modes of heat transfer.
c. To develop an ability to understand mathematical representation of different modes of heat transfer methods.
d. To apply the knowledge of conduction, convection and radiation to analyze the heat transfer through extended surfaces, black bodies and heat exchangers.

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 70 Marks	Practical Examination: 50%

Course Content:

Introduction: Steady and unsteady heat transfer, Different modes & laws of heat transfer, Thermal conductance, Thermal resistance, Thermal conductivity, Electrical analogy, Thermal diffusivity

Conduction: General three dimensional heat conduction equation in Cartesian coordinates, General three dimensional heat conduction equation in cylindrical & spherical coordinates (no derivation), Steady state one dimensional heat conduction without heat generation & temperature distribution in the: plane wall, composite wall, sphere and composite cylinder, Thermal contact resistance , Critical radius of insulation and its importance, Introduction to unsteady state heat conduction system with negligible internal resistance.

Extended surfaces: Types and Applications of fins, Heat transfer from a fin of uniform cross section area, Different end conditions to solve fin problems, Efficiency & Effectiveness of fins, errors in the measurement of temperature in a thermo-well.

Convection: Hydrodynamic & thermal boundary layer, Local & average heat transfer coefficient, Effect of various parameters on heat transfer coefficient, Free & force convection, physical significance of the dimensionless numbers related to free & forced convection, Empirical relations for free convection heat transfer over horizontal, vertical plate & cylinder.

Radiation: Fundamental concepts, Basic laws of radiation: Planks law, Kirchoffs law, Stefan Blotzman Law, Weins displacement law and Lambert's cosine law, Emissivity, Radiosity, Radiation heat exchange between two black bodies, Shape factor for simple geometries, Radiation heat exchange between two infinitely parallel plates & cylinders, Radiation shields, Heat transfer with radiation shields.

Heat Exchangers: Heat exchangers classification, Overall Heat transfer coefficient, heat exchanger analysis- use of log mean temperature difference (LMTD) for parallel & counter flow heat exchangers, Special case of condensers & evaporators and heat exchangers where heat capacities of fluids are same, The effectiveness-NTU method for parallel and counter flow heat exchangers.

List of Experiments:

Any eight experiments and assignments on the above topics.

1. Determination of thermal conductivity of metal rod.
2. Determination of thermal conductivity of insulating powder.
3. Determination of thermal conductivity of composite wall.
4. Determination of heat transfer coefficient in natural convection.
5. Determination of heat transfer coefficient in forced convection.
6. Determination of emissivity of a test surface.
7. Study of performance of parallel & counter flow heat exchanger.
8. Determination of critical thickness of insulation.
9. Heat transfer from pin fin apparatus**.**

Practical Examination:

It shall consist of oral/practical examination based on above syllabus.

Reference Books:

1. J. P. Holman, "Heat transfer" McGraw Hill Book Company 1989, New York.
2. Yunus A. Cengel, "Heat & Mass Transfer: A practical Approach" TATA McGraw Hill Education 2007.
3. Dr. S. P. Sukhatme, "A Textbook on Heat Transfer" Universities Press 2005.
4. Dr. D. S. Kumar, "Heat and Mass Transfer", S.K.Kataria & Sons publishers 2013
5. R.C. Sachdeva, "Fundamentals of Engineering Heat and Mass Transfer" New Age International 2012.
6. R. Yadav, "Heat and Mass Transfer" Central Publishing House 1992

Course outcomes:

1. Student will be able to analyze heat conduction with and without internal heat generation, critical thickness of insulation and extended surfaces with the practical utilities.
2. Student demonstrates the concept and mechanism of convection, conduction and radiation.
3. Student exhibits application of mathematical approach to analyze and solve the numerical on complex heat transfer phenomena's.
4. Student can explain the design, performance analysis and practical applications of heat exchangers.

MATHEMATICS-IV (COMPLEX ANALYSIS)

(CREDITS THEORY: 04)

Course code: MA302A **Contact Hours /Week:** Th.04

Course objectives:

- **a.** To perform algebra with complex numbers.
- **b.** To identify complex-differentiable functions.
- **c.** To compute complex line integrals.
- **d.** To use residue theorem.
- **e.** To understand the conformal mappings and their engineering applications.

Evaluation Scheme:

Theory	Practical
Mid Term: 30 Marks	--------
End Term: 70 Marks	--------

Course Content:

1. **Introduction:** Introduction to Complex Variables.
2. **Function of complex variables: L**imit, continuity, differentiability, analytic functions and their properties, Cauchy-Riemann equation, harmonic functions, elementary complex functions and their properties.
3. **Line Integral:** Cauchy's theorem, Cauchy's Integral formula, and their applications.
4. **Series:** Taylor and Laurent theorems, classification of singularities, residues, Cauchy's residue theorem, improper Integrals, conformal mappings.

Reference Books:

1. Anant R. Shastri, An Introduction to Complex Analysis, Macmillan Publishers India (2000).
2. James W. Brown, Ruel V. Churchill, Complex Variables and Applications (Seventh Edition), Mc Graw Hill (2003).
3. Erwin Kreyszig, Advanced Engineering Mathematics (10th Edition), Wiley Publication

Course Outcomes:

1. Student will be able to compute sum, product, division, polar form, and nth roots of complex numbers and will also be able to understand their geometry.
2. Student will able identify the analytic functions and will be able to express these functions as a power series.
3. Student will be able to compute line integrals of complex functions through parameterization of curves.
4. Student will be able to use Cauchy's theorem, residue theorem to calculate line integrals and improper integrals.
5. Student will be able to use analytic functions as conformal mappings.

MATHEMATICS-IV (STATISTICS & PROBABILITY)

(CREDITS THEORY: 04)

Course code: MA302B **Contact Hours /Week:** Th.04

Course Objective:

- **a.** To equip the students with the broad perspective of probability theory.
- **b.** To develop the understanding of various discrete and continuous distributions along with their properties.
- **c.** To understand and differentiate among various statistical and random processes techniques

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	--------
End Term: 70 Marks	--------

Course Content:

1. Introduction: Sample Space and Events, Classical Probability, Conditional Probability, Independent Events, Bayes Theorem, Random Variable, Probability Measure, Sigma Field, Distribution Function
2. Functions of Random Variables: Expectation, Moment Generation Function and Its Properties, Characteristic Function.
3. Distributions: Special Discrete Distributions – Binomial, Poisson, Geometric, Special Continuous Distributions – Uniform, Exponential, Beta, Gamma. Normal Distribution
4. Chebychev's Inequality, Transformation of Variables, Joint and Marginal Distributions, Conditional Distribution.
5. Covariance: Correlation, Transformation of Variables, Independence of Random Variables, Random Vector, Weak Law of Large Numbers, Central Limit Theorem, Bivariate Normal Distribution
6. Regression: Regression, Least Square Method, Sampling Distributions of Parameters, Chi-Square, t and F Distribution.
7. Theory of Estimation: Theory of point estimation, Properties of Point Estimator, Maximum Likelihood Estimator, Interval Estimation, Confidence Interval, Testing of Hypotheses, Likelihood Ratio Test, Goodness of Fit test, Stochastic Processes

Reference Books:

1. Sheldon M. Ross, *Introduction to Probability and Statistics for Engineers and Scientists*, Elsevier (2012)
2. Vijay K. Rohatgi and A. K. Md. Ehsanes Saleh, *An introduction to probability and statistics,* Wiley (2011)
3. Richard A. Johnson, Miller and Freund, *Probability and Statistics for Engineers*, PHI Learning(2010)
4. Athanasios Papoulis and S. Unnikrishna, *Probability, Random Variables, and Stochastic Processes*, Tata McGraw Hill (2002)
5. Erwin Kreyszig, *Advanced Engineering Mathematics (Tenth Edition),* Wiley Publication.

Course Outcomes:

1. Student will demonstrate the ability of data analysis and will be able to describe sample space for various random experiments
2. Student will identify the random variables as discrete and continuous random variables and will be able to apply appropriate distribution methods.
3. Student will be able to interpret the mean of a random variable in terms of the Law of Large Numbers.
4. Student will be able to use the Normal distribution, including the preservation of Normality under linear transformation.
5. Student will apply the Central Limit Theorem to problems involving sums and averages of variables from arbitrary distributions.
6. Student will be able to apply the tests of goodness of fit

MATHEMATICS-IV (NUMERICAL ANALYSIS)

(CREDITS THEORY: 04)

Course code: MA302C **Contact Hours /Week:** Th.04

Course objectives:

- **a.** To be aware of the use of numerical methods in modern scientific computing.
- **b.** To make the students familiar with finite precision computation, and numerical solutions of nonlinear equations in a single variable
- **c.** To learn numerical interpolation and approximation of functions
- **d.** To be familiar with numerical integration and differentiation, numerical solution of ordinary differential equations, partial differential equations.
- **e.** To provide knowledge of Eigen value problems, QR Method

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	--------
End Term: 70 Marks	--------

Course Content:

1. Interpolation by polynomials, divided differences, error of the interpolating polynomial, piecewise linear and cubic spline interpolation.
2. Numerical integration, composite rules, error formulae.
3. Solution of a system of linear equations, implementation of Gaussian elimination and Gauss-Seidel methods, partial pivoting, row echelon form, LU factorization Cholesky's method, ill-conditioning, norms.
4. Solution of a nonlinear equation, bisection and secant methods.
5. Newton's method, rate of convergence, solution of a system of nonlinear equations, numerical solution of ordinary differential equations, Euler and Runge-Kutta methods, multi-step methods, predictor-corrector methods, order of convergence, finite difference methods, numerical solutions of elliptic, parabolic, and hyperbolic partial differential equations.
6. Eigen value problem, power method, QR method.

Reference Books:

1. Kendall Atkinson, Weimin Han, Elementary Numerical Analysis (Third edition), Wiley Publication (2004)
2. Amos Gilat, Numerical Methods for Engineers and Scientists (Third Edition), Wiley Publication (2014)
3. Steven Chapra, Raymond Canale, Numerical Methods for Engineers (Seventh Edition), McGraw Hill Education (2014)
4. Erwin Kreyszig, Advanced Engineering Mathematics (10th Edition), Wiley Publication

Course Outcomes:

1. Students would be able to assess the approximation techniques to formulate and apply appropriate strategy to solve real world problems and be aware of the use of numerical methods in modern scientific computing.
2. Be aware of numerical methods to solve nonlinear equations.
3. Students would be able to apply interpolation formulas for real life problems.
4. Be familiar with numerical solution of integration, linear equations, ordinary differential equations, interpolations.
5. Students would be able to use linear algebra techniques and numerical techniques

COMPUTER AIDED DESIGN

(CREDITS THEORY: 04, PRACTICAL: 01)

Course code: ME309 **Contact Hours /Week:** Th.03, Tu. 01, Pr.02

Course Objective:

- **a.** To introduce students to the applications of computers in design process.
- **b.** To demonstrate the different aspects of computer graphics.
- **c.** To demonstrate various geometric modelling techniques.
- **d.** To impart skills in different CAD software so as to apply them in design.
- **e.** To demonstrate the ability to utilize CAD software for CAD data exchange and collaborative engineering.

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 70 Marks	Practical Examination: 50%

Course Content:

Fundamentals of CAD: Introduction, The design Process, Application of computers for Design, benefits of Computer-Aided Design and hardware in CAD.

Computer Graphics: The Software Configuration of a Graphics System, Functions of a Graphics Package, Constructing the Geometry, Graphics Primitives, Co-ordinate Systems used in Graphics and Windowing, View Ports.

Geometric Modelling Techniques: Salient Features of Solid Modelling, Wireframe modelling. Solid modelling techniques- Half space, Octree, sweep, Constructive solid Geometry, B-rep, Feature Based Modelling, and Parametric modelling. Surface modelling. Introduction to Curves and Surfaces.

Geometric Transformation: Transformation of Geometric models, Translation, scaling, Refection, Rotation, 2-D Transformations, Homogeneous Transformations, Combination Transformations, 3-Dimensional Transformations. Projections, Scan Conversion, Rendering, Rasterizing Polygons, Hidden Surface Removal, Anti-Aliasing, Reflection, Shading, Generation of Characters.Modeling Drafting and Assembly in various CAD software-parts and assembly design in software like UGNX/CREO etc.

Application Programming Interfaces (API): General purpose and System dependent API, Introduction to Visual BASIC (VB), VB Application in Auto CAD, Open C, or GRIP in UGNX.

CAD/CAM Data Exchange: Assembly modeling, product data exchange, Evolution of data- exchange formats, IGES data representations and structure, STEP Architecture, implementation, PDES, ACIS & DXF.

Collaborative Engineering: Collaborative Design, Principles, Approaches, Tools, Design Systems. Product Data Management (PDM).

Term Work:

It will consist of assignment(s) based on Software documentation, tutorials, and manuals of any high end CAD software.

Practical Examination:

The practical examination consists of an oral/practical based on the syllabus prescribed.

Reference Books:

1. Groover M.P. and Zimmers E. W., "CAD/CAM: Computer Aided Design and Manufacturing," Prentice Hall International, New Delhi, 1992.
2. P. Radhakrishnan, S. Subramanayan and V.Raju, "CAD/CAM/CIM," New Age International (P) Ltd., New Delhi.
3. Chris McMahon and Jimmie Browne, "CAD/CAM – Principle Practice and Manufacturing Management," Addision Wesley England, Second Edition, 2000.
4. Ibrahim Zeid, "CAD/CAM theory and Practice," Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
5. Rogers, D.F. and Adams, A., "Mathematical Elements for Computer Graphics," McGraw Hill Inc, NY, 1989

Course outcomes:

1. To develop an ability to use the CAD concepts in design engineering.
2. Students exhibits skill of using CAD software such as UGNX, CREO, for design.
3. Student comprehend the concept of 2-D, 3-D transformation and various techniques of CAD modelling.
4. Student contributes in various CAD software development activities.

STEAM AND GAS TURBINES

(CREDITS THEORY: 04, PRACTICAL: 01)

Course code: ME310 **Contact Hours /Week:** Th.03, Tu. 01, Pr.02

Course Objective:

a. To introduce and explain principle of operation of steam turbine.
b. To demonstrate the processes velocity diagrams and its importance.
c. To introduce the students working , analysis, performance and design of Turbines.

Evaluation Scheme:

Theory	Practical
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 70 Marks	Practical Examination: 50%

Course Content:

UNIT – I

Impulse Turbine: Steam turbine– Principal of operation of steam turbine, Types, Impulse turbine compounding of steam turbine- pressure compounded velocity compounded and pressure– velocity compounded impulse turbine, Velocity diagram for impulse turbine, Force on the blade and work done, Blade or diagram efficiency, Gross stage efficiency. Influence of ratio of blade to steam speed on blade efficiency in a single stage impulse turbine. Efficiency of multi-stage turbine, Impulse blade sections, Choice of blade angle. Blade height in velocity compounded impulse turbine.

UNIT – II

Impulse Reaction Turbine: Velocity diagram, Degree of reaction, Impulse-reaction turbine with similar blade section and half degree of reaction (Parson's turbine), Height of reaction Turbine blade section, Internal losses in steam turbine Nozzle, Losses, Blade friction losses, Disc friction losses, Blade windage losses or partial admission losses, Gland leakage or clearance losses, Leaving velocity or residual loss, Carry loss.

UNIT – III

State Point Locus and Reheat Factor: Factor-Stage, Efficiency of impulse turbines, Stage point locus of an impulse turbine, State point locus for multistage turbine reheat factor. Internal efficiency, Overall Efficiency, Relative efficiency, governing of steam turbine. Throttle governing, Nozzle governing, Bypass governing, Combination of throttle and nozzle, Governing and combination.

UNIT – IV

Gas Turbine: Classification of gas turbine, Simple open cycle gas turbine, Ideal and actual cycle (Brayton Cycle) for gas turbine, Optimum pressure ratio for maximum specific output in actual gas

turbine, Regeneration, Reheat and inter cooling and effect of these modification on efficiency and output, Closed cycle gas turbine.

UNIT – V

Turbo Compressors: Introduction, Classifications of Centrifugal compressors – components, Working, Velocity diagrams, Calculations of power and efficiencies, Slip factor, Surging and choking power and efficiencies.

Axial Flow Compressor: Construction and working, Velocity diagram, Calculation of power and efficiencies, Degree of reaction, Work done factor, Stalling, Comparison of centrifugal and axial flow compressor.

Term Work:
It will consist of assignment(s) based on above syllabus

Practical Examination:
The practical examination consists of an oral/practical based on the syllabus prescribed.

Text Books:

1. Steam and Gas turbine – By R. Yadav - Central Publishing House, Allahabad.

Reference Books:

1. Turbine compressors and Fans – S. M. Yahya – TMH
2. Gas Turbine – V. Ganeshan – TMH

COURSE OUTCOME- At the end of this course, the students will be able to

1. Understand and explain principle of operation of steam turbine.
2. Understand, analyze and Draw velocity diagram in turbo machinery stages at inlet and outlet conditions.
3. Understand and detail the performance of impulse and reaction steam turbine.
4. Understand the differences between ideal and actual gas turbine.
5. Understand, analyze and Carry out detailed analysis of compressor and its operational characteristics.

ADVANCE MACHINING TECHNIQUES

(CREDITS THEORY: 04, PRACTICAL: 01)

Course code: ME311 **Contact Hours /Week:** Th.03, Tu. 01, Pr.02

Course Objective:

- **a.** To gain knowledge about non-traditional machining processes.
- **b.** To understand the theory behind material removal
- **c.** To study and evaluate various process parameters involved in different nonconventional machining processes.
- **d.** To explore practical applications of different machining techniques.

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 70 Marks	Practical Examination: 50%

Course Content:

Introduction: Historical background of Non Traditional Machining Technologies., Classification, Basic fundamentals of various process, their process capabilities and related comparison.

Mechanical Processes: Processes principles, equipment, processes parameters & Applications of Abrasive Jet Machining, Ultrasonic Machining, Water Jet Cutting, and Magnetic Abrasive Machining. Evaluation of material removal rate (MRR) in AJM.

Electrochemical Machining (ECM): Background, Electrochemistry, Classification, Equipment required, Process capabilities, Processes parameters & Trouble shootings. Electro chemical Grinding, Electrochemical deburring, electro chemical cutting. Application examples of ECM processes, Evaluation of MRR of pure metal in ECM.

Electrical Discharge Machining (EDM): Fundamental principle, Equipments required mechanism of machining, process parameters, process capabilities, application example & trouble shooting, Introduction to wire EDM and other recent developments in EDM technologies.

Chemical Machining: Introduction, fundamental principles, process parameters, classification & selection of etchant, accuracy of the process, applications etc. Photo chemical machining and blanking.

Laser Beam Machining (LBM): Introduction, Background of laser action, production of photon cascade in solid optical laser. Machining applications of laser wire drilling, cutting, marking, welding, heat treating, cladding, and surfacing.

Allied Processes: Process principles, equipment, and mechanism of machining, applications examples of: Plasma Arc Cutting, Thermal Energy Method, Abrasive Water Jet Machining, and Electro Chemical Discharge Machining.

Term Work: It shall consist of at least six assignment based on above syllabus.

Practical Examination:

The practical examination consists of an oral/practical based on the syllabus prescribed.

Text books:

1. V. K. Jain, "Advanced Machining Processes", Allied Publishers Pvt. Ltd, (2005)
2. P.K. Mishra, "Non-conventional machining", Narosa Publications

Reference Books:

1. P.C. Pandey & H. S. Shah, "Modern machining process" 1st Edition, TMH, 2010.
2. El-Hofy, Hassan Abdel-Gawad, "Advanced Machining Processes":Nontraditional And Hybrid Machining Processes", McGraw-Hill, 2005.

Course Outcomes:

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

1. Exhibit basic understanding of the machining capabilities, limitations, productivity and classification of advanced manufacturing processes.
2. Apply the working principles and processing characteristics of non-traditional machining to the production of precision components.
3. Explain the mechanism, equipments used, process parameters considered, applications and limitations of Mechanical machining processes
4. Analyses various parameters of different machining processes and contribute to research and development work.

MECHATRONICS-I

(CREDITS THEORY: 04, PRACTICAL: 01)

Course code: ME312 **Contact Hours /Week:** Th.03, Tu. 01, Pr.02

Course Objective:

a. To demonstrate fundamental principles of Mechatronics System.
b. To reinforce already learned analytical skills, and use these skills in analyzing and designing mechatronic systems.
c. To develop an ability to and solve control problems.
d. To comprehend the data and signal transfer among various sub-systems.

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 70 Marks	Practical Examination: 50%

Course content:

Introduction: A mechatronic system, A Measurement System with its constituent elements; Open and Closed Loop Systems; Sequential Controllers; Micro-processor Based Controllers; The Mechatronics Approach.

System Modeling: Introduction, System Modeling and Analogies, Transfer Functions for first and Second Order System, Simple Mechanical, Thermal, Pressure and Fluid systems, Block Diagram & Signal Flow Graphs.

Signal Conditioning: Signal conditioning, Operational amplifier, Protection of Components, Filtering, Signal Manipulation, Sampling and Quantizing, Analog to Digital and Digital to Analog Converters, Multiplexers, Digital logic, Number system, Logic gates, Boolean algebra, Karnaugh graph, Application of logic gates, Sequential logic.

Pneumatic and Hydraulic Actuation System: Actuation systems, pneumatic and hydraulic system, Direction control valves, pressure control valves, Cylinders, Process control valves, Rotary actuators.

Electrical Actuation System: Electrical system, Mechanical Switches, Solid-state Switches, solenoids, D.C motors, A.C motors, Steeper motors.

Controllers: Analog Controllers like Two Position (ON/OFF). Proportional (P), Integral (I), Derivative (D), PI,PD and PID, Hydraulic, Pneumatic and Electronic controllers.

Data Presentation Systems: Display, Display Presentation elements, Magnetic recording, Displays, Data acquisition and Data acquisition System, measurement system, Testing and Calibration, Problem.

Term Work:

It shall consist of at least six assignments / practical based on the above syllabus.

Practical Examination:
It shall consist of oral/practical based on the above syllabus.

Reference Books:

1. Mechatronics: "Electronic control system in Mechanical and Electrical Engineering," W. Bolton, Pearson Education Asia.
2. D.G. Alciatore and M.B.Histand "Introduction to Mechatronics and Measurement System," Tata Mc Graw Hill.
3. Kastuhiko Ogatta, "Modern Control Engineering" [Phi]
4. Sudhir Gupta, "Elements of Control system," Prentice Hall.

Course Outcomes:

1. Student understands the complete design procedure of automated system modeling.
2. Student will be able to select correct mechanism for operation of automated mechanisms.
3. Student understands the use of electronic components for controlling mechanical work.
4. Student exhibits the basic knowledge of automation leading to contribute in field of robotics.

PRODUCTION PLANNING AND CONTROL

(CREDITS THEORY: 04, PRACTICAL: 01)

Course code: ME313 **Contact Hours /Week:** Th.03, Tu. 01, Pr.02

Course Objectives:

- **a.** To gain an understanding and appreciation of the fundamental principles and methodologies relevant to planning, design, operation, and control of Production Systems.
- **b.** To reinforce analytical skills already learned, and build on these skills to further increase ones "portfolio" of useful analytical tools.
- **c.** To gain ability to recognize situations in a production system environment those suggest the use of certain quantitative methods to assist in decision making.
- **d.** To learn how to think about, approach, analyze, and solve production system problems using both technology and people skills.
- **e.** To increase knowledge and broaden perspective of the "industrial world" in which one will contribute his / her talent and leadership as an Industrial Engineer.

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 70 Marks	Practical Examination: 50%

Course Contents:

Introduction - Functions of PPC, types of production, production consumption cycle, coordination of production decisions

Product Development and Design – Product Design and Company Policy, Product Analysis: Marketing Aspect, Product Characteristics, Economic Analysis, Production Aspect,

Forecasting - Introduction, Time Series Methods, Casual Methods, Forecast Errors

Production Order – Purpose of production order, procedure for formulating production order, process outlines, process and activity charts, production master program, operation and route sheet, production order

Batch Production – Quantities in batch production, criteria for batch size determination, minimum cost batch size, production range, maximum profit batch size, maximum return and maximum rate of return economic batch size

Machine Output - Machine output, multi-machine supervision by one operator, machine interference, balancing of machine lines, analysis of process capacities in a multi-product system

Production and Operations Planning – Aggregate Planning, Strategies and techniques for Aggregate Planning, Production Planning in Mass Production Systems and Assembly Line Balancing, Sequencing problems such as 1 machine n jobs, 2 machines n jobs & its extension, m machines 2 jobs, scheduling jobs with random arrivals

Inventory Control – Inventory and its purpose, the relevant costs, selective inventory analysis (ABC analysis), Classical Inventory Model, EOQ with quantity discounts, EOQ for multiple items with constraints on resources, Safety Stock, determining safety stock when usage and lead time vary, Fixed Order Period Inventory Control System

Term work – At least six assignment based on theoretical concepts and problems.

Practical Examination:
It shall consist of oral/practical based on the above syllabus and term work.

References:

1. Simuel Eilon, "Elements of Production Planning and Control", Macmillon Publications
2. James L. Riggs, "Production Systems Planning and Analysis & Control"
3. Narasimhan, Mcleavey, Billingten, Production Planning & Inventory Control, Prentice Hall of India
4. Chary S.N., Theory and Problems in Production and Operation Management, Tata McGraw Hill, Edition 1995.

Course Outcomes:

1. Student can analyze the product development and design technique along with types of production systems.
2. Student will be able to predict the demand for the products and its plan to manufacture.
3. Student will be able to suggest the appropriate plant layout for the manufacture of product.
4. Student exhibits knowledge of different inventory control systems and inventory models contributing economy of organization.

INDUSTRIAL FLUID POWER

(CREDITS THEORY-04, PRACTICAL-01)

Course Code: ME314 **Contact Hours:** Th.03, Tu.01, Pr:02

Course Objectives:

a. To impart knowledge of the fluid power and its various applications.
b. To familiarize physical laws and principles that governs the behavior of fluid power systems.
c. To acquaint components utilized in industrial fluid power systems.
d. To demonstrate the control systems designed for fluid power.

Evaluation Scheme:

Theory	Practical
Mid Term: 30 Marks	Continuous Evaluation : 50%
End Term: 70 Marks	Practical Examination : 50%

Course contents:

Introduction to Fluid Power

Fluid power system: Components, advantages and applications. Transmission of power at static and dynamic states. Pascal's law and its applications such as hydraulic press/Jack (Numerical treatment). Fluids for hydraulic system: Types, properties, selection. Additives, effect of temperature and Pressure on hydraulic fluid. Types of pipes, hoses, material, quick acting couplings. Pressure drop in hoses/pipes.

Pumps

Types, classification, principle of working and constructional details of Vane pumps, gear pumps, radial and axial plunger pumps, screw pumps, power and efficiency calculations, characteristics curves, selection of pumps for hydraulic Power transmission.

Power units and accessories: Types of power units, reservoir assembly, constructional details, pressure switches, temperature switches

Accumulators: Types, selection, applications of accumulators.

Fluid Power Control

Symbols for hydraulic and pneumatic circuits. Control of fluid power through different valves such as pressure control valves, directional control valves, and flow control valves (Principle, classification, constructional details, symbols, advantages, disadvantages and applications).Flow rate, working pressure, differential pressure Check valve, Servo valves, Proportional valves and Cartridge valves, cut off Valves.

Hydraulics

Actuators: Linear and Rotary, Hydraulic motors- Types- Vane, gear, Piston types, radial piston. Methods of control of acceleration, deceleration. Types of cylinders and mountings. Calculation of piston velocity, thrust under static and dynamic applications, considering friction, inertia loads. Design considerations for cylinders. Cushioning of cylinders. (Numerical treatment)

Industrial circuits – Simple reciprocating, Regenerative, Speed control (Meter in, Meter out and bleed off), Sequencing, Synchronization, transverse and feed, circuit for riveting machine, automatic reciprocating, fail safe circuit, counter balance circuit, actuator locking, circuit for hydraulic press, unloading circuit (Numerical treatment), motor breaking circuit.

Pneumatics

Principle of Pneumatics, Comparison of Pneumatics with Hydraulic power transmissions, Types of filters, regulators, lubricators, mufflers, dryers, Pressure regulating valves, Solenoid operated valves, push button, lever control valves, Speed regulating - Methods used in Pneumatics, Pneumatic actuators-rotary, reciprocating, Air motors- radial piston, vane, axial piston, Basic pneumatic circuit, selection of components, Application of pneumatics

System Design

Design of hydraulic/pneumatic circuit for practical application, Selection of different components such as reservoir, various valves, actuators, filters, pumps based on design. (Students are advised to refer manufacturer's catalogues)

Term Work: Minimum Eight assignments based on the above syllabus.

Practical Examination:

It shall consist of oral/practical examination based on the above syllabus and term work

Reference Books:

1. Pinches, Industrial Fluid Power, Prentice hall
2. D. A. Pease, Basic Fluid Power, Prentice hall
3. J. J. Pipenger, Industrial Hydraulics, McGraw Hill
4. Andrew A. Parr, Hydraulics and Pneumatics, Elsevier Science and Technology Books.
5. Majumdar, Pneumatic Systems, Tata McGraw Hill
6. Majumdar, Oil Hydraulics- Principle and Maintenance, Tata McGraw Hill.
7. Product Manuals and books from Vickers/ Eaton, FESTO, SMC pneumatics can be referred

Course Outcomes:

On successful completion of this course, Students should;

1. Demonstrates knowledge of basic fluid power systems.
2. Shows ability to formulate and analyse mathematical models of hydraulic and pneumatic circuits.
3. Shows skill for Design & implement simple fluid power systems common in industrial applications.

MACHINE DESIGN-II

(CREDITS THEORY: 04, PRACTICAL: 01)

Course code: ME306 **Contact Hours /Week:** Th. 03, Tu.01, Pr.02

Course Objective:

a. To demonstrate the terminology and design principles of different motion transmitting components.
b. To explain the principles of spring design under different loading conditions.
c. To develop the design approach for sliding and rolling contact bearings under static and dynamic loading.
d. To develop an ability to understand the gear terminology along with the force and strength analysis.
e. To comprehend safety and reliability concepts in the design of machine elements.

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 70 Marks	Practical Examination: 50%

Course Content:

Springs: Introduction, Types of springs, Terminology of helical spring, Stress and defection equations, Material for helical spring, Design of helical springs, Wahl's correction factor, Design against fluctuating load, Optimum design, Surging, Helical torsion spring, Leaf spring.

Belt, Ropes & Chain Drives: Introduction, Type of belts, Types of flat belt drives, Tension ratio in belts, Length of belt, Power transmitted by belt,Maximum power condition, Rope drive, Stresses in wire rope, Chain drives, Power transmitted by chain.

Sliding contact bearings: Introduction, Classification of bearing, Modes of Lubrication, Viscosity, Bearing materials, Petroff's eq^{n}, McKee's investigation, Hydrostatic step bearing, Sommerfeld number, Heat generated in journal bearing, Raimondi and boyd method, Bearing design, Thrust bearing.

Rolling contact bearings: Types of rolling contact Bearings, Static and dynamic load carrying capacities, Stribeck's equation, Equivalent bearing load, Load-life relationship, Selection of bearing from manufacture's catalogue, Design for cyclic loads and speeds.

Spur Gears: Introduction, Gear terminology, Gear tooth failure, Selection of gear material, Gear blank design, Beam strength (Lewis) equation, Velocity factor, Service factor, Load concentration factor, Effective load on gear tooth, Estimation of Dynamic and Static tooth load, Wear strength (Buckingham's) equation, Design of spur gear.

Helical, Worm and Bevel Gear: Helical Gears: Terminology, Tooth proportions, Force analysis,

Strength analysis and Effective load on gear tooth. Bevel Gears: Terminology, Force analysis, Strength analysis and Effective load on gear tooth.Worm Gear: Terminology, Tooth proportions, Force analysis, Strength analysis.

Tem Work:
Assignments consisting of theoretical questions and full imperial size sheets with the design problems.

List of Experiments:

1. To measure power transmitted with varied belt tensions.
2. To measure % slip at fixed belt tension by varying load on break drum and plot the graph of (T1-T2) vs %slip i.e. "Slip characteristics".
3. To study the creep of belt.
4. Determine the pressure distribution in the oil film of bearing for various speeds and plot polar curve for various speed.
5. Determine the stiffness of various springs by using spring testing machine

Practical Examination:
It shall consist of oral/practical examination based on above syllabus.

Reference Books:

1. Joseph E.Shigley and Charles R.Mischke, "Mechanical Engineering Design," Tata McGraw Hill Publication, 6th Edition,2005
2. V.B.Bhandari, "Design of Machine Element," Tata McGraw Hill Publications, 4th Edition, 1997
3. C.S Sharma & Kamlesh Purohit, "Design of Machine Elements," Prentice Hall of India publications, New-Delhi, Eastern Economy 3rd Edition, 2003.
4. Spott's M.F. and Shoup T.E. – "Design of Machine elements," Prentice Hall International.
5. Black P.H. and O. Eugene Adams, "Machine Design," McGraw Hill Book Co. Ltd.

Design Data Book:

1. Design Data Book for Mechanical Engineers, K.Mahadevanan & K.Balaveera Reddy, CBS Publishers & Distributor Delhi, 4th Edition 2008
2. Design Data Book – B. D. Shiwalkar, Central Techno Publication Nagpur, 2nd Edition

Course outcomes:

1. Students show ability to design and model components using knowledge they acquired.
2. Student exhibit ability to identify, formulates, and solves engineering problems.
3. Student demonstrates the skill of designing motion transmission parts.
4. Students contribute in design of new mechanical systems.

INTERNAL COMBUSTION ENGINES

(CREDITS THEORY: 04, PRACTICAL: 01)

Course code: ME307 **Contact Hours/Week:** Th.03, Tu.01, Pr.02

Course objective:

- **a.** To develop an ability to understand the fundamentals of internal combustion engines.
- **b.** To demonstrate the various operational processes from intake to exhaust.
- **c.** To get analysed the performance of internal combustion engines.
- **d.** To demonstrate cooling and lubrication systems in internal combustion engines.
- **e.** To make aware of I. C. engine emissions and methods to control them.
- **f.** To make aware of different possible alternative engines.

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 70 Marks	Practical Examination: 50%

Course Content:

Introduction: Classification of I.C. engines, Analysis of Engine Cycles, Analysis of fuel-air cycle and actual cycles.

Carburetion and fuel injection:
Theoryof carburetion, simple carburetor, calculation of Air-Fuel ratio for simple carburetor with and without compressibility of air, petrol injection system, LUCAS petrol injection system, aircraft carbur ettor. Requirements, heat release pattern, types of injection systems namely common rail, individual p ump distributor and unit injection systems, types of nozzles.

Combustion in S.I. and C. I. Engines: Fuel ignition systems, Types- battery and magneto ignition system. Combustion in S.I. engines: Ignition limits and stages of combustion, engine variables affecting stages of combustion, normal and abnormal combustion, pre-ignition, detonation, effect and control of detonation, combustion chamber design principles, various types of combustion chambers used and their comparison. Combustion in C. I. engines: Stages of combustion, variables affecting stages of combustion, delay period, knocking, its effect and control, types of combustion chambers used.

Testing performance of Engines& supercharging: Performance parameters, methods for measurement of B.P, I.P. and F.P., performance of S.I. and C.I. engines, heat balance sheet. Supercharging: Introduction, necessity of supercharging, advantages and limitations of supercharging, Methods of supercharging.

Engine Friction, Lubrication and cooling: Total engine friction, effect of engine variables on friction, Lubrication requirements, theory of lubrication, types of lubrication, splash lubrication system, petrol lubrication system, forced feed lubrication system. Air cooling and water cooling – forced cooling systems, comparison of air and water cooling system.

I.C. Engine Emissions and control: Emissions from S.I. and C. I. engines, pollutant s and their effects, methods for controlling emissions, current techniques of emission control.

Alternative potential engine: Stratified charged engine, Wankel engine, Variable compression engine, Sterling Engine, Pulse jet engine, Ramjet engine.

Term Work:

Term work shall consist of record of any eight experiments from the following.

1. Trial on diesel engine with variation of load.
2. Trial on diesel engine with variation in speed for torque speed characteristics.
3. Trial on petrol engine with variation of load.
4. Trial on petrol engine with variation in speed for torque speed characteristics.
5. Study of ignition system and variation of timing of spark and adjustment of contact breaker gap and spark plug gap.
6. Dismantling and assembling of fuel pumps and injectors for single and multi cylinder engines any one.
7. Dismantling and assembling of any one automotive carburettor.
8. Actual valve timing diagram for high and low speed engines.
9. Analysis of exhaust emission from S.I. engine.

Practical Examination:

It shall consist of oral/practical examination based on above syllabus.

Reference Books:

1. J. B. Heywood, “Internal Combustion Engine Fundamentals”, McGraw Hill Book Co, 1988.
2. V. Ganesan, “Internal Combustion Engines”, Tata McGraw Hill Book Co, 2005
3. Mathur, Sharma, “Internal combustion engines”, Dhanpat Rai publications, 2005
4. Gill P W., J H. Smith, “Fundamentals of Internal Combustion Engines”, Oxford and IBH Publishing Company, 1972
5. Lester Clyde Lichty, “ Internal Combustion Engines”, McGraw-Hill book company, inc., 1939

Course Outcomes:

1. Student exhibits fundamentals of internal combustion engines.
2. Student demonstrates working and construction of internal combustion engines.
3. Student demonstrates knowledge about Carburetion and fuel injection systems.
4. Student shows competency about combustion in SI and CI Engines along with emission of pollutants and related control measures.

REFRIGERATION & AIR CONDITIONING

(CREDITS THEORY: 04, PRACTICAL: 01)

Course code: ME308 **Contact Hours/Week:** Th.03, Tu.01, Pr.02

Course objective:

- **a.** To comprehend the basic principles of refrigeration and air conditioning.
- **b.** To impart the different properties of refrigerants used.
- **c.** To make aware of operating thermodynamic cycles for refrigerating devices.
- **d.** To inculcate psychometric principles to apply them in air conditioning.
- **e.** To demonstrate the performance of different refrigerating & air conditioning machines.

Evaluation Scheme:

Theory	Practical
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 70 Marks	Practical Examination: 50%

Course Content:

Introduction & Air refrigeration cycles: Refrigeration, Applications of refrigeration, elements of refrigeration system, unit of refrigeration, Co-efficient of performance (COP), Air refrigerator working on a reversed Carnot cycle, reversed Brayton cycle, Bootstrap, Regenerative, Reduced ambient air refrigeration cycles.

Refrigerants: what is refrigerant, classification of refrigerants, Designation of refrigeration, desirable properties of ideal refrigerant, properties and applications of commonly used refrigerants, Leak detection.

Vapour Compression Cycle: Introduction**,** simple vapour compression system, functions of parts of a simple vapour compression system, pressure enthalpy (p-h) chart, simple VCC on p-h chart, factors affecting the performance of a simple vapour compression system, actual vapour compression cycle, mathematical analysis of vapour compression refrigeration, methods of improving vapour compression cycle, refrigeration controls like hand expansion valve, automatic expansion valve, capillary tube etc, introduction to vapour compression refrigeration system with multiple evaporators and compressors.

Vapour Absorption Refrigeration: Simple vapour absorption system, actual vapour absorption system, properties of ideal absorbent, advantages of vapour absorption refrigeration system over vapour compression refrigeration system, comparison between VAS and VCS, Lithium Bromide absorption refrigeration system, Electrolux refrigeration system, enthalpy concentration charts.

Psychometric: Definitions, psychometric relations, different psychometrics, psychometric charts, and Psychometric process such as mixing of air streams, sensible heating, sensible cooling, cooling and dehumidification, heating and dehumidification, cooling and humidification, heating and humidification. Bypass factor sensible hear factor.

Air conditioning: Introduction, factors affecting human comfort, Air conditioning cycle, classification of Air-conditioning systems, ice storage air conditioning, selection of system, Room

sensible heat factor, Grand sensible heat factor, Mobile air conditioning, applications of Air conditioning.

Term Work:

Term work shall consist of any eight experiments from the following.

1. Experiment on of vapour compression refrigeration system
2. Experiment on split air conditioner.
3. Experiment on window air conditioner.
4. Demonstration of different compressors used in refrigeration.
5. Experiment on vapour absorption refrigeration.
6. Demonstration of household refrigeration.
7. Study of different controls used in refrigeration system such as thermostat, solenoid valve.
8. Study of Cascade refrigeration system.
9. Study of psychrometer used in determination of D.B.T. W.B.T study of humidistat.
10. A report on Visit to air-conditioned / air-cooled premises
11. Visit to ice factory.

Practical Examination:

The practical examination consists of an oral/practical based on the syllabus prescribed above.

Reference Books:

1. C. P. Arora, "Refrigeration & Air-conditioning"-Tata McGraw Hill.
2. R. K Rajput, "Refrigeration & Air-conditioning" S.K.Kataria & Sons publication.
3. S. Domkundwar, S. C. Arora , "A course in Refrigeration & Air-conditioning".
4. R. J. Dossat, "Principles of refrigeration," Willey Eastern Publication.
5. W. F. Stoker and J. W. Jones, "Refrigeration and air-conditioning," Tata McGraw Hill Publication.

Course Outcomes:

At the end of this course the students should be able to;

1. Illustrate the fundamental principles and applications of refrigeration and air conditioning system
2. Obtain cooling capacity and coefficient of performance by conducting test on vapor compression refrigeration systems
3. Present the properties, applications and environmental issues of different refrigerants
4. Calculate cooling load for air conditioning systems used for various applications
5. Operate and analyze the refrigeration and air conditioning systems.

TOOL DESIGN

(CREDITS THEORY: 04, PRACTICAL: 01)

Course code: ME304 **Contact Hours/Week:** Th.03, Tu.01, Pr.02

Course objective:

a. To demonstrate Tool design methodologies for different elements of machines and their models.

b. To demonstrate the use of locating and clamping devices in industries.

c. To make aware of the designing principles in jig, fixture and die designing.

d. To apply the designing principles in designing dies for different machining operations.

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 70 Marks	Practical Examination: 50%

Course Content:

JIG and FIXTURE:

Locating and Clamping Devices: Degrees of freedom, 3-2-1 method of location, choosing a locating surfaces, redundant locaters, fool proofing, locating methods and devices, clamping methods, power clamping: pneumatic, hydraulic, hydro–pneumatic, vacuum, magnetic and non-conventional clamps.

Jig / Fixture Design Considerations: Design principles of Jig/Fixture and their parts, fastening elements, construction elements, and process planning for Jig/Fixture manufacturing.

JIG Design: Drill bush types, fixed, plain, headed renewable, slip, threaded and special, design principles for drill bush, drill bush materials, jig feet, Types of jigs, templates, plate, angle-plate, leaf, turnover, box, multi-station and indexing jigs.

Fixture Design: Cutter setting and mounting devices, milling fixture design, single piece, sting, progressive, index and rotary milling, design of lathe, boring and broaching fixtures.

DIE DESIGN:

Blanking and Piercing Die Design: Introduction, Die cutting operations, Power press types, General press information, Cutting action in Punch and Die Operations, Die clearance, Types of Die construction, Die design fundamentals, Pilots, Strippers and Pressure pads, Press Work Material, Strip layout. Design problems.

Design of Bending, Forming and Drawing Dies: Introduction, Bending dies, Forming dies, Drawing Operations, variables that affect metal flow during Drawing, Determining Blank size, Drawing force, Single and Double action draw dies. Design problems.

Forging Dies: Types of forging dies, advantages and limitations; forging equipment and machines, press forging, drop forging, open die forging, close forging, dogging defects. Forging design, factors-

draft, fillet, corner radius, parting line, shrinkage, die wear, mismatch, and tolerances, forging operations stock size determination, forging die design.

Term Work:

It shall consist of **one full imperial sheet each** on:

1. Jig design and
2. Fixture design
3. Cutting die design
4. Shaping die design

Journal based on above syllabus for:

1. Jig design
2. Fixture design
3. Design of a cutting die (punching, blanking, compound, and progressive), bending die, and drawing die
4. Press tool Design and / or 3D Modeling, assembling and drawing assignment using computer.

Practical Examination:

The practical examination consists of an oral/practical based on the syllabus prescribed above.

Reference Books:

1. Kempster "Introduction to Jig and Tool Design": M.H.A. English language book society.
2. Joshi P.H, "Jigs and Fixtures," Tata McGraw Hill, New Delhi.
3. Sharma P.C. "Production Engineering," S. Chand and co. Ltd. New Delhi 7th edition 1982.
4. Donaldson, Lecain, Good "Tool Design Tata McGraw" Hill co. Ltd 3rd Edition 1976).
5. Pollack Herman W "Tool Design" D.B. Tarapurwall son's and co. pvt. Ltd. Mumbai 1983.

Course Outcomes:

1. Student show skill to draw and represent the design of mechanical components
2. Student show ability selects proper Jig, fixture, positioning, and handling of component to provide ease in manufacture.
3. Student demonstrates the sheet metal operation and can explain phenomenon of metal flow during operation.
4. Student show ability to design and select proper die and tools required for manufacturing.

FINITE ELEMENT ANALYSIS

(CREDITS THEORY: 04, PRACTICAL: 01)

Course code: ME315 **Contact Hours/Week:** Th.03,Tu. 01, Pr.02

Course objective:

a. To impart basics of Finite Elements Analysis.

b. To demonstrate the detailed procedure involved in Finite element analysis.

c. To motivate the students for applying finite elements analysis methods to real life problems.

d. To demonstrate the idea about pre and post processing in Finite Element Analysis.

e. To inculcate knowledge of FEA and use the commercial finite element packages effectively through hands on practice in the laboratory.

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation: 50%
End Term: 70 Marks	Practical Examination: 50%

Course Content:

Introductory Concepts: Historical Background, Introduction to FEM. General FEM procedure. Applications of FEM in various fields. Advantages and disadvantages of FEM. stresses & equilibrium boundary conditions, strain displacement relations, stress – strain relations, temperature, effects, variational approach solution techniques.

FEA Procedure: Step wise procedure of Finite element method, variational techniques for derivation of finite element equations, assembly procedure, solution methods

FEM of One Dimensional Problem: Introduction, finite element modeling, shape functions, variational approach, weighted residual approach, Assembly of finite element equations, Higher-order element, Boundary conditions, Temperature effects.

FEA of Two Dimensional Problems: Introduction, FE modeling, formulation of constant strain triangular element, problem modeling & boundary conditions.

Preprocessor and Post Processors: Introduction, Mesh Generation, post processing, requirements of a preprocessor and post processor, preprocessor and post processors in analysis softwares. Introduction to FEA Software.

Term Work:

The term work shall consist of the following assignments, using analysis software.

1. Assignments on mesh generation for different geometries.
2. Assignment on static structural analysis.
3. Assignment on steady state thermal analysis
4. Assignment on thermo-structural analysis

Practical Examination:

The practical examination consists of an oral/practical based on the syllabus prescribed above.

Reference Books:

1. S. S. Rao, "Introduction to Finite Element Method in Engineering", Butterworth Heinmann Publication.
2. Nitin S. Gokhale, "Practical Finite Element Analysis" Finite to Infinite
3. Bathe K.J. "Finite Element Procedures by using ANSYS & other software manuals", Prentice Hall of India, New Delhi.
4. P. Seshu "Textbook of Finite Element Analysis" Prentice Hall of India, New Delhi
5. Reddy J. N. "Finite Element Method" Mc-GRAW-HILL

Course Outcomes:

1. Student shows ability to analyze and design real world components
2. Student shows ability to suggest whether the given solid is safe for the load applied.
3. Student can select proper methodology for designing and solving a design problem.
4. Student shows ability to work with different software skills sets required to work with.

MECHATRONICS-II

(CREDITS THEORY: 04, PRACTICAL:01)

Course code: ME316 **Contact Hours/Week:** Th.03, Tu. 01, Pr.02

Course Objective:

a. To comprehend different responses from a digital control system.
b. To inculcate the working of digital controllers and microprocessors.
c. To develop logic in assembly and high level languages.
d. To develop ability to apply the knowledge of logical programming in controlling simple systems.
e. To make aware of the working principles of a communication system.

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation : 50%
End Term: 70 Marks	Practical Examination : 50%

Course content:

Dynamic Responses of system: Modelling dynamic systems, First and second order systems, Performance measures for second order systems, system identification.

Frequency Responses: Sinusoidal input, phasors, Frequency response, Bode plots, Performance specification, Stability.

Introduction to Digital Controllers: Digital controllers, Control system performance, Controller tuning, Velocity control, Adaptive control.

Microprocessors: Control, Microprocessor system, Microcontrollers, Applications, Programming.

Assembly and High Level Language: Languages, Instruction sets, Assembly language programs, Need of HLL, program structure, Branches and loops, Arrays, Pointers, Program development, Examples of programs.

Input / Output system: Interfacing, IO/OP addressing, peripheral interface adapters, Serial communication interface, Examples of interfacing.

Programmable Logic Controllers: Programmable Logic Controllers, Basic structure, IO/OP Processing, Programming, Mnemonics, Timers, internal, relays, counters, Shift registers, Master and jump controls, Data handling, Analogue IO/OP, Selection of a PLC.

Communication System:
Digital communication, centralized, hierarchical and distributed control, Networks, Protocols, Open system interconnection communication model, Communication interfaces.

Term Work:

It shall consist of assignments / practical based on the above syllabus, including following practical.

- Demonstration of Accelerometer sensor using LABVIEW and MYRIO
- Demonstration of Gyroscope sensor using LABVIEW and MYRIO
- Demonstration of Compass sensor using LABVIEW and MYRIO
- Demonstration of Ambient Light Sensor using LABVIEW and MYRIO
- Demonstration of IR Range Finder sensor using LABVIEW and MYRIO
- Demonstration of Servo sensor using LABVIEW and MYRIO
- Demonstration of Sonar Range Finder sensor using LABVIEW and MYRIO

Practical Examination:
It shall consist of oral/practical examination based on the above syllabus and term work.

Reference Books:

1. W. Bolton, "Mechatronics: Electronic control system in Mechanical and Electrical Engineering," Pearson Education Asia.
2. D.G. Alciatore and M.B.Histand "Introduction to Mechatronics and Measurement System," Tata Mc Graw Hill.
3. "Mechatronics (HMT)" Tata Mc Graw Hill.
4. Sudhir Gupta, "Elements of Control system," Prentice Hall.
5. Kastuhiko Ogatta, "Modern Control Engineering" [Phi]

Course Outcomes:

1. Student shows ability to model and analyze electrical and mechanical systems and their interconnection.
2. Be able to do the complete design, building, interfacing and actuation of a mechatronic system for a set of specifications.
3. Student shows proficiency in the use of LabVIEW software for data acquisition.
4. Student show ability to do programming of microcontrollers.

PRODUCTIVITY IMPROVEMENT TECHNIQUES

(CREDITS THEORY-04, PRACTICAL-01)

Course Code: ME317 **Contact Hours: Th. 03, Tu.01 Pr. 02**

Course Objective:

- **a.** To introduce the concepts, principles and framework of contents of Productivity improvement techniques
- **b.** To acquaint the students with various productivity enhancement techniques.
- **c.** To acquaint the students with different aspects of Work measurement.
- **d.** To make students apply knowledge of PIT in actual practice.
- **e.** To develop ability to introduce techniques of time saving and improve productivity.

Evaluation scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation : 50%
End Term: 70 Marks	Practical Examination : 50%

Course Contents:

Introduction to Work Study: Definition: Purpose of study, objectives, brief history and evolution, work study and productivity, human factor in application of work study, scope, applications, relationship, between Productivity & standard of living, basic work content, excess work content Management, techniques to reduce excess work content due to product process and ineffective time in control of workers and Management. (4 hrs)

Ergonomics: Introduction, Principles, Work system design, Man-machine system, Human behavior and equipment design, Tools, Techniques and applications, Effect of environment on performance of worker, working conditions, prevention accidents and hazards, lighting, ventilation etc. (4 hrs)

Method Study: Definition, Concept, Objectives and Procedure of method study, Flow and handling of materials; Process chart symbols, recording techniques like Flow process charts, Operation, Flow and Two handed Process charts, Flow diagram, String diagram, Multiple Activity chart, travel chart, Operation Analysis, Analysis of motion, analysis and critical examination of existing methods and development of improved methods, Motion economy, Design of work place layout, Therbligs, SIMO chart. (12 hrs)

Work Measurement: Definition, significance of work measurement; origin, development and procedure of work measurement, introduction to various work measurement techniques. (02 hrs)

Time Study and Other Works Measurement Techniques: Time study: definition, equipment for basic time study, time study forms and other equipment. Steps in use of techniques of time study; selecting

the job, breaking the job into elements, approach to the worker, the elements, timing each element, Maynard Operation Sequencing Technique (MOST),Average and qualified worker, rating procedures, criteria affecting the choice of rating procedures, continuous timing, fly back timing, accumulative timing; standard ratings, comparison of observed and standard ratings, factors affecting the rate of working, scales of rating, rating factors, recording the rating, summarizing the study, allowances, calculation and application of allowances. Work sampling and production studies; General study of standard data & PTS. Introduction to standard data and synthetic time standards, special timing devices and equipment, introduction of work study in an organization, introductory idea about incentives, problems in India in increasing productivity through work study and wage incentives. (12 hrs)

Use of the time Standards: Define work covered by allowance time, work specification, work unit, program planning & utilization of plant &labor, estimation, standard costing, budgetary control & incentive schemes. (2 hrs)

Term Work: Minimum Eight assignments based on the above syllabus.

Practical Examination:
It shall consist of oral/practical examination based on the above syllabus and term work.

Reference Books

1. Introduction to work study – ILO
2. Motion & Time study Design & Measurement of Work - Ralph Barnes (Wiley Eastern)
3. Work Study - R.M. Currie &J.Faraday. (ELBS Pitman)
4. Hand Book of Industrial Engineering - Irson& Grant
5. Productivity management - Concepts & Techniques- S. C. Sawhney

Course Outcomes

1. Student recognizes the impact of human factor at workplace for productivity improvement.
2. Student shows ability to calculate productivity of any industry.
3. Student demonstrates use of ergonomics in designing of different products for human comfort at work place.
4. Student shows skill of implementing method study technique in industries.
5. Student can evaluate the percentage utilization of man power and machines in industries

COMPUTATIONAL FLUID DYNAMICS

(CREDITS THEORY-04, PRACTICAL-01)

Course code: ME318 **Contact Hours:** Th. 03,Tu.01,Pr:02

Course Objectives:

- **a.** Students should be able to model fluid / heat transfer problems and apply fundamental conservation principles.
- **b.** Students should be able to discretize the governing differential equations and domain by Finite Difference Method.
- **c.** Students should be able to solve basic convection and diffusion equations and understands the role in fluid flow and heat transfer.
- **d.** To prepare the students for career in industry in CAE through use of software tools.
- **e.** To prepare the students for research leading to higher studies

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation : 50%
End Term: 70 Marks	Practical Examination : 50%

Course Content:

Introduction to CFD: Computational approach to Fluid Dynamics and its comparison with experimental and analytical methods, Basics of PDE: Elliptic, Parabolic and Hyperbolic Equations.

Governing Equations: Review of Navier-Stokes Equation and simplified forms, Solution

Methodology: FDM and FVM with special emphasis on FVM, Stability, Convergence and Accuracy.

Finite Volume Method: Domain discretization, types of mesh and quality of mesh, SIMPLE, pressure velocity coupling, Checkerboard pressure field and staggered grid approach

Geometry Modeling and Grid Generation: Practical aspects of computational modeling of flow domains, Grid Generation, Types of mesh and selection criteria, Mesh quality, Key parameters and their importance

Methodology of CFDHT: Objectives and importance of CFDHT, CFDHT for Diffusion Equation, Convection Equation and Convection-Diffusion Equation

Solution of N-S Equations for Incompressible Flows: Semi-Explicit and Semi-Implicit Algorithms for Staggered Grid System and Non Staggered Grid System of N-S Equations for Incompressible Flows

Term Work: Minimum Eight assignments based on the above syllabus.

Such as following

1. Problems on Gauss-Siedel/Jacobi/TDMA.
2. Numerical simulation of quasi one dimensional nozzle flow.
3. Analysis of boundary layer over a flat plate. (Blasius equation)
4. Transient Conduction equation in 2 dimensions
5. Convection-Diffusion Equation in 2 dimensions

6. Analysis of internal flow
7. Analysis of external flow: Aerofoil or similar shape
8. Validation of natural convection in a square cavity.
9. CFD analysis of heat transfer in pin fin.
10. Study of different mesh generation schemes

Practical Examination:
It shall consist of oral/practical examination based on the above syllabus and term work

References:

1. S. V. Patankar, Numerical Heat Transfer and Fluid Flow, McGraw-Hill.
2. John D. Anderson Jr, Computational Fluid Dynamics, McGraw Hill Book Company.
3. H. K. Versteeg & W. Malalasekera, An Introduction to Computational Fluid Dynamics, Longman Scientific & Technical.
4. T. J. Chung, Computational Fluid Dynamics, Cambridge University Press.
5. J. H. Ferziger and M. Peric, Computational Methods for Fluid Dynamics, Springer.
6. John C. Tannehill, Dale A. Anderson and Richard H. Pletcher, Computational Fluid Mechanicsand Heat Transfer, Taylor &Francis.
7. J. Blazek, Computational Fluid Dynamics: Principles and Applications, Elsevier.

Course Outcomes:

1. Student shows ability to analyze and model fluid flow and heat transfer problems.
2. Student shows ability to generate high quality grids and interpret the correctness of numerical results with physics.
3. Student shows ability to use a CFD tool effectively for practical problems and research.
4. Student shows ability to use the CFD software tools effectively leading to enhance employability.

ELEMENTS OF PLM

(CREDITS THEORY-04, PRACTICAL-01)

Course code: ME319 **Contact Hours:** Th. 03,Tu.01,Pr:02

Course Objectives:

a. Establishing industry partnerships that guide, support, and validate PLM research and education activities.

b. Assisting with the integration of PLM into College curricula

c. Facilitating the pursuit of PLM career opportunities by SGGS graduates

d. Serving as a knowledge base for the PLM discipline.

Evaluation Scheme:

Theory	**Practical**
Mid Term: 30 Marks	Continuous Evaluation : 50%
End Term: 70 Marks	Practical Examination : 50%

Course Content:

Introduction: Background, Overview, Need, Benefits, and Concept of Product Life Cycle, Product lifecycle management systems, Components / Elements of PLM, Emergence of PLM, Significance of PLM.

Product organizational structure, Human resources in product lifecycle, Information, Standards, Vendors of PLM Systems and Components, Integration of the PLM system with other applications, Examples of PLM in use. The PLM Strategy,

Product Data, Product and Product Data, Product Data Examples, Product Data Issues, Metadata, Product Data Models.

Deployment: Problems in deployment. Stages of deployment, company's vision.PLM software and tools. Product Data security.

Product structure, workflow, Terminologies in workflow, The Link between Product Data and Product Workflow, PLM applications, PDM applications. Introduction to Internet of the Things.

Term Work: Minimum six assignments based on the above syllabus.

Practical Examination:

It shall consist of oral/practical examination based on the above syllabus and term work

References:

1. Grieves, Michael, **Product Lifecycle Management**, McGraw-Hill, 2006. ISBN 0071452303
2. AnttiSaaksvuori, AnselmiImmonen, **Product Life Cycle Management** - Springer, 1st Edition (Nov.5, 2003)
3. Stark, John. **Product Lifecycle Management: Paradigm for 21st Century Product Realization,** Springer-Verlag, 2004. ISBN 1852338105
4. Relevant recent technical articles, research papers, key note addresses, etc

Course Outcomes:

After completion of this course student should,

1. Evaluate the difference between the terms PDM and PLM.
2. Demonstrate the basic components and functionality of a PLM system.
3. Analyze PLM tools and techniques for application in a range of practical situations.
4. Integrate and evaluate information from a variety of sources to plan and complete a project.