Sandip University

Neelam Vidya Vihar, Vill.: Sijoul. P.O. : Mailam, Dist.:Madhubani, Bihar -847235
Website : http://www.sandipuniversity.edu.in
Toll-Free No.- 1800-313-2714 Ph: 7549991044.

School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Second Year	Semester -III
Course: Engineering Mathematics-III	Course Code: ME 301T
Theory: 4Hours/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 4

Objectives :	
1	To become familiar with linear differential equations of higher order applicable to mechanical engineering problems
2	To study partial differential equations and be able to use that in physical phenomena.
3	To study boundary value problems, one-dimensional wave equation and heat equation.
4	To study two dimensional heat equation and Laplace equation.
5	To study Fourier transforms of simple functions and convolution theorem.

Unit Number	Details	Hours
1	**Linear Differential Equations and Applications:** Linear Differential Equations with constant coefficients of n_{th} order method of variation of parameters, Cauchy's and Legendre's Differential Equations , Simultaneous Differential Equations , Symmetric simultaneous Differential Equations , Modeling of mass spring systems using eigen values and eigen vectors.	10
2	**Partial Differential Equations:** Solution of standard types of first order equations, Lagrange's equation, Linear Homogeneous partial differential equations of second and higher order with constant coefficients.	9
3	**Boundary Value Problems :**Classification of second order linear partial differential equations, Solutions of one-dimensional wave equation, one dimensional heat equation.	9
4	**Two dimensional Heat Equation:**Steady state solution of two dimensional heat equation Laplace equation Fourier series solutions in Cartesian	10

	coordinates and Polar coordinate.	
5	**Fourier Transforms:**Statement of Fourier integral theorem (without proof), Fourier transform pairs, Fourier Sine and Cosine transforms, Properties , Transforms of simple functions, Convolution theorem, Parseval's identity.	7
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Student will be able to solve linear differential equations and apply them on simple mechanical problems.
CO2	Student will gain the basic knowledge of patial differential equations
CO3	Student will understand the use of boundary value problems and one dimensional equations,
CO4	Student will be able to solve the problems on two dimensional heat equation.
CO5	Student will be able to gain the knowledge of Fourier transforms and perform transformation of simple functions.

Resources	
Recommended Books	1. B.V.Ramana "Higher Engineering Mathematics" Tata McGraw-Hill, 2006. 2. B. S. Grewal," Higher Engineering Mathematics", Khanna publishers, 42nd edition, 2013.
Reference Books	1. Peter V. O' Neil, Advanced Engineering Mathematics, 7_{th}ed, Cengage Learning. 2. P. Kandasamy, Engineering Mathematics, Vol. II & Vol. III (4_{th} revised ed), S.Chand&Co. 3. Ervin Kreyszig, Advanced Engineering Mathematics, 10_{th} ed, John Wiley and Sons.
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Second Year	Semester -III
Course: Mechanics of Solids	Course Code: ME 302T
Theory : 4 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 4

Objectives :	
1	The behaviour of Engineering Material under the loading .
2	Computation of stresses and strains in simple members.
3	Computation of area moment of inertia of cross section of the beams.
4	Determination of bending and shear stress in beams.
5	Computation of Torsional shear stresses in shaft.

Unit Number	Details	Hours
1	**Simple Stresses and Strains:**Mechanical properties of materials, analysis of internal forces, simple stress and strain, stress-strain curve, Hooke's law, modulus of elasticity, shearing, thermal stress, Hoop stress, Poisson's ratio, volumetric stress, bulk modulus, shear modulus, relationship between elastic constants. Thermal stresses – simple bars.	9
2	**Analysis of Beams:** Types of beams and loads. Shear Force and Bending Moment diagram for point load, uniformly distributed load and uniformly varying load. Maximum bending moment and position of points of contra flexure.	9
3	**Stresses in Beams:**Moment of inertia of different sections, bending and shearing stresses in a beam, theory of simple bending, derivation of flexural formula, economic sections, horizontal and vertical shear stress, distribution shear stress for different geometrical sections- rectangular, solid circular, I-section, other sections design for flexure and shear.	9

4	**Transverse Beam Deflections:** Differential equation of deflected beam, slope and deflection at a point, calculations of deflection for determinate beams by double integration, Macaulay's method, deflection of cantilever beams, deflection in simply supported beams.	9
5	**Torsion in Circular Shaft:** Torsional shear stress in solid, hollow and stepped circular shafts, angular deflection and power transmission capacity.	9
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Understand the behaviour of Engineering Material under the loading.
CO2	Compute of stresses and strains in simple members.
CO3	Compute of area moment of inertia of cross section of the beams.
CO4	Determine of bending and shear stress in beams.

Resources	
Recommended Books	1.Popov, E.P., Introduction to Mechanics of Solid, Prentice-Hall, Second Edition.
Reference Books	1. Crandall, S.H., Dahl, N.C., and Lardner, T.J., An Introduction to the Mechanics of Solids, Tata McGraw Hill. 2. Shah, H.J., Junnarkar, S.B., Mechanics of Structure vol.1, 31st ed, Charotar Publishers, Anand (India). 3. Punmia, B.C. Jain, A.K., Strength of Materials, Laxmi Publications.
E-Resources	http://nptel.ac.in/

Tutorials:
Tutorial assessment shall be conducted for the Project, Tutorials, Industrial Visit report and Seminar. Tutorial is continuous assessment based on work done, submission of work in the form of report/journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the school. At the end of the semester, the final grade for a Tutorial shall be assigned based on the performance of the student and is to be submitted to the University.

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Second Year	Semester -III
Course: Metallurgy and Material Science	Course Code: ME 303T
Theory : 4 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.:2.5 Hrs	Credit: 3

Objectives :	
1	To acquaint students with the basic concepts and properties of Material Science 2 3 4 5
2	To impart a fundamental knowledge of Materials Processing
3	Selection and application of different Metals & Alloys
4	To understand the structure of Engineering Materials
5	To develop futuristic insight into Materials

Unit Number	Details	Hours
1	**1. Introduction to Materials, Structure of Materials & Diffusion in Solids:**Introduction to Materials, Classification and selection of engineering materials. **Structure of Materials -** Bonds in solids: Types of bonds and their energies, Primary Bonds or Interatomic bonds, Ionic, covalent & Metallic bonds, Secondary Bonds, Vander Waals forces. Chemical Bonding and Properties of Solid materials. Comparison between Ionic, Covalent and Metallic bonds. Crystal Structure, Indexing of Lattice Planes and Lattice Directions, Co-ordination Number, Atomic Packing Factor, Volumetric and planar density calculations. Defects in crystals, **Diffusion in Solids -** Introduction, Applications of diffusion, Laws of diffusion, Ficks First Law of Diffusion and Ficks Second Law of Diffusion.	10
2	**1. Phase Diagrams and Mechanical Properties of materials** **Phase Diagrams -** Introduction, Mono Component Systems,Gibbs Phase	

	Rule, Binary Phase Diagrams, IsomorphousSystem,Application of Phase Diagrams, Lever Rule, Alloy Systems, Phase diagrams of common Engineering alloy systems. **Mechanical Properties -** Different types of loads or forces in determining the mechanical properties of materials. Relation between Engineering Stress Strain Curve and True Stress Strain Curve. Evaluation of Mechanical Properties. Various tests in assessment of Mechanical Properties like Tensile test, Compressive test, Impact Test, Various Hardness Tests &Jominy End Quench Test for Hardenability.	9
3	**1. Deformation behavior of materials and Heat Treatment** **Deformation behavior of materials -** Elastic and Plastic Deformation. Modes of Plastic deformation: Slip and Twinning. Critical Resolved Shear Stress for single crystal, Work hardening , Rotation of slip plane method and Theory of dislocations (Frank-Reed source) Strengthening Mechanisms of Materials. Changes in properties due to cold working & hot working **Heat Treatment** – Iron –Iron Carbide Equilibrium diagram, Time Temperature Transformation (TTT) Diagram, Continuous Cooing Transformation (CCT) Diagrams, Heat Treatment of Steels, Various Heat Treatment Processes.	9
4	**1. Thermal, Electronic and Magnetic Properties of Materials** **Thermal Properties of Materials -** Introduction, Temperature Scale, Specific Heat Capacity, Specific Latent Heat, Thermal Expansion Coefficient, Thermal Conductivity, Thermal Sensors, Measurements using Thermal Sensors, Thermal Conductivity and Thermal Diffusivity. High Temperature materials and Insulating Materials. **Electronic and Magnetic Properties of Materials –** Electrical Conductivity, Electron Mobility, Electrical Resistivity of materials, Intrinsic and Extrinsic Semi Conduction, Magnetic Properties of Materials, Diamagnetic, paramagnetic and Ferromagnetic materials Superconductivity.	9
5	**1. Polymers -** Introduction, Formation of Polymers, Classification of Polymers, Thermoplast and Thermosetting Polymers. Polymerization Mechanisms: Addition polymerization and Condensation polymerization. **Composite Materials -** Introduction, Classification, Fibre reinforced materials, Laminated materials and Disperse materials, Loading under isostrain conditions and Loading under isostress conditions. (Numerical) **Ceramics -** Introduction to Ceramic materials, Glass transition temperature, applications of ceramics.	8
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Understand the basic concepts and properties of Material.
CO2	Understand about material fundamental and processing.
CO3	Select proper metal, alloys, for specific requirement.
CO4	Detect the defects in crystal and its effect on crystal properties.
CO5	Recognize how metals can be strengthened by cold - working and hot working.

Resources	
Recommended Books	1. V. Raghvan, Materials Science and Engineering, 5_{th} ed, Prentice Hall of Learning Private Limited, India. 2. I.P. Singh, Subhash Chander and Rajesh K. Prasad, Material Science and Metallurgy.
Reference Books	1. Callister Jr, W.D., Jr., Rethwisch, D.G., Materials Science and Engineering: An Introduction, 9_{th} ed, John Wiley & Sons, Inc. 2. Abbaschian, R., Lara Abbaschian and Robert E. Reed-Hill, Physical Metallurgy Principles, 4_{th} ed. CL Engineering. 3. Lawrence H. Van Vlack, Elements of Materials Science & Engineering, 6_{th} ed, Pearson Publication, 4. Dieter, G.E., Mechanical Metallurgy, 3_{rd} ed, McGraw-Hill Education, London. 5. Kodgire, V.D., Material science and Metallurgy Everest Publishing House.
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Second Year	Semester -III
Course: Basic Thermodynamics	Course Code: ME 304T
Theory : 4 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 4

Objectives :	
1	To learn the basic principles of classical thermodynamics.
2	To understand various ideal gas laws and its applications to gas mixtures.
3	To learn the thermodynamic processes and cycles.
4	To use thermodynamic tables, charts, and equation of state to obtain appropriate property data to solve thermodynamics problems.
5	To get conversant with steam generator and its performance calculations

Unit Number	Details	Hours
1	**Introduction of Thermodynamics:** Basic concepts of Thermodynamics, Thermodynamic system - Closed and open systems, Macro and Microscopic Approach, State and equilibrium, Properties of a system, processes and cycles, introduction to gas laws and gas equations, concept of enthalpy, forms of energy - Work and heat transfer, Temperature and Zeroth law of thermodynamics, First law of thermodynamics, Applications of first law to flow and non flow processes and cycles. Steady flow energy equation and its application to different devices like turbine, centrigugal pump, compressors, boiler, condensor, evaporator.etc. PMM I.	9
2	**Second Law of Thermodynamics:** Limitations of first law of thermodynamics, Heat Engine, Heat Pump and Refrigerator, Second Law of Thermodynamics, Equivalence of Clausius and Kelvin Planck Statement,	10

	PMM II., Carnot cycle, Carnot Principle & Theorem. Concept of Reversibility and Irreversibility, Clausius inequality, Concept of Entropy, Entropy changes during reversible processes. Temperature-Entropy diagrams, Principle of increase of entropy, Numerical Treatment to estimate entropy of a system/process.	
3	**Ideal gas equation and Processes:** Ideal Gas definition, Equation of State, Ideal Gas constant and Universal Gas constant, Ideal gas processes on P-V and T-S diagrams, Constant Pressure, Constant Volume, Isothermal, Adiabatic, Polytrophic, Throttling Processes, Calculations of heat transfer, work done, internal energy. Change in entropy, enthalpy for different processes. **Thermodynamic cycles :** Air Standard Cycle, Efficiency and Mean Effective Pressure, Otto Cycle, Diesel cycle, Dual cycle, Comparison of cycles.	9
4	**Properties of Pure substances:** Property diagram for phase change processes.Steam properties, Dryness fraction, Wet, dry and superheated steam, Use of Steam Table and Mollier Chart to find out specific volume, enthalpy, entropy and internal energy for wet, dry saturated and superheated steam, Study of steam calorimeters (Barrel, Separating, Throttling and combined) **Vapour power cycles**: Carnot cycle, Rankine cycle, Comparison of Carnot cycle and Rankine cycle, Efficiency of Rankine cycle (Numerical Treatment), Reheat & Regenerative cycle. (no numerical for reheat & regenerative).	8
5	**Steam Generators& Fuels –Combustion: Classification** of Boilers, Features of Low pressure & High pressure boiler, Boiler mountings and accessories Boiler Performance Calculations-Equivalent evaporation, Boiler efficiency. **Fuels &Combustion: Introduction** to fuels, Theoretical amount of Oxygen / Air required for combustion. Stoichiometric Air: Fuel ratio, Excess air, lean and rich mixtures, Bomb and Boy's gas calorimeters. (No Numerical Treatment on fuels and combustion)	9
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Students will be able to umderstand thermal processes and their applications.
CO2	Students will be able to determine thermal properties as well as heat, work and entropy
CO3	Students will be able to determine dryness fraction of steam, performance of boiler, efficiencies of cycles and remedies to improve efficiency of cycle.
CO4	Students will be able to calorific value of fuels and their use with effective combustion.
CO5	Students will be able to learn and use of steam tables and Mollier Diagram for applications.

Resources	
Recommended Books	1. Nag, P.K., Engineering Thermodynamics, 5th ed, Tata McGraw Hill Publication. 2. Rajput, R.K., Engineering Thermodynamics, 5th ed, Laxmi Publications. 3. Kumar, D.S.,Thermal Science & Engineering, S.K. Kataria& Sons.
Reference Books	1. Yunus A. Cengel and Michael A. Boles, Thermodynamics: An Engineering Approach, 8th ed, Tata McGraw Hill publication. 2. Arora, C.P., Thermodynamics, 1st ed, Tata McGraw Hill Education. 3. Sonntag, Borgnakke and Van Wylen, Fundamentals of Thermodynamics, 7th ed, John Wiley & Sons. 4. Gupta, S.C. , Thermodynamics,1st ed, Pearson Education India. 5. Rathakrishnan,E., Fundamentals of Engineering Thermodynamics, 2nd ed, Prentice-Hall India Learning Pvt. Ltd.
E-Resources	http://nptel.ac.in/

Tutorials:
Tutorial assessment shall be conducted for the Project, Tutorials, Industrial Visit report and Seminar. Tutorial is continuous assessment based on work done, submission of work in the form of report/journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the school. At the end of the semester, the final grade for a Tutorial shall be assigned based on the performance of the student and is to be submitted to the University.

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Second Year	Semester -III
Course: Electrical Technology	Course Code: ME 305T
Theory : 3 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5Hrs	Credit: 3

Objectives :	
1	To introduce basic concept of Electrical Energy
2	To impart basic knowledge of electrical measurement, tariff, illumination and transformers
3	Principle of operation and speed control of DC machines
4	Principle of operation and speed control of AC machines
5	Induction motor principle and its applications
6	Working principle of special purpose motors
7	Power electronics devices with their characteristics

Unit Number	Details	Hours
1	**a) Electrical Power Measurement:** - Measurement of active and Reactive Power in three phase balanced loads by using one wattmeter & two wattmeter, effect of power factor on wattmeter reading. **b) Electrical Energy Measurement:** - Single Phase Energy meter (construction and Working), Use of CT & PT for measurement of Power / Energy in single phase and three phase system (Theoretical Treatment only), standard specifications of single and three phase energy meter. **c) Tariff**- Introduction, objectives & Details of H.T. and L.T tariff, TOD tariff, advantages and improvement of power factor (Theoretical Treatment only)	9
2	**a) Single phase Transformer:** - Types, KVA rating, approximate equivalent circuit, voltage regulation and efficiency of transformer, condition for maximum efficiency.	10

	b) Three phase Transformers: Types of transformer connection (star/star, star/delta,delta/star, and delta/delta) and applications based on connections. (Theoretical Treatment only) Introduction of power transformer, distribution transformer, study of typical distribution transformer substation, specifications of transformer (KVA rating, voltage ratio, current rating) **c) Three phase Induction Motor:**-Constructional feature, working principle of three phase induction motors, types; torque equation, torque slip characteristics; power stages; efficiency; types of starters; methods of speed control Industrial applications	
3	**a) Single phase induction motors:** Types, construction, working principle of split phase and shaded pole type induction motors, applications. Specifications of induction motors (KW rating, rated voltage, current rating, frequency, speed) **b) Synchronous Generator:** Constructional features (Salient and non-salient), working principle, e m f equation, synchronous speed of an alternator, concept of synchronous reactance and impedance, phasor diagram of loaded alternator, voltage regulation of alternator by direct loading method and synchronous impedance method. Specifications of synchronous generator.	9
4	**D.C. Machines:** Construction, working principle of D.C. generator, emf equation of D C generator. (Theoretical concept only). Working principle of D.C. motor. Types of D. C. motor, back emf , torque equation for D.C. motor, characteristics of D. C. motor (series, shunt and compound), starters of D.C. shunt and series motor, methods for speed control of D.C shunt and series motors, Industrial applications. **Special purpose motors:** Construction, working principle, characteristic and applications of stepper motors, A.C. and D.C servomotors, universal motors, Industrial applications.	9
5	**SCR:**-Construction detail, V-I Characteristics, Methods to turn ON, switching action during ON & OFF, specification, Concept of commutation of SCR. applications **DIAC:**- Construction, V-I Characteristics **TRIAC:**- Construction, V-I Characteristics, turning ON process. **MOSFET:**- Construction, transfer Characteristics, output characteristics, Methods to turn ON & OFF, applications **IGBT:**- Construction detail, transfer Characteristics, output characteristics, Methods to turn ON & OFF, applications , GTO Construction ,working and characteristic	8
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Use two watt-meter method to measure active and reactive power.
CO2	Analyse tariff applicable to various consumer types
CO3	Control the speed of DC shunt motor
CO4	Classify transformers based on construction
CO5	Understand performance and characteristics of various Power Electronics devices

Resources	
Recommended Books	1. Theraja, B.L., Electrical Technology, S.Chand Publication Co Ltd. 2. Husain, A., Fundamentals of Electrical Engineering, Dhanpat Rai& Co. 3. Kothari, D.P., Nagrath, I.J., Electrical machines , 3 rd ed., Tata McGraw Hill. Bhattacharya, S.K. ,Electrical Machinery, TTTI Chandigarh 4. Edward Hughes, Electrical Technology, Pearson Education. 5. Pratap, H., Art and Science of Utilization of Electrical Energy , 3 rd ed., DhanpatRai and Co. 6. Bhimbra, P.S., Power Electronics, , Khanna Publication
Reference Books	1. Lowe, Electrical Machines, , Nelson Publications. 2. Fitzgerald, A.E., Kingsley, C., Umans, S.D., Electrical Machines, 5 th ed., Tata McGraw Hill Publication Ltd.
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Second Year	Semester -III
Course: Machine Drawing & CAD Lab	Course Code: ME 307P
Practical : 3 Hrs/Week	Max. University Practical Examination: 25Marks
	Lab Continuous Internal Assessment: 25 Marks
Max. Time for Exam.: 2 Hrs	Credit: 1

Sr. No.	Description
1	Symbolic representation of machine elements
2	Draw the rigid or flexible coupling, muff coupling, bracket etc
3	Draw the simple machine elements in first angle projection
4	Draw the missing line problems, principle of visualization of objects, sectional views, full and half sectional views, auxiliary views
5	Draw the engine connecting rod
6	Draw the pipe and flanged joint / Draw a rivetted joint.
7	Draw the various views of screw threads

Lab Work:
Lab Work assessment shall be conducted for the Project, Tutorials and Seminar. Lab Work is continuous assessment based on work done, submission of work in the form of report/journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the institute. At the end of the semester, the final grade for a Lab Work shall be assigned based on the performance of the student and is to be submitted to the University.

Notes	
1	Each student should perform all the above experiments.
2	The regular attendance of students during the syllabus practical course will be monitored and marks will be given accordingly .
3	Good Laboratory Practices

Practical/Oral/Presentation:
Practical/Oral/Presentation shall be conducted and assessed jointly by internal and external examiners. The performance in the Practical/Oral/Presentation examination shall be assessed by at least a pair of examiners appointed as examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University, authenticate and seal it. Sealed envelope shall be submitted to the head of the department or authorized person.

Notes	
1	One experiment from the regular practical syllabus will be conducted. (Total 25 Marks).
2	Complete laboratory journal/records (15 Marks).
3	Viva-voce (10 Marks).

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Second Year	Semester -III
Course: Mechanics of Solids Lab	Course Code: ME 306P
Practical : 3 Hrs/Week	Max. University Practical Examination: 25 Marks
	Lab Continuous Internal Assessment: 25 Marks
Max. Time for Exam.: 2 Hrs	Credit: 1

Practical Objectives :	
1	To provide knowledge about testing of electrical machines.
2	To provide knowledge about speed control of electrical motors.

Sr. No.	Practical Description
1	Tension test
2	Double Shear Test
3	Fatigue test on Aluminum rod
4	Charpy Impact test on metal specimen
5	Izod Impact test on metal specimen
6	Hardness test on metals : • Brinell's Hardness • Rockwell Hardness • Vickers Hardness
7	Deflection test on beams
8	Compression test on helical springs
9	Strain Measurement using Rosette strain gauge
10	Effect of hardening-Improvement in hardness and impact resistance of steels

Lab Work:

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Notes

Each student should perform all the above experiments.
The regular attendance of students during the syllabus practical course will be monitored and marks will be given accordingly .
Good Laboratory Practices

Practical/Oral/Presentation:

Practical/Oral/Presentation shall be conducted and assessed jointly by internal and external examiners. The performance in the Practical/Oral/Presentation examination shall be assessed by at least a pair of examiners appointed as examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University.

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Second Year	Semester -III
Course: Electrical Technology Lab	Course Code: ME 308P
Practical : 3 Hrs/Week	Max. University Practical Examination: 25 Marks
Max. Time for Exam.: 2 Hrs	Lab Continuous Internal Assessment: 25 Marks
	Credit: 1

Sr. No.	Practical Description
1	Measurement of active power in a three phase balanced inductive load using two Wattmeter method
2	Study of a) D.C. motor starters, b) three phase induction motor starter
3	Speed control of a D. C. shunt motor by armature voltage and flux control methods
4	Load test on a D. C. shunt motor
5	Load test on a D. C. series motor
6	Load test on a three phase induction motor
7	Regulation of an alternator by synchronous impedance method
8	Regulation of an alternator by direct loading method
9	Study of V-I characteristics of SCR & TRAIC
10	Study of a distribution transformer substation and HT/LT energy bill

Lab Work:
Lab Work assessment shall be conducted for the Project, Tutorials and Seminar. Lab work is continuous assessment based on work done, submission of work in the form of report/journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the institute. At the end of the semester, the final grade for a Lab Work shall be assigned based on the performance of the student and is to be submitted to the University.

Notes	
1	Each student should perform all the above experiments.
2	The regular attendance of students during the syllabus practical course will be monitored and marks will be given accordingly (05 Marks).
3	Good Laboratory Practices (05 Marks)

Practical/Oral/Presentation:
Practical/Oral/Presentation shall be conducted and assessed jointly by internal and external examiners. The performance in the Practical/Oral/Presentation examination shall be assessed by at least a pair of examiners appointed as examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University.

Notes	
1	One experiment from the regular practical syllabus will be conducted. (Total 15 Marks).
2	Complete laboratory journal/records (05 Marks)
3	Viva-voce (05 Marks).

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Second Year	Semester -IV
Course: Numerical Methods and Computation	Course Code: ME 401T
Theory: 3Hours/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 3

Objectives :	
1	To provide knowledge about nymerical methods of problem solving. (Taylor's series, Runge-Kutta Method, etc)
2	To provide knowledge about complex variables.
3	To learn about probability distribution and sampling theory.

Unit Number	Details	Hours
1	**Numerical Methods:** Numerical Methods: Numerical solution of ordinary differential equations of first order and first degree, Taylor's series method, modified Euler's method, Runge - Kutta method of fourth order.Milne's and Adams-Bashforth predictor and corrector methods (No derivations of formulae).	9
2	**Numerical Methods:** Numerical solution of second order ordinary differential equations, Runge-Kutta method and Milne's method.Special Functions: Series solution-Frobenious method. Series solution of Bessel's differential equation leading to Jn(x)-Bessel's function of first kind. Basic properties and orthogonality. Series solution of Legendre's differential equation leading to Pn(x)-Legendre polynomials. Rodrigue'sformula, problems	9
3	**Complex Variables:** Review of a function of a complex variable, limits, continuity, differentiability. Analytic functions-Cauchy-Riemann equations in cartesian and polar forms. Properties and construction of analytic functions. Complex line integrals-Cauchy's theorem and Cauchy's integral formula, Residue, poles, Cauchy's Residue theorem (without proof) and	9

	problems.Transformations: Conformal transformations, discussion of transformations: w=z2, w=e2, w=z+(1/z)(z≠0) and bilinear transformations-problems	
4	**Probability Distributions:** Random variables (discrete and continuous), probability mass/density functions. Binomial distribution, Poisson distribution. Exponential and normal distributions, problems.Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance, correlation coefficient.	9
5	**Sampling Theory:** Sampling, Sampling distributions, standard error, test of hypothesis for means and proportions, confidence limits for means, student's t-distribution, Chi-square distribution as a test of goodness of fit.Stochastic process:Stochastic processes, probability vector, stochastic matrices, fixed points, regular stochastic matrices, Markov chains, higher transition probability simple problems.	9
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Students should be able to solve physical problems through numerical methods.
CO2	Students should gain knowledge about complex variables, probability distribution, sampling theory and be able to use them in simple problems.

Resources	
Recommended Books	1. B.V.Ramana "Higher Engineering Mathematics" Tata McGraw-Hill, 2006. 2. B. S. Grewal," Higher Engineering Mathematics", Khanna publishers, 42nd edition, 2013.
Reference Books	1. Peter V. O' Neil, Advanced Engineering Mathematics, 7_{th}ed, Cengage Learning. 2. P. Kandasamy, Engineering Mathematics, Vol. II & Vol. III (4_{th} revised ed), S.Chand&Co. 3. Ervin Kreyszig, Advanced Engineering Mathematics, 10_{th} ed, John Wiley and Sons.
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Second Year	Semester -IV
Course: Kinematics of Machinery	Course Code: ME 402T
Theory : 4 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 4

Objectives :	
1	To impart students with the knowledge about motion, masses and forces in machines.
2	To enable students to apply fundamental of mechanics to machines which include engines, linkages etc.
3	To understand and calculate degrees of freedom of mechanism & its importance.
4	Students should be able to perform position, velocity & acceleration analysis.
5	To understand the importance of friction in mechanism.

Unit Number	Details	Hours
1	**Simple Mechanisms:** Introduction, Kinematics, Kinetics, Static & Dynamics, Machine, Kinematic link or element, Type of links, Structure, Difference Between a Machine and a structure, Types of Constrained Motions, Classification of Kinematic Pairs. Kinematic Chain, Types of Joints in a Chain, Types of Kinematic Chains, Mechanism, Number of Degrees of Freedom for Plane Mechanisms, Application of Kutzbach Criterion to Plane Mechanisms, Grubler's Criterion for Plane Mechanisms. Inversion of Mechanism, Four Bar Chain or Quadric Cycle Chain, Inversions of Four Bar Chain, Single Slider Crank Chain, Inversions of Single Slider Crank Chain, Double Slider Crank Chain, Inversions of Double Slider Crank Chain.	9
2	**Velocity in Mechanisms:** Relative velocity method: Relative velocity of a point on a link, Angular velocity of a link, Sliding velocity, Velocity polygons for simple mechanisms. Instantaneous center of rotation (ICR) method: Definition of ICR, Types of ICRs, Methods of locating ICRs.	9

3	**Acceleration in Mechanisms:** Introduction to Linear, Angular, Centripetal, Tangential acceleration, Acceleration Diagram for a Link, Acceleration of a Point on a Link, Acceleration in the Four bar Mechanisms. Acceleration in the Slider Crank Mechanism and other inversions. Introduction to Coriolis Component of Acceleration, magnitude and direction, Coriolis Component of Acceleration for different mechanisms. Klien's Construction, different cases of slider crank mechanisms.	9
4	**Inertia Forces in Reciprocating Parts:** Introduction, D-Alembert's Principle, Analytical Method for Velocity and Acceleration, Forces on the Reciprocating Parts of an Engine. Equivalent Dynamical System, Determination of Equivalent Dynamical System of Two Masses by Analytical Method, Correction Couple, Analytical Method for Inertia Torque.	9
5	**Friction:** Introduction, Types of Friction, Friction Between Lubricated Surfaces, Limiting Friction, Laws of Solid Friction, Laws of Fluid Friction, Coefficient of Friction, Limiting Angle of Friction, Angle of Repose, Friction of a Body Lying on a Rough Inclined Plane, Efficiency of Inclined Plane. Friction in Journal Bearing- Friction Circle, Friction of Pivot and Collar Bearing, Flat Pivot Bearing, Conical Pivot Bearing, Trapezoidal or Truncated Conical Pivot Bearing, Flat Collar Bearing. Friction Clutches, Single Disc or Plate Clutch, Multiple Disc Clutch, Cone Clutch, Centrifugal Clutch	9
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Students are able to differentiate between motion, masses and forces in machines.
CO2	Students are able to determine velocities & accelerations of various planar mechanisms
CO3	Students are able to understanding of static force relationships and inertia forces and their effect that exist in machines
CO4	Students are able to calculate degrees of freedom of mechanism
CO5	Students are able to understand the importance of friction in mechanism.

Resources	
Recommended Books	1. Rattan, S.S., Theory of Machines, Tata McGraw Hill, New Delhi, 4_{th} ed. 2. Singh, V.P., Theory of Machines, DhanpatRai& Co., 3_{rd} ed.
Reference Books	1. Lal, Jagdish, Theory of Mechanisms & Machines, Metropolitan Book Co. 2. Green, W.G., Theory of Machines, Blackie & Sons, London. 3. Shigley, J.E., Pennock, G.R.,Uicker, J.J.,Theory of Machines and MechanismsSi Edition, Oxford University Press; 4_{th} ed.
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Second Year	Semester -IV
Course: Thermal Engineering	Course Code :ME 403T
Theory : 4 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5Hrs	Credit: 4

Objectives :	
1	To grasp the fundamentals of I. C. Engines, cycles and systems.
2	To understand the combustion characteristics of SI Engines and controlling variables.
3	To get acquainted combustion characteristics of CI Engines and controlling variables
4	To plot the various characteristics of SI and CI engines for comparisons.
5	To learn the basics of Compressors and apply the fundamentals for their design.

Unit Number	Details	Hours
1	**Introduction to of IC Engines and cycles:** Nomenclature, classification, IC engine components and materials, Demonstration of various IC Engine systems and its components, Valve timing diagram, Air standard cycles, Effect of variables on performance, Actual cycle and various losses Fuel air and Actual cycle- Otto, Diesel and Dual; Comparison with air standard cycles. IC Engine systems- Intake and oulet.	9
2	**Combustion in S.I. Engines:** Theory of carburetion, Carburetor, Types of carburetors, fuel injection systems, stages of combustion, Effect of engine variables, Phenomenon of Detonation in SI engines, effect of engine variables on Detonation. Combustion Chambers.	9
3	**Combustion in C.I. Engines:** Fuel supply system, Fuel injection pump and injectors, Combustion in CI engine, Stages of combustion in CI engines, Factors affecting the delay period - compression ratio, engine speed, output, atomization and duration of injection, quality of fuel, intake temperature, intake pressure, Phenomenon of knock in CI engines, rating of fuels,	9

	Comparison of knock in SI and CI engines, types of combustion chambers, Supercharging and turbo-charging methods and their limitations.	
4	**Testing of IC Engines and Engine Emissions:** Objectives of testing, Engine testing and Performance Evaluation, Factors affecting the Performance and Efficiency of S.I and C.I. Engines. , Heat balance calculations, Engine Emissions, sources of emissions, Emission norms- Euro norms, Bharat stage norms, Emission control methods.	9
5	**Engine systems & Reciprocating Compressors. Engine Systems:** Cooling system, Lubrication system, Ignition System, Governing System. **Reciprocating Compressor** - Single stage compressor – computation of work done, isothermal efficiency, effect of clearance volume, volumetric efficiency, Free air delivery, Theoretical and actual indicator diagram, Multi-staging of compressor, Computation of work done, Volumetric efficiency, Condition for maximum efficiency, Inter-cooling and after cooling, Capacity control of compressors & Numerical Treatment- Single stage and multi-stage.	9
	Total (Hrs)	45

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Course Outcome	
Later effective conclusion of course, a Student Should able to :	
CO1	Explain the various IC Engine components, IC Engine Systemsand also differentiate the various cycles.
CO2	Determine performance and combustion characteristics of SI and CIengines.
CO3	Demonstrate the ability to enhance the efficiency and performance of IC, also explain the type of emission and methods for its controls in IC Engines.
CO4	Emphasize on the recent trends in the IC Engines.

Resources	
Recommended Books	1. Ganesan, V.,Internal Combustion Engines, Tata McGraw-Hill. 2. Mathur, M.L., Sharma, R.P., Internal Combustion Engines, Dhanpat Rai. 3. Domkundwar, A., Domkundwar, V.M.,ACourse in Internal Combustion Engines,DhanpatRai& Co (P) Ltd.
Reference Books	1. Taylor, C.F., Taylor, E.S., The Internal Combustion Engine in Theory and Practice: Vol. 1- 2nd Edition, The MIT Press; second edition, revised ed. 2. Heywood,J.B.,Internal Combustion Engine Fundamentals,Tata McGraw-Hill. 3. Gupta,H.N.,Fundamentals of Internal Combustion Engines, PHI Learning Pvt. Ltd. 4. Agarwal, S.K., Internal Combustion Engines:, New Age International. 5. R K. Rajput, A Text Book of Internal Combustion Engines:,Laxmi Publications.
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Second Year	Semester -IV
Course: Fluid Mechanics	Course Code: ME 404T
Theory : 4 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 4

Objectives :	
1	To develop an appreciation for the properties of Newtonian fluids and understand the concept of pressure measurement.
2	To understand the hydrostatic forces acting on submerged bodies and their calculation.
3	To apply the concept of mass, moment and energy conservation to fluid flows.
4	To get acquainted with dimensional analysis and flow through pipes

Unit Number	Details	Hours
1	**Fundamentals of Fluid Mechanics** :Concept of fluid, continuum, ideal and real fluids, Newtonian and nonNewtonian fluids. Fluid properties: Density, Specific gravity, Specific volume, Specific Weight, Dynamic viscosity, Kinematic viscosity, Surface tension, Capillarity, Vapour pressure, compressibility. **Fluid Pressure & Pressure Measurement:** Fluid pressure, Pressure head, Pressure intensity, Concept of absolute vacuum, gauge pressure, atmospheric pressure, absolute pressure. Simple and differential manometers, Bourden pressure gauge	9
2	**Hydrostatics:** Pascal's law and its engineering applications, Total pressure, center of pressure, Hydrostatic forces on immersed bodies in liquid in horizontal, vertical, inclined position, curved submerged surfaces. Buoyancy and flotation, stability of floating and submerged bodies, meta-centric height and its determination.	9
	Fluid Kinematics: Classification of fluid flows, Types of fluid flows- Laminar, turbulent, steady, unsteady, uniform, non uniform, rotational,	

3	irrotational. Continuity equation, velocity and acceleration of fluid particle, local and convective acceleration, normal and tangential acceleration(no numerical treatment to acceleration), streamline, path line and streak line, continuity equation in Cartesian coordinates, rotational flows, stream and velocity potential functions, concept of flow net.	9
4	**Fluid Dynamics:** Difference between Eulerian and Langragian approach of fluid flow, Euler's equation, Bernoulli's equation and steady flow energy equation, Introduction to Navier-Stokes equation,impulse momentum equation, flow along a curved streamline, free and forced vortex motions. Applications of Bernoulli's equation Orifice-meter, Venturi-meter, Mouthpiece, Flow measurement in open channels: notches, Pitot tube with types.	9
5	**Dimensional Analysis & Flow through pipes:** Dimensional Analysis: Similitude, Fundamental and derived units and dimensions, dimensional homogeneity, Buckingham's Pi method for dimensional analysis; Dimensionless numbers and their significance **Flow Through Pipes:** Major and minor losses in pipes, Darcy- Weisbach equation, hydraulic gradient and total energy lines, series and parallel connection of pipes, branched pipes; equivalent pipe, power transmission through pipes. Siphon	9
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Use various properties to understand the fluid and fluid flow.
CO2	Calculate the hydrostatic forces on submerged bodies
CO3	Apply the concept of mass, momentum and energy conservation in fluid flows.
CO4	Apply the various concept of fluid flow through pipes.

Resources	
Recommended Books	1. Bansal, R.K., Fluid Mechanics and Hydraulic Machines, Laxmi Publications. 2. Rajput, R K., Fluid Mechanics and Hydraulic Machines, S chand& Co. Ltd. 3. Som, S.K.,Biswas, G., Introduction to Fluid Mechanics and Fluid Machines, McGraw Hill,3rd ed.. 4. Modi, P.N., Seth, S.M., Hydraulics and Fluid Mechanics, Standard book house,Delhi.
Reference Books	1. Streeter, V.L., Wylie, E.B., Fluid Mechanics, McGraw-Hill.. 2. Shames,I.H., Mechanics of Fluids, McGraw Hill. 3. Kumar, D.S., Fluid Mechanics and Fluid Power Engineering, S.K. Kataria and Sons. 4. Balachandran, P., Gas Dynamics for engineers, PHI Learning Pvt. Ltd. 5. Kundu, Cohen, Dowling, Fluid Mechanics, Academic Press; 5th ed. 6. Shaughnessy, E., James Schaffer, I.K., Introduction to Fluid Mechanics, Oxford University Press. 7. Cengel, Y.A.,Cimbala, J.M., Fluid Mechanics fundamentals and its applications, McGraw-Hill.
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Second Year	Semester -IV
Course : Manufacturing Process - I	Course Code: ME 405T
Theory : 4 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 4

Objectives :	
1	To study fundamentals of Pattern making processes
2	To know the fundamentals of metal casting
3	To familiarize with different Joining Processes
4	To study hot and cold working of metals

Unit Number	Details	Hours
1	**Casting Process:** Types and Properties of moulding sand, patterns - types of patterns, selection of patterns – pattern allowances - Classifications of castings - according to mould materials and moulding methods. Special casting techniques - Fettling and finishing of castings - defects in castings. Gating design – Elements of gating systems, pouring time, riser design. Numerical on gating system	10
2	**Joining Process:** Introduction to joining process. Principle of Gas welding, Arc welding, resistance welding, Solid State Welding, Thermo chemical welding and radiant energy welding - Brazing and soldering - thermal cutting of metal/alloys.	9
3	**Forging:** Classification of forging processes - forging processes - forging defects and inspection. Rolling: Classification of rolling processes - rolling mill - rolling of bars and shapes.	9
4	**Sheet Metal Working:** Introduction, Terminology, Sheet metal forming methods: Shearing, Blanking, Bending, Stretch Forming, deep forming. Spinning: Spinning processes, Classification of dies, Introduction to design parameters, Types of processes	9

5	**Metal Drawing:** Drawing of rods, wires and tubes. Extrusion: Classification of extrusion processes - extrusion equipment – examples.	8
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Understanding the basic concept and various types of Casting process.
CO2	Understanding the basic concept and various types of Joining and Forging processes.
CO3	Understanding the basic concept and various types of Sheet Metal working.
CO4	Understanding the basic concept and various types of Metal drawing

Resources	
Recommended Books	1. Chaudhary, H, Workshop Technology, Elements of Workshop Technology Vol-1, Media Promoters. 2. Jain, R.K., Production Technology, Khanna Publishers.
Reference Books	1. Jain, P.L., Principle of Foundry Technology, McGraw-Hill Higher Education; 4th ed. 2. Raghuwanshi, Workshop Technology I & II, DhanpatRai& Co. 3. Lindberg, R.A., Processes and Materials of Manufacture Prentice Hall 4th ed. 4. Goel,Sinha, Foundry Technology, StandardPublishers,New Delhi. 5. Bawa, Workshop Technology Vol. I & II, McGraw-Hill Education.
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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Second Year	Semester -IV
Course: Manufacturing Process Lab	Course Code: ME 406P
Practical : 3 Hrs/Week	Max. University Practical Examination: 25 Marks
	Lab Continuous Internal Assessment: 25 Marks
Max. Time for Exam.: 2 Hrs	Credit: 1

Sr. No.	Practical Description
1	Study and demonstration of any one of casting process
2	To perform various welding joints by using different welding process
3	Study of various forging operation
4	To manufacture a component by using various sheet metal operation

Notes	
1	Each student should perform all the above experiments.
2	The regular attendance of students during the syllabus practical course will be monitored and marks will be given accordingly (05 Marks).
3	Good Laboratory Practices (05 Marks)

Practical/Oral/Presentation:
Practical/Oral/Presentation shall be conducted and assessed jointly by internal and external examiners. The performance in the Practical/Oral/Presentation examination shall be assessed by at least a pair of examiners appointed as examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University.

Notes	
1	One experiment from the regular practical syllabus will be conducted. (15 Marks)
2	Complete laboratory journal/records (05 Marks)
3	Viva-voce (05 Marks).

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Second Year	Semester -IV
Course: Computer Aided Modeling & Drafting Lab	Course Code: ME 407P
Practical : 3 Hrs/Week	Max. University Practical Examination: 25 Marks
	Lab Continuous Internal Assessment: 25 Marks
Max. Time for Exam.: 2 Hrs	Credit: 1

Sr. No.	Practical Description
1	Introduction of interface and demonstration of 2D modeling software.
2	Limits, Fits, Tolerances, Drawing standards and drafting the sheet on drawing conventions.
3	Drafting the details and assembly of any mechanical component like C-Clamp, Steam stop valve etc.
4	Drafting the details and assembly of any mechanical component like screw jack, tailstock, Plummer block etc
5	Introduction of interface and demonstration of 3D modeling software.
6	Creating 3D models for the parts of the experiment 3
7	Creating 3D models for the parts of the experiment 4
8	Assembly of parts modeled in assignment 6
9	Assembly of parts modeled in assignment 7

Notes

Each student should perform at least 9 experiments from the list of experiments. First Five Experiments are compulsory. Any two experiments on DC Machine & one on single phase induction. Report on industrial visit is compulsory.
The experiments from the regular practical syllabus will be performed. The regular attendance of students during the syllabus practical course will be monitored and marks will be given accordingly.
For good Laboratory Practices Minimum one visit should be arranged to electrical Machine manufacturing company.

Term Work:
Term Work assessment shall be conducted for the Project, Tutorials and Seminar. Term work is continuous assessment based on work done, submission of work in the form of report/journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the institute. At the end of the semester, the final grade for a Term Work shall be assigned based on the performance of the student and is to be submitted to the University

Practical/Oral/Presentation:
Practical/Oral/Presentation shall be conducted and assessed jointly by internal and external examiners. The performance in the Practical/Oral/Presentation examination shall be assessed by at least a pair of examiners appointed as examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University.

Notes:	
1	One experiment from the regular practical syllabus will be conducted. (15 Marks)
2	Complete laboratory journal/records (05 Marks).
3	Viva-voce (05 Marks)

Resources:	
Reference Books	1. Bhat N. D., “Machine Drawing”, Charotar Publications. 2. Ajeet Singh, “Machine Drawing”, McGraw Hill Publications. 3. ASME Y14.5 -2009, ASME, 2009

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Second Year	Semester -IV
Course: Fluid Mechanics Lab	Course Code: ME 408P
Practical : 3 Hrs/Week	Max. University Practical Examination: 25 Marks
Max. Time for Exam.: 2 Hrs	Lab Continuous Internal Assessment: 25 Marks
	Credit: 1

Sr. No.	Practical Description
1	Pressure measurement using any two types of manometer
2	Determination of viscosity of liquids.
3	Determination of metacentric height of floating object
4	Draw flow net using electrical analogy apparatus
5	Verification of modified Bernoulli's equation
6	Calibration of venture meter/ orifice meter
7	Calibration of notches (V & rectangular)
8	Study of Laminar and turbulent flow by Reynolds's apparatus
9	Determination of minor losses due to various pipe fittings
10	Determination of major losses through metal and non-metal pipes

Notes	
1	Each student should perform at least 6 experiments
2	The experiments from the regular practical syllabus will be performed.
3	The regular attendance of students during the syllabus practical course will be monitored and marks will be given accordingly. (05 marks)
4	Good Laboratory Practices. (05 marks)

Lab Work:
Lab work assessment shall be conducted for the Project, Tutorials and Seminar. Lab work is continuous assessment based on work done, submission of work in the form of report/journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the institute. At the end of the semester, the final grade for a Lab work shall be assigned based on the performance of the student and is to be submitted to the University.

Practical/Oral/Presentation:
Practical/Oral/Presentation shall be conducted and assessed jointly by internal and external examiners. The performance in the Practical/Oral/Presentation examination shall be assessed by at least a pair of examiners appointed as examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University.

Notes	
1	One experiment from the regular practical syllabus will be conducted. (15 Marks). Complete laboratory journal/records (05 Marks).
2	Complete laboratory journal/records (05 Marks).
3	Viva-voce (05 Marks).

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Second Year	Semester -VIII
Course: Internship / Training	Course Code: ME 409P
	Credit: 3

Practical Objectives :	
1	As an intern, each student gets an opportunity to apply the skills and knowledge base acquired on campus and to experience a real world environment of responsibility.

Sr. No.	Practical Description
1	Students will go Industrial training of Eight weeks in any industry or reputed organization after the III rd semester examination in summer. They will also prepare an exhaustive technical report of the training which will be duly signed by the officer under whom training was taken in the industry/organization. They will have to present about the training before a committee consisting of faculty members constituted by the concerned Head of the Department.

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Third Year	Semester -V
Course: Measurement and Metrology	Course Code: ME 501T
Theory: 4Hours/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 4

Objectives :	
1	Determination of process capabilities
2	Determination of the measuring instrument capabilities and ensure that they are quite sufficient for their respective measurements.
3	To standardise measuring methods.
4	To maintain accuracies of the measurement

Unit Number	Details	Hours
1	**Definitions:** Precession and accuracy, linearity repeatability sensitivity, readability .Types and sources of errors Linear measurement: Virnier height gauge, tests for their accuracy. **Micrometer:** Instruments for internal measurement, telescopic internal gauge, hemi spherical gauge for small bores, pin gauge for bores, ball type plug gauge, Kelipart gauge for deep bores, and four ball methods slips gauge. **Comparator:** Characteristics, uses and special requirements, sigma mechanical comparator, reed types mechanical comparator, Eden Rolt comparator, mechanical optical comparator, Zeiss ultra optimeter, pneumatic comparator, velocity type and back pressure type, solex pneumatic gauge differential comparator, electrical comparator, relative merit and demerit of comparator.	10
2	**Angular Measurement:** Sine centre, straightness test by spirit level and auto collimator.	

	Measurement by light wave interference: Flatness testing, fringe patterns, NPL, flatness-interferometer, the pitter-NPL gauge, interferometer, Michelson Interferometer, parallelism testing. Checking angle off a piece tapered on one side, to check angle of a tapered hole, to determine the included angle of an internal dove fall, to measure the angle of a V-groove, to determine the width of a V-groove, to measure internal taper angle gauges.	9
3	**Fits and Gauges:** Definitions of terminology, composed tolerance, tolerance accumulation, fundamental deviation, calculation of limits, clearance, tolerance, etc. Types of fits, Taylor's principle of limit gauging, type of limits gauges, materials of limit gauge, inter changeability and selective assembly. **Gauge tolerance:** Design of ring and plug gauges.	9
4	**Measurement of surface finish:** Terminologies centre line average, root mean square, maximum peak to valley height, surface inspection by comparison methods, roughness measurement by instruments.	10
5	**Measurement of screw thread:** Screw terminology, error in screw threads, measurement of major diameter, minor diameter and effective diameter, two wire methods and three wire methods, best size of wire, checking thread form.	7
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Design tolerances and fits for selected product quality.
CO2	Choose appropriate method and instruments for inspection of various gear elements and thread elements.
CO3	Understand the standards of length, angles, they can understand the evaluation of surface finish and measure the parts with various comparators.
CO4	Evaluate the quality of the machine tool with alignment test

Resources	
Recommended Books	Engineering Metrology by R.K. Jain
Reference Books	Mechanical Measurements by Beckwith Marangoni and Lienhard
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Third Year	Semester -V
Course: Dynamics of Machinery	Course Code: ME 502T
Theory : 4 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5Hrs	Credit: 4

Objectives :	
1	To equip the student with fundamental knowledge of dynamics of machines so that student can appreciate problems of dynamic force balance, transmissibility of forces, isolation of systems, vibrations.
2	Develop knowledge of analytical and graphical methods for calculating balancing of rotary and reciprocating masses
3	Develop understanding of vibrations and its significance on engineering design.
4	Develop understanding of dynamic balancing, flywheel analysis, gyroscopic forces and moments.

Unit Number	Details	Hours
1	**Force Analysis of Mechanisms:** Dynamics of plane motion rigid body, equivalent mass systems, forces in mechanisms and machines, friction in link mechanism.	9
2	**Dynamics of direct acting engine mechanism:** Displacement velocity and acceleration of the piston, turning moment diagrams, fluctuation of crank shaft speed and energy flywheels.	9
3	**Cams:** Classification of cams and followers, radial cam, nomenclature, type of follower motions uniforms, simple harmonic, parallel cycloidal, generation of cam profile by graphical method, analytical cam design, pressure angle cams with specified contours.	9
4	**Gyroscopic motion:** Principles of Cyroscope, Cyroscopic acceleration, Cyroscopic couple and reaction.	9

	Balancing of inertia forces and moments in machines: Balancing of reciprocating masses, primary and secondary forces and couples, concept of direct and reverse cranks, balancing of multicylinder engines.	
5	**Vibrations:** Basic concepts- simple harmonic motion, degree of freedom, types of damping, equivalent systems, free and forced vibrations, linear and angular, single degree freedom systems with and without damping, whirling of shaft vibration, isolation and absorbers, elementary treatment of system with two degree of freedom.	9
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Master the knowledge in dynamics of planar mechanism
CO2	Analyze static and dynamic force analysis of mechanisms
CO3	Take notice of importance of the balancing and learn procedures of the basic balancing
CO4	Ability to understand the implications of computed results in dynamics to improve the design of a mechanism

Resources	
Recommended Books	1. Theory of Machines by Sigley and J.I. 2. Theory of Machine by SS Rattan 3. Theory of Machine by Shah and Jadhuvansi
Reference Books	1. Theory of Machines by Thomas Bevan
E-Resources	http://nptel.ac.in/

Tutorials:
Tutorial assessment shall be conducted for the Project, Tutorials, Industrial Visit report and Seminar. Tutorial is continuous assessment based on work done, submission of work in the form of report/journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the school. At the end of the semester, the final grade for a Tutorial shall be assigned based on the performance of the student and is to be submitted to the University.

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Third Year	Semester - V
Course: Engineering Economics	Course Code: ME 503T
Theory : 3 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 3

Objectives :	
1	Review with students basic economic principles
2	Introduce to students basic capital appraisal methods used for carrying out economic analysis of different alternatives of engineering projects or works
3	Educate the students on how to systematically evaluate the various cost elements of a typical manufactured product, an engineering project or service, with a view to determining the price offer

Unit Number	Details	Hours
1	**Introduction:** Engineering Decision-Makers, Engineering and Economics, Problem solving and Decision making, Intuition and Analysis, Tactics and Strategy. Engineering Economic Decision, Maze. Law of demand and supply, Law of returns, Interest and Interest factors: Interest rate, Simple interest, Compound interest, Cash - flow diagrams, Personal loans and EMI Payment, Exercises and Discussion.	10
2	**Present Worth Comparisons :** Conditions for present worth comparisons, Basic Present worth comparisons, Present-worth equivalence, Net Presentworth, Assets with unequal lives, infinite lives, Future-worth comparison, Pay-back comparison, Exercises, Discussions and problems. **Equivalent Annual Worth Comparison :** Equivalent Annual-Worth Comparison methods, Situations for Equivalent Annual-Worth Comparisons, Consideration of asset life, Comparison of assets with equal and unequal lives, Use of shrinking fund method, Annuity contract for	9

	guaranteed income, Exercises, Problems.	
3	**Rate of Return Calculations and Depreciation:** Rate of return, Minimum acceptable rate of return, IRR, IRR misconceptions, Cost of capital concepts. Causes of Depreciation, Basic methods of computing depreciation charges, Tax concepts, corporate income tax. **Estimating and Costing:** Components of costs such as Direct Material Costs, Direct Labor Costs, Fixed Over-Heads, Factory cost, Administrative Over-Heads, First cost, Marginal cost, Selling price, Estimation for simple components.	9
4	**Introduction, Scope of Finance, Finance Functions :** Statements of Financial Information: Introduction, Source of financial information, Financial statements, Balance sheet, Profit and Loss account, relation between Balance sheet and Profit and Loss account. Simple Numericals	7
5	**Finance Raqtio Analysis :** Introduction, Nature of ratio analysis, Liquidity ratios, Leverage ratios, Activity ratios, Profitability ratios, Evaluation of a firm's earning power. Comparative statements analysis. Simple numericals **Finance and Profit Planning :** Introduction, Financial planning, Profit planning, Objectives of profit planning, Essentials of profit planning, Budget administration, type of budgets, preparation of budgets, advantages, problems and dangers of budgeting. Introduction to Bench Marking of Manufacturing Operation.	10
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Eplain the basic economic principles of wants, scarcity, choice, opportunity cost, etc as applied to business organizations and engineering firms
CO2	Uderstand the concept of depreciation of fixed assets and know how to calculate depreciation values using different methods of depreciation
CO3	Clculate important financial ratios and know how to make useful deductions from the values of these ratios
CO4	Ealuate the profit of a firm, carry out the break even analysis and employ this tool to make production decision

Resources	
Recommended Books	1. Engineering Economics by Paneerselvam R 2. Economics for Engineering Students by Seema Singh
Reference Books	1. Engineering Economics by James Riggs
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Third Year	Semester -V
Course: Design of Machine Elements I	Course Code: ME 504T
Theory : 4 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 4

Objectives :	
1	Develop an ability to apply knowledge of mathematics, science, and engineering
2	To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.
3	To develop an ability to identify, formulate, and solve engineering problems

Unit Number	Details	Hours
1	**Introduction to Design and Design against Static Loads :** Basic principle of Machine Design, Design considerations, Principle stresses & strains, Fits and tolerances, Factor of safety, Theories of failures, Standards & Codes, Preferred Series and Numbers. Design of Cotter joint, Knuckle joint, Levers - hand / foot lever, lever for safety valve, bell crank lever, components subjected to eccentric loading.	9
2	**Shafts and Couplings :** Design of Shaft on the basis of strength, torsional rigidity and lateral rigidity, A.S.M.E. code for shaft design. Types of Keys, their design and selection based on shafting condition. Classification of coupling, Design of Flange couplings, Bush pin type flexible couplings.	10
3	**Design of Fasteners and Welded Joints:** Nomenclature for bolts and screws, Choice of appropriate bolts, bolts subjected to tensile, compressive and torsional loading, Determining shear loads, for various types of eccentric loading conditions. Welding symbols, Stresses in butt and fillet welds, Strength of butt, parallel and transverse fillet welds, Axially loaded	9

	unsymmetrical welded joints, Eccentric load in plane of welds.	
4	**Design against Fluctuating Loads:** Stress concentration, variables stresses, reversed, repeated, fluctuating stresses. Fatigue failure, Endurance limit-estimation of endurance limit, Design for finite and infinite life, Soderberg and Goodman design criteria, Fatigue design under combined stresses	8
5	**Design of Springs:** Basic spring nomenclature, Various spring configurations viz. types, application & materials, Designing of Helical Compression & Tension springs for static and fatigue loads, Springs in series and parallel, Concentric helical springs, Leaf springs.	9
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Be able to analyze the stress and strain on mechanical components; and understand, identify and quantify failure modes for mechanical parts
CO2	Demonstrate knowledge on basic machine elements used in machine design; design machine elements to withstand the loads and deformations for a given application, while considering additional specifications.
CO3	Be able to approach a design problem successfully, taking decisions when there is not a unique answer

Resources	
Recommended Books	1. Bhandari V.B., "Design of Machine Elements", Tata McGraw Hill Publication Co. Ltd 2. C. S. Sharma and KamleshPurohit, "Design of Machine Elements", Prentice Hall India Publication. 3. Shigley J.E. and Mischke C.R., "Mechanical Engineering Design", McGraw Hill Publication Co. Ltd.
Reference Books	1. Robert L. Norton, "Machine Design: An Integrated Approach", Fifth Edition 2. Richard Budynas, Keith Nisbett,"Shigley"s Mechanical Engineering Design", Mc Graw Hill, Ninth Edition 3. Bhandari V. B., "Machine Design data book", Tata McGraw Hill Publication Co. Ltd. 4. Machine Tool Design Handbook, CMTI.
E-Resources	http://nptel.ac.in/

Tutorials:
Tutorial assessment shall be conducted for the Project, Tutorials, Industrial Visit report and Seminar. Tutorial is continuous assessment based on work done, submission of work in the form of report/journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the school. At the end of the semester, the final grade for a Tutorial shall be assigned based on the performance of the student and is to be submitted to the University.

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Third Year	Semester - V
Course: Refrigeration and Air Conditioning	Course Code: ME 505TE-A
Professional Elective I -A	
Theory : 3 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 3

Objectives :	
1	Introduce students to basic use of Psychrometrics chart for Refrigerating and Air Conditioning systems
2	Provide students with opportunities to develop their knowledge of Refrigerating and Air Conditioning systems design.

Unit Number	Details	Hours
1	**Refrigerant and Applications of Refrigeration and Air Conditioning:** Classification of refrigerants, Designation of refrigerants, Desirable properties of refrigerants, environmental issues, Ozone depletion and global warming, ODP, GWP & LCCP, selection of environment friendly refrigerants, secondary refrigerants, anti-freeze solutions, Zeotropes and Azeotropes, refrigerant:recovery reclaims, recycle and recharge. **Applications** Domestic Refrigerator, Domestic Air Conditioners, Automotive Air Conditioners, Evaporative coolers, water coolers, Commercial Refrigeration- Dairy, Cold storage, Ice plant, Commercial Air Conditioning- Multiplex, Hospitals.	9
2	**Vapour Compression System:** Working of simple vapour compression system, representation of vapour compression cycle (VCC) on T-s and P-h diagram, COP, EER, SEER, IPLV, NPLV, effect of operating parameters on performance of VCC, actual VCC, methods of improving COP using flash chamber, sub-cooling, liquid vapour heat exchanger, comparison of VCC with Reverse Carnot cycle, Air Refrigeration systems. **Vapour absorption systems:** Introduction, Working of simple vapour	10

	absorption system (VAS), desirable properties of binary mixture (aqua-ammonia), performance evaluation of simple VAS (simple numerical treatment), actual VAS, Li-Br absorption system, three fluid system (Electrolux refrigeration)	
3	**Multiple pressure refrigeration system:** Introduction, need of multistage system, Intermediate pressure, two stage compression with flash gas removal and liquid intercooler, single compressor with multiple evaporator: individual and multiple expansion valves, individual compressors, cascade system: application and numerical (numerical by using p-h chart), **Introduction to cryogenics**: (Linde - Hampson cycle) and applications (no numerical treatment)	9
4	**Psychrometry & Human Comfort:** **Psychrometry**: Basic Psychrometry and processes, BPF of coil, ADP, adiabatic mixing of two air streams, SHF, RSHF, GSHF, ESHF. Factors contributing to cooling load, Numerical based on load analysis **Human Comfort** : Thermodynamics of human body, comfort and comfort chart, factors affecting human comfort, concept of infiltration and ventilation, indoor air quality requirements	9
5	**Air Conditioning Systems:** Working of summer, winter and all year round AC systems, all air system, all water system, air water system, variable refrigerant flow and variable air volume systems, unitary and central air conditioning. **Components of refrigeration and air conditioning systems** Working of reciprocating, screw and scroll compressors, working of air cooled, water cooled and evaporative condensers, working of DX, Flooded, Forced feed evaporators, Expansion devices –Capillary tube, TXV, EXV, operating and safety controls.	8
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Use the Psychrometric chat for Refrigerators and Air-Conditioners designs.
CO2	Identify the comfort design conditions for a particular location
CO3	Carry out simple design calculations and Equipment Selection

Resources	
Recommended Books	1. Arora C. P., Refrigeration and Air Conditioning, Tata McGraw-Hill 2. Manohar Prasad, Refrigeration and Air Conditioning, New Age Publication. 3. Arora and Domkundwar, Refrigeration & Air Conditioning, Dhanpatrai& Company, New Delhi . 4. Khurmi R.S. and Gupta J.K., Refrigeration and Air conditioning, Eurasia Publishing House Pvt. Ltd, New Delhi. 5. Ballaney P.L., Refrigeration and Air conditioning, Khanna Publishers.
Reference Books	1. Dossat Ray J, Principles of refrigeration, S.I. version, Willey Eastern Ltd. 2. Stockers W.F and Jones J.W., Refrigeration and Air conditioning, McGraw Hill International.
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Third Year	Semester - V
Course: Gas Dynamics	Course Code: ME 505TE-B
Professional Elective I- B	
Theory : 3 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 3

Objectives :	
1	To impart the basic concepts and results for the compressible flow of gases and introduction to the numerical method of characteristics
2	Topics to be covered include conservation laws, propagation of disturbances, isentropic flow, compressible flow in ducts with area changes, normal and oblique shock waves and applications, Prandtl-Meyer flow and applications, simple flows such as Fanno flow and Rayleigh flow with applications to nozzles, and propulsion related concepts .
3	The method of characteristics will be described in one dimensional unsteady isentropic flow.
4	The emphasis will be on the physical understanding of the phenomena and basic analytical results.

Unit Number	Details	Hours
1	**Fundamentals of compressible flow:** Ideal gas relationship, The adiabatic energy equation, Mach number and its significance, Mach waves, Mach cone and Mach angle, static and stagnation states, relationship between stagnation temperature, pressure, density and enthalpy in terms of Mach number, stagnation velocity of sound, reference speeds, various regions of flow, Effect of Mach number on compressibility, Area velocity relationship.	9
2	**One Dimensional Isentropic flow:** General features of isentropic flow, performance curve, Comparison of adiabatic and isentropic process, One dimensional isentropic flow in ducts of varying cross-section- nozzles and diffusers, operation of nozzles under varying pressure ratio, mass flow rate in nozzles, critical properties and choking, area ratio as function of Mach number, Impulse function, non-dimensional mass flow rate in terms of	10

	pressure ratio, area ratio and Mach number, Working charts and gas tables, Application of Isentropic flow	
3	**Normal shock Waves:** Development of shock wave, Thickness of shock wave, governing equations, Strength of shock waves, Prandtl-Mayer relation, Rankine-Hugoniot relation, Mach number in the downstream of normal shock, variation of flow parameters across the normal shock, normal shock in Fanno and Rayleigh flows, impossibility of a rarefaction shock, supersonic diffusers, supersonic pitot tube.	9
4	**Flow in constant area duct with friction (Fanno flow):** Fanno curve and Fanno flow equations, solution of Fanno flow equations, variation of flow properties, variation of Mach no. with duct length, isothermal flow in constant area duct with friction, tables and charts for Fanno flow, Experimental friction coefficients.	9
5	**Flow in constant area duct with heat transfer (Rayleigh flow):** Simple heating relation of a perfect gas, Rayleigh curve and Rayleigh flow equations, variations of flow properties, maximum heat transfer, tables and charts for Rayleigh flow.	8
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Formulate and solve problems in one -dimensional steady compressible flow including: isentropic nozzle flow, constant area flow with friction (Fanno flow) and constant area flow with heat transfer (Rayliegh flow).
CO2	Derive the conditions for the change in pressure, density and temperature for flow through a normal shock.
CO3	Determine the strength of oblique shock waves on wedge shaped bodies and concave corners.
CO4	Determine the change in flow conditions through a Prandtl-Meyer expansion wave.
CO5	Complete a numerical analysis to solve an unsteady one-dimensional flow problem.

Resources	
Recommended Books	1. Gas Dynamics, E. Rathakrishnan, PHI Learning Pvt. Ltd 2. Fundamental of Compressible flow, S. M. Yahya, New age international Publication, Delhi 3. Fundamentals of compressible fluid dynamics- P. Balachandran, PHI Learning, New Delhi 4. The dynamics and thermodynamics of Compressible fluid low Volume-I, Ascher H. Shapiro, the Ronald Press Company, New York.
Reference Books	5. Gas Dynamics and Jet Propulsion- P. Murugaperumal, Scitech Publication, Chennai. 6. Modern Compressible Flow: With Historical Perspective, John D. Anderson, McGraw-Hill Higher Education.
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Third Year	Semester - V
Course: Renewable Energy Sources	Course Code: ME 505TE-C
Professional Elective I- C	
Theory : 3 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 3

Objectives :	
1	Understand the various forms of conventional and non conventional energy resources.
2	Learn the present energy scenario and the need for energy conservation.
3	Explain the concept of various forms of renewable energy
4	Outline division aspects and utilization of renewable energy sources for both domestics and industrial application
5	Analyse the environmental aspects of renewable energy resources

Unit Number	Details	Hours
1	**Principles of Solar Radiation:** Role and potential of new and renewable source, the solarenergy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrialand terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.	9
2	**Solar Energy Collection:** Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors. **Solar Energy Storage and Applications**: Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion	9
	Wind Energy: Sources and potentials, horizontal and vertical axis	

3	windmills, performance characteristics, Betz criteria **Bio-Mass**: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.	9
4	**Geothermal Energy:** Resources, types of wells, methods of harnessing the energy, potential in India. **Ocean Energy:** OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.	9
5	**Direct Energy Conversion:** Need for DEC, Carnot cycle, limitations, and principles of DEC. Thermo-electric generators, seebeck, peltier and joul Thomson effects, Figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD Engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cells, principles, faraday's law's, thermodynamic aspects, selection of fuels and operating conditions.	9
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	List and generally explain the main sources of energy and their primary applications in India, and the world.
CO2	Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment
CO3	Discuss remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources
CO4	Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation.

Resources	
Recommended Books	1. Reneweble energy resources/ Tiwari and Ghosal/Narosa. 2. Non conventional Energy Sources / G.D.Rai CBS.
Reference Books	1. Renewable Energy Sources / Twidell & Weir 2. Solar Energy/ Sukhatme
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Third Year	Semester - V
Course: Thermal Engineering Lab	Course Code: ME 506P
Practical : 3 Hrs/Week	Max. University Practical Examination: 25 Marks
	Lab Continuous Internal Assessment: 25 Marks
Max. Time for Exam.: 2 Hrs	Credit: 1

Sr. No.	Description
1	Valve Timing and Port Timing diagrams.
2	Actual p-v diagrams of IC engines.
3	Performance Test on 4 – stroke Diesel Engine.
4	Heat Balance Test on 4 – stroke Diesel Engine.
5	Morse Test on Multi-cylinder Petrol Engine.
6	Retardation Test on a Diesel Engine.
7	Determination of Flash Point and Fire Point of various fuels / lubricants.

Lab Work:
Lab Work assessment shall be conducted for the Project, Tutorials and Seminar. Lab Work is continuous assessment based on work done, submission of work in the form of report/journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the institute. At the end of the semester, the final grade for a Lab Work shall be assigned based on the performance of the student and is to be submitted to the University.

Notes	
1	Each student should perform at least 5 of the above experiments.
2	The regular attendance of students during the syllabus practical course will be monitored and marks will be given accordingly.
3	Good Laboratory Practices

Practical/Oral/Presentation:
Practical/Oral/Presentation shall be conducted and assessed jointly by internal and external examiners. The performance in the Practical/Oral/Presentation examination shall be assessed by at least a pair of examiners appointed as examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University, authenticate and seal it. Sealed envelope shall be submitted to the head of the department or authorized person.

Notes	
1	One experiment from the regular practical syllabus will be conducted. (Total 15 Marks).
2	Complete laboratory journal/records (05 Marks).
3	Viva-voce (05 Marks).

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Third Year	Semester - V
Course: Measurement and Metrology Lab	Course Code: ME 507P
Practical : 3 Hrs/Week	Max. University Practical Examination: 25 Marks
	Lab Continuous Internal Assessment: 25 Marks
Max. Time for Exam.: 2 Hrs	Credit: 1

Sr. No.	Practical Description
	Mechanical Measurements:
1	Calibration of Pressure Gauge
2	Calibration of Thermocouple
3	Calibration of LVDT
4	Calibration of Load cell
5	Determination of modulus of elasticity of a mild steel specimen using strain gauges.
	Metrology:
6	Measurements using Optical Projector / Toolmaker Microscope.
7	Measurement of angle using Sine Center / Sine bar / bevel protractor.
8	Measurement of alignment using Autocollimator / Roller set.
9	Measurement of cutting tool forces using a) Lathe tool Dynamometer OR b) Drill tool Dynamometer.
10	Measurements of Screw thread Parameters using two wire or Three-wire methods.
11	Measurements of Surface roughness, Using Tally Surf/Mechanical Comparator.
12	Measurement of gear tooth profile using gear tooth Vernier /Gear tooth micrometer.
13	Calibration of Micrometer using slip gauges.

14	Measurement using Optical Flats

Lab Work:
Lab Work assessment shall be conducted for the Project, Tutorials and Seminar. Lab Work is continuous assessment based on work done, submission of work in the form of report/journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the institute. At the end of the semester, the final grade for a Lab Work shall be assigned based on the performance of the student and is to be submitted to the University.

Notes

Each student should perform at least 8 of the above experiments.
The regular attendance of students during the syllabus practical course will be monitored and marks will be given accordingly .
Good Laboratory Practices

Practical/Oral/Presentation:
Practical/Oral/Presentation shall be conducted and assessed jointly by internal and external examiners. The performance in the Practical/Oral/Presentation examination shall be assessed by at least a pair of examiners appointed as examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University.

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: ThirdYear	Semester -V
Course: Computational Mechanical Engineering Lab	Course Code: ME 508P
Practical : 3 Hrs/Week	Max. University Practical Examination: 25 Marks
Max. Time for Exam.: 2 Hrs	Lab Continuous Internal Assessment: 25 Marks
	Credit: 1

Sr. No.	Practical Description
1	Introduction of softwares such as ANSYS and MATLAB
2	Solving simple mathematical problems and curve plotting using MATLAB
3	Learning basics of ANSYS
4	Simulation of fluid and thermal related simple problems.

Lab Work:
Lab Work assessment shall be conducted for the Project, Tutorials and Seminar. Lab work is continuous assessment based on work done, submission of work in the form of report/journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the institute. At the end of the semester, the final grade for a Lab Work shall be assigned based on the performance of the student and is to be submitted to the University.

Notes	
1	Each student should perform all the above experiments.
2	The regular attendance of students during the syllabus practical course will be monitored and marks will be given accordingly (05 Marks).
3	Good Laboratory Practices (05 Marks)

Practical/Oral/Presentation:
Practical/Oral/Presentation shall be conducted and assessed jointly by internal and external examiners. The performance in the Practical/Oral/Presentation examination shall be assessed by at least a pair of examiners appointed as examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University.

Notes	
1	One experiment from the regular practical syllabus will be conducted. (Total 15 Marks).
2	Complete laboratory journal/records (05 Marks)
3	Viva-voce (05 Marks).

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Third Year	Semester -VI
Course: Operations Research	Course Code: ME 601T
Theory: 3Hours/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 3

Objectives :	
1	Introduce students to the techniques of operations research in engineering operations
2	Provide students with basic skills and knowledge of operations research and its application in industrial problems.
3	Introduce students to practical application of operations research in big projects.

Unit Number	Details	Hours
1	**Introduction:** Evolution of OR, definition of OR, scope of OR, application areas of OR, steps (phases) in OR study, characteristics and limitations of OR, models used in OR, linear programming (LP) problem-formulation and solution by graphical method. **Solution Of Linear Programming Problems:** The simplex methodcanonical and standard form of an LP problem, slack, surplus and artificial variables, big M method and concept of duality, dual simplex method.	8
2	**Transportation Problem:** Formulation of transportation problem, types, initial basic feasible solution using different methods, optimal solution by MODI method, degeneracy in transportation problems, application of transportation problem concept for maximization cases. Assignment Problem-formulation, types, application to maximization cases and travelling salesman problem.	9
3	**Integer Programming:** Pure and mixed integer programming problems, solution of Integer programming problems-Gomory's all integer cutting	10

	plane method and mixed integer method, branch and bound method, Zero-One programming. **PERT-CPM Techniques:** Introduction, network construction - rules, Fulkerson's rule for numbering the events, AON and AOA diagrams; Critical path method to find the expected completion time of a project, floats; PERT for finding expected duration of an activity and project, determining the probability of completing a project, predicting the completion time of project; crashing of simple projects.	
4	**Queuing Theory :** Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), empirical queuing models – M/M/1 and M/M/C models and their steady state performance analysis.	10
5	**Game Theory:** Formulation of games, types, solution of games with saddle point, graphical method of solving mixed strategy games, dominance rule for solving mixed strategy games. **Sequencing:** Basic assumptions, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing 2 jobs on 'm' machines using graphical method.	8
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Explain the meaning of operations research
CO2	Know the various techniques of operations research
CO3	Apply the techniques used in operations research to solve real life problem in engineering
CO4	Select an optimum solution with profit maximization
CO5	

Resources	
Recommended Books	1. Kanawaty G., "Introduction to work study" International Labor Office, Geneva, 1992 2. Barnes, R.M. "Motion and Time Study" John Wiley and Sons, 1980 3. Mahajan M.," Statistical Quality Control" Dhanpat Rai & Co. 4. Gupta & Hira "Operations Research" S. Chand Publications 5. Chary S.N., "Production & Operations Management" Tata McGraw Hills
Reference Books	1. Barnes Ralph M., "Motion & Time study: Design and Measurement of Work", Wiley Recommended Books, 2001. 2. Marvin E, Mundel& David L, "Motion & Time Study: Improving Productivity", Pearson Education, 2000. 3. Patil S.B, Karad, Kushare, "Industrial Engineering and Management" Technical Publication Pune, 2008 4. Chapman S.N, "The Fundamentals Of Production Planning And Control" Pearson Education, 2006
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Third Year	Semester -VI
Course: Design of Machine Elements II	Course Code: ME 602T
Theory : 3 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 3

Objectives :	
1	To teach students how to apply the concepts of stress analysis, theories of failure and material science to analyze, design and/or select commonly used machine components.
2	To illustrate to students the variety of mechanical components available
3	To teach students how to apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical systems.

Unit Number	Details	Hours
1	**Design of Spur & Helical Gears Spur Gear:** Basic nomenclature of Spur gear, Stresses induced in gears, Lewis bending equations, Buckinghams equation for wear, Calculation of appropriate safety factors and power rating, Design of spur gears for simple power transmission. **Helical Gear:** Basic nomenclature of Helical gear, Transverse and normal module,Virtual no of teeth, Force analysis, Beam and wear strengths, Design of helical gears.	9
2	**Design of Bevel & Worm Gears Bevel Gears:** Basic nomenclature of Bevel gear, Formative number of teeth, Force analysis, Beam and wear strengths, Design of straight tooth bevel gears. **Worm Gears:** Basic nomenclature of Worm gear, Types of worm and worm gears, Standard dimensions, Force analysis of worm gear drives, Friction in Worm gears and its efficiency, Worm and worm-wheel material, Thermal considerations.	9
	Sliding Contact Bearings: Design of hydrodynamic bearings for various	

3	types of shaft loadings and end conditions, 2D Basic Reynolds Equation, Somerfield number, Raimondi and Boyd method, Temperature Rise & Parameters of bearing design. Introduction to hydro static bearings, Properties, additives & selection of lubricating oils, Types and selection of Mechanical seals.	9
4	**Rolling Contact Bearings:** Types of bearing and designation, Stribeck's Equation, Equivalent bearing load, Load-life relationship, Selection of bearing life, Choice of rolling contact bearings based on constant, variable load & speed conditions from charts, Lubrication and mounting of bearings, Preloading of rolling contact bearings, Types of failure in rolling contact bearings – causes and remedies.	9
5	**Design of Belts & Flywheel Belts**: Nomenclature, types of drives, derivation of belting equation, Design of flat belt and V belt for simple power transmission between shafts, concept of slip & creep Selection of flat and V belts from manufacturer's catalogue & Choices of pulleys appropriate for the drives. **Flywheel:** Introduction, Fluctuation of energy and speed, turning moment diagram, estimating inertia of flywheel for reciprocating prime movers and machines, stresses in rims and arms. **Wire Rope & Chain Drive:** (No Numerical Treatment) Construction of wire ropes, lay of wire ropes, stresses in wire rope, selection of wire ropes, Types of power transmission chains, Geometry of Chain, Polygon effect of chain, Modes of failure for chain, Lubrication of chains.	9
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Describe and identify the main gears
CO2	Analyze the stress-strain state of power transmission train gears loading.
CO3	Predict potential failure conditions
CO4	Specify maintenance program of every element

Resources	
Recommended Books	1. Bhandari V.B., "Design of Machine Elements", Tata McGraw Hill Publication Co. Ltd 2. C. S. Sharma and KamleshPurohit, "Design of Machine Elements", Prentice Hall India Publication. 3. Shigley J.E. and Mischke C.R., "Mechanical Engineering Design", McGraw Hill Publication Co. Ltd.
Reference Books	1. Robert L. Norton, "Machine Design: An Integrated Approach", Fifth Edition 2. Richard Budynas, Keith Nisbett, "Shigley"s Mechanical Engineering Design", Mc Graw Hill, Ninth Edition 3. D.K.Aggarwal&P.C.Sharma, "Machine Design", S.K Kataria and Sons 4. Black P.H. and O. Eugene Adams, "Machine Design", McGraw Hill Book Co. 5. Spotts M.F. and Shoup T.E., "Design of Machine Elements", Prentice Hall Int. 6. Design Data - P.S.G. College of Technology, Coimbatore. 7. Bhandari V. B., "Machine Design data book", Tata McGraw Hill Publication Co.Ltd.
E-Resources	http://nptel.ac.in/

Tutorials:
Tutorial assessment shall be conducted for the Project, Tutorials, Industrial Visit report and Seminar. Tutorial is continuous assessment based on work done, submission of work in the form of report/journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the school. At the end of the semester, the final grade for a Tutorial shall be assigned based on the performance of the student and is to be submitted to the University.

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Third Year	Semester - VI
Course: Heat Transfer	Course Code: ME 603T
Theory : 3 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 3

Objectives :	
1	To introduce a basic study of the phenomena of heat and mass transfer, to develop methodologies for solving a wide variety of practical engineering problems.
2	A knowledge-based design problem requiring the formulations of solid conduction and fluid convection and the technique of numerical computation progressively elucidated in different chapters will be assigned and studied in detail
3	To provide useful information concerning the performance and design of particular systems and processes.

Unit Number	Details	Hours
1	**Fundamentals of Heat Transfer:** General heat conduction equation in Cartesian, cylindrical and spherical coordinates, Poisson"s, Fourier and Laplace Equations, isotropic, anisotropic, homogeneous and non-homogeneous materials; Boundary conditions, Steady state heat conduction: one-dimensional heat conduction without heat generation in slab; composite slab; cylinder and sphere, effect of temperature on conductivity, critical thickness of insulation. One-dimensional, steady state heat conduction with internal heat generation in slabs; composite slabs; cylinders and spheres. Applications of heat conduction with and without heat generation	9
2	**Conduction:** Heat transfer from extended surfaces with all boundary conditions and fin performance. Cooling of Electronics Components. Unsteady state/ transient heat conduction: lumped capacitance method, Heisler chart. Applications : Introduction to Multi-dimensional Heat	9

	conduction: Different solution methods and numerical methods	
3	**Convection :**Basic concepts, natural, forced and mixed convection, hydrodynamic and thermal boundary layers, mass, momentum and energy equations in forced convection, momentum and energy integral equations, dimensionless numbers, solution of laminar flow over a flat plate, governing equations, empirical correlations for forced and natural convection.	9
4	**Boiling and Condensation Heat Transfer:** Pool boiling, pool boiling curve, nucleate and film boiling, introduction to flow boiling, drop-wise and film-wise condensation, Nusselt theory of film wise condensation. **Heat Exchanger:** Classification of heat exchanger, recuperative and regenerative heat exchangers, parallel, counter and cross flow heat exchangers, Shell and tube heat exchangers, compact heat exchanger, heat exchanger analysis – LMTD for parallel and counterflow heat exchanger, LMTD correction factor, design criteria for heat exchanger, effectiveness–NTU method for parallel and counter flow heat exchanger, cross flow heat exchanger, performance of heat exchangers, effectiveness, Number of transfer unit and heat capacity ratio. Introduction of TEMA Standards.	9
5	**Thermal Radiation:** Basic concept of surface and gas radiation, radiation properties, Kirchhoff‟s Law of Radiation, Weins Law, Planck Law, Lambart Law, radiation heat exchange between two finite black surfaces, shape factor, radiation heat exchange between two non-black and gray surfaces, radiation shield.Applications of radiation heat exchange.	9
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Understand the basic laws of heat transfer
CO2	Account for the consequence of heat transfer in thermal analyses of engineering systems
CO3	Analyze problems involving steady state heat conduction in simple geometries
CO4	Develop solutions for transient heat conduction in simple geometries.
CO5	Understand the fundamentals of convective heat transfer process
CO5	Calculate radiation heat transfer between black body and gray body surfaces

Resources	
Recommended Books	1. S.P. Sukhatme, A Textbook on Heat Transfer, Universities Press. 2. R.C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age Science. 3. P.K. Nag, Heat & Mass Transfer, McGraw Hill Education Private Limited. 4. M. M. Rathod, Engineering Heat and Mass Transfer, Third Edition, Laxmi Publications, New Delhi 5. V. M. Domkundwar, Heat Transfer, Dhanpat Rai Publications. 6. Dr. D. S. Kumar, Heat Transfer, Kataria Publication.
Reference Books	1. F.P. Incropera, D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley. 2. Y. A. Cengel and A.J. Ghajar, Heat and Mass Transfer – Fundamentals and Applications, Tata McGraw Hill Education Private Limited. 3. S. P. Venkatesan, Heat Transfer, Ane Books Pvt. Ltd 4. Holman, Fundamentals of Heat and Mass Transfer, McGraw – Hill publication.
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Third Year	Semester -VI
Course: Manufacturing Process II	Course Code: ME 604T
Theory : 3 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 3

Objectives :	
1	Impart knowledge to students in the latest technological topics on Production Engineering
2	To study the basics of metal machining and mechanics of metal machining
3	To study the different cutting tool materials and types & geometry of cutting tools
4	To learn introductory concepts of various advanced machining processes
5	To determine the shear plane angle and shear strain during the cutting of single point cutting tool of mild steel sheet and to study the different cutting tool materials and types & geometry of cutting tools

Unit Number	Details	Hours
1	**Lathe:** Classification, constructional features of turret and capstan lathe **Drilling machine**: Types of drills and operations. Twist drill geometry, Types of drilling machine, Tool holder. **Milling machine:** Types of milling machines, Cutter types and geometry and their applications. Universal dividing head, Methods of Indexing: Simple, Compound, Differential. Numericals based on indexing. Calculation of machining time for Drilling and Milling processes	9
2	**Theory of Metal Cutting:** Single point cutting tool nomenclature, geometry, Merchants circle diagram and analysis, shear angle relationship, problems of Merchant‟s analysis, tool wear and tool failure, tool life, effects of cutting parameters on tool life, tool failure criteria, Taylor‟s tool life equation, problems on tool life evaluation, machinability factors affecting machinability	10

3	**Jigs and fixtures:** Principles of location and clamping, synthesis of simple jigs and fixtures. Principles of assembly engineering, Concept of degree of freedom, 3-2-1 principle of location, General guidelines to design Jigs and fixtures, advantages of jig and fixtures. Elements of jig with the types, Location guidelines, Principles of guiding element, Channel jig, Template jig, Plate jig, Angle plate jig, Turn over jig, Box jig, Latch type jig. Elements of fixtures, Principles of setting element, Turning fixture, Welding fixture, Milling fixture, Assembly and Inspection fixtures. Indexing methods, Power work holding devices with their advantages, Pokayoke concept in jigs and fixtures.	9
4	**CNC Technology:** Introduction, Construction and working of CNC, DNC and machining center. CNC axes and drives. Automatic Tool Changer (ATC) and Automatic pallet changer (APC) CNC Programming: Word address format (WAF) ISO Standard, G & Mcodes, Type of CNC Control systems, Manual part programming, Subroutine,Canned cycles FMS.	8
5	**Non-conventional Machining Processes:** Introduction, Types of Non-Conventional Methods of Machining, applications, working Principles, Process Parameters for: Chemical Machining, Electro Chemical Machining (ECM), Electric Discharge Machining (EDM), Plasma Arc Machining (PAM), Laser Beam Machining (LBM), Abrasive Jet Machining (AJM) and UltraSonic Machining (USM).	9
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Understand the basics of metal machining and the introductory concepts of various advanced machining processes
CO2	Determine the shear plane angle and shear strain during the cutting of single point cutting tool of mild steel sheet The students have also studied the introductory concepts of various advanced machining processes
CO3	Know the forces in different tools while material removal or plastic deformation on the job

Resources	
Recommended Books	1. Hazara Choudhry, Vol-II, Workshop Technology Media Promoters & Publishers Pvt. Ltd. 2. R. K. Jain, Production Technology Khanna Publications. 3. Tata MacGraw Hill, Production technology HMT 2001. 4. Mikell. P. Grover, Fundamentals of Modern Manufacturing, Pearson Publications 5. P. C. Sharma, Production Engineering, S. Chand Publication
Reference Books	1. G. Boothroyd and W. A. Knight, Fundamentals of Machining and Machine Tools, Marcel Dekker, 1989 2. Ibrahim Zeid, Mastering CAD-CAM , McGraw Hill 3. V. K Jain, Advanced machining processes , Allied Publisher, New Delhi 4. M. H. A Kempster, An Introduction to Jig and Tool Design, ELBS 5. P. H. Joshi, Jigs and fixtures , Tata McGraw Hill 6. P. N. Rao, CAD/CAM Principles and Applications, McGraw Hill Education,Third Edition. 7. P. K. Mishra, Non- Conventional Machining, Narosa Publishing House
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Third Year	Semester -VI
Course: CIM and Automation Professional Elective II-A	Course Code: ME 605TE-A
Theory : 3 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 3

Objectives :	
1	To provide knowledge on principle, constructional features of CNC tools.
2	To intoduce programming, tooling and work holding devices in CNC machine tools.

Unit Number	Details	Hours
1	**Automation and Control technologies:** Levels Of Automation, Continuous Versus Discrete Control - Continuous Control Systems -Discrete Control Systems Computer Process Control - Control Requirements - Capabilities of Computer Control. **Computer Process Control:** Forms of Computer Process Control - Computer Process Monitoring - Direct Digital Control - Numerical Control and Robotics - Programmable Logic Controllers - Supervisory Control - Distributed Control Systems and Personal Computers in process control, Enterprise - Wide Integration of Factory Data.	9
2	**Features of NC Machine tools:** Fundamentals of numerical control, advantages and limitations of N.C systems-classification of N.C systems, Design consideration of N.C machine tools, Methods of improving machine accuracy, increasing productivity with N.C machines, Machining centers, MCU Functions. **Control loops of N C Systems and CNC hardware basics:** Introduction, control of point-to point systems, Control Loops in Contouring systems. CNC Hard ware Basics: Structure of CNC machine tools, Drives, Actuation systems, Feedback devices, Axes-standards.	10
3	**CNC Machine tools and control systems:** CNC Machining centres, CNC	

	Turning centres, High-speed machine tools, Machine control unit, Support systems, Touch trigger probes. **Tool Changing Systems:** Turning-tool geometry, Milling Tooling Systems, Tool Presetting, Methods of optimizing output from NC machine tools, Automatic Tool Changers, Work holding.	9
4	**CNC programming:** Part Programming Fundamentals – Manual Part Programming methods using ISO codes, Preparatory functions, Miscellaneous functions, Tool length compensation, canned cycles, Cutter radius compensation, canned cycles, Part Programs on milling, Drilling and Tapping operations. **Turning centre Programming:** Comparisons between machining centre and turning centres, Tape format, Axes system, General programming functions, motion commands, cut planning, Thread cutting, canned cycles, Part programs on turning.	9
5	**Computerized Numerical Control:** CNC concepts, advantages of CNC, Digital computer, Reference-pulse Technique, sampled-Data technique, Microcomputers in CNC. Adaptive **Control Systems:** Introduction, Adaptive control with optimization, Adaptive control with constraints, variable- gains AC systems, Adaptive control of Grinding.	8
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Discuss the Levels Of Automation. & Explain the Computer Process Control
CO2	Describe the features of NC Machine tools & Apply the knowledge in selection of control loops, drives, feedback devices and actuation systems
CO3	Discuss CNC Machining centres, CNC Turning centres and Tool Changing Systems
CO4	Develop part programs for given component on turning and milling machine
CO5	Explain CNC concept, Reference-pulse Technique, sampled-Data technique, Microcomputers in CNC & Adaptive Control Systems

Resources	
Recommended Books	1. Y. Koren, "Computer Controls of Manufacturing Systems," McGraw Hill, 1983. 2. 2. P.N. Rao, "CAD/CAM Principles and Applications,"3 rd Edition, McGraw Hill, Education Pvt. Ltd., New Delhi,26 May 2010, 3. 3. M.P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing," Prentice Hall India Pvt. Ltd.,3rd Edition, 24 July 2007,
Reference Books	1. Martin J, "Numerical Control of Machine Tools," Butterworth-Heinemann, 20th May 1991, 2. Y. Koren& J. Ben-Uri, "Numerical Control of Machine Tools," Khanna Publishers, Delhi, 1978. 3. Wilson, "Numerical Control in Manufacturing," McGraw Hill New York, 1963. 4. Sherawat & Narang, "CNC Machines," Dhanpat Rai and Co (P)
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Third Year	Semester -VI
Course: Composite Materials Professional Elective II-B	Course Code: ME 605TE-B
Theory : 3 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 3

Objectives :	
1	Introduce students to the concepts of modern composite materials.
2	Equip the students with knowledge on how to fabricate and carry out standard mechanical test on composites.

Unit Number	Details	Hours
1	**Introduction To Composite Materials:** Definition, classification and characteristics of composite Materials – fibrous composites, laminated composites, particulate composites. Applications: Automobile, Aircrafts. missiles. Space hardware, Electrical and electronics, Marine, recreational and sports equipment, future potential of composites.	9
2	**Fiber Reinforced Plastic Processing:** Lay up and curing, fabricating process, open and closed mould process, hand lay up techniques; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermo-forming, injection molding, blow molding.	8
3	**Micro Mechanical Analysis of a Lamina:** Introduction, Evaluation of the four elastic moduli by Rule of mixture, Numerical problems. Macro Mechanics of a Lamina: Hooke's law for different types of materials, Number of elastic constants, Two - dimensional relationship of compliance and stiffness matrix.	9
	Macro Mechanics of a Lamina: Hooke's law for two-dimensional angle	

4	lamina, engineering constants - Numerical problems. Stress-Strain relations for lamina of arbitrary orientation, Numerical problems. **Macro Analysis of Laminate:** Introduction, code, Kirchoff hypothesis, CL T, A, B, and D matrices (Detailed derivation) , Special cases of laminates, Numerical problems. **Failure Analysis of Laminates:** Introduction, Special Cases of Laminates, Applications, Failure Criterion for a Laminate.	10
5	**Metal Matrix Composites:** Reinforcement materials, types, characteristics and selection base metals selection. Need for production MMC's and its application. Fabrication Process For MMC's: Powder metallurgy technique, liquid metallurgy technique and secondary processing, special fabrication techniques. Physical Mechanical, Wear, machinability and Other Properties. Effect of size, shape and distribution of particulate on properties.	9
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Identify and explain the types of composite materials and their characteristic features.
CO2	Understand the differences in the strengthening mechanism of composite and its corresponding effect on performance and application.
CO3	Understand and explain the methods employed in composite fabrication.
CO4	learn simple micromechanics and failure modes of composites

Resources	
Recommended Books	1. Mechanics of Composite Materials/ R. M. Jones/ Mc Graw Hill Company, New York, 1975. 2. Engineering Mechanics of Composite Materials/Isaac and M Daniel/ Oxford University Press, 1994.
Reference Books	1. Analysis and performance of fibre Composites? B. D. Agarwal and L. J. Broutman? Wiley- Inter science, New York, 1980. 2. Mechanics of Composite Materials/ Second Edition (Mechanical Engineering)? Autar K. Kaw/Publisher: CRC
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Third Year	Semester -VI
Course: Tool Design Professional Elective II-C	Course Code: ME 605TE-C
Theory : 3 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 3

Objectives :	
1	To intoduce to students the fundamentals of tool design and important parameters regarding it.
2	To teach them about the design of jigs and fixtures and the cutting force calculations in various traditional machining operations.
3	To make them aware of the basics of the design of various cutting and forming tools.
4	To intoduce to students the tools and their design for CNC machines.

Unit Number	Details	Hours
1	**Introduction to Tool Design:** Introduction –Tool Engineering – Tool Classifications– Tool Design Objectives – Tool Design in manufacturing- Challenges and requirements- Standards in tool design-Tool drawings -Surface finish – Fits and Tolerances - Tooling Materials- Ferrous and Non ferrous Tooling Materials- Carbides, Ceramics and Diamond -Non metallic tool materialsDesigning with relation to heat treatment	9
2	**Design of Cutting Tools:** Mechanics of Metal cutting –Oblique and orthogonal cutting- Chip formation and shear angle - Single-point cutting tools – Milling cutters – Hole making cutting tools- Broaching Tools - Design of Form relieved and profile relieved cutters-Design of gear and thread milling cutters	8
3	**Design of Jigs and Fixtures:** Introduction – Fixed Gages – Gage Tolerances –selection of material for Gages – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – Chip formation in drilling – General	9

	considerations in the design of drill jigs – Drill bushings – Methods of construction –Thrust and Turning Moments in drilling - Drill jigs and modern manufacturing- Types of Fixtures – Vise Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures – Lathe Fixtures – Grinding Fixtures – Modular Fixtures – Cutting Force Calculations.	
4	**Design of Forming Tools:** Types of Sheet Metal Dies –Method of Die operation–Clearance and cutting force calculations- Blanking and Piercing die design – Pilots – Strippers and pressure padsPresswork materials – Strip layout – Short-run tooling for Piercing – Bending dies – Forming dies – Drawing dies-Design and drafting. Design of Bulk forming dies and moulds for metals and plastics.	10
5	**Tool Design for CNC Machine Tools:** Introduction –Tooling requirements for Numerical control systems – Fixture design for CNC machine tools- Sub plate and tombstone fixtures-Universal fixtures– Cutting tools– Tool holding methods– Automatic tool changers and tool positioners – Tool presetting– General explanation of the Brown and Sharp machine.	9
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Tell the fundamental concepts involved in the design of various tools.
CO2	Calculate the cutting forces and power required in various machining operations.
CO3	Calculate the forces and power required in forming operations and effective measures to minimise the operation costs involved.
CO4	Understand the tooling requirements for a CNC machine.

Resources	
Recommended Books	1. Cyrll Donaldson, George H.LeCain, V.C. Goold, "Tool Design", Tata McGraw Hill Publishing Company Ltd., 2000 2. E.G.Hoffman," Jig and Fixture Design", Thomson Asia Pvt Ltd, Singapore, 2004
Reference Books	1. Venkataraman K., "Design of Jigs, Fixtures and Presstools", TMH, 2005 2. Haslehurst M., "Manufacturing Technology", The ELBS, 1978
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: ThirdYear	Semester -VI
Course: Theory of Machines Lab	Course Code: ME 606P
Practical : 3 Hrs/Week	Max. University Practical Examination: 25Marks
	Lab Continuous Internal Assessment: 25 Marks
Max. Time for Exam.: 2 Hrs	Credit: 1

Sr. No.	Description
1	To draw conjugate profile for any general type of gear tooth
2	To generate involute gear tooth profile and to study the effect of undercutting and rack shift using model.
3	To study various types of gearboxes- constant mesh, sliding mesh, synchromesh gear box, Industrial gearbox, differential gearbox.
4	To measure holding torque of the epicyclic gear train.
5	To verify the gyroscopic principles.
6	To verify the cam jump phenomenon for an eccentric cam
7	Motion analysis and plotting of displacement-time, velocity-time, acceleration-time, jerktime and Layout of cam profiles- 3 to 5 Problems
8	To synthesize the four bar and slider crank mechanisms using relative pole and inversion methods with three precision positions
9	Assignment on synthesis of mechanism using analytical method.

Lab Work:
Lab Work assessment shall be conducted for the Project, Tutorials and Seminar. Lab Work is continuous assessment based on work done, submission of work in the form of report/journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the institute. At the end of the semester, the final grade for a Lab Work shall be assigned based on the performance of the student and is to be submitted to the University.

Notes	
1	Each student should perform at least 6 of the above experiments.
2	The regular attendance of students during the syllabus practical course will be monitored and marks will be given accordingly .
3	Good Laboratory Practices

Practical/Oral/Presentation:
Practical/Oral/Presentation shall be conducted and assessed jointly by internal and external examiners. The performance in the Practical/Oral/Presentation examination shall be assessed by at least a pair of examiners appointed as examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University, authenticate and seal it. Sealed envelope shall be submitted to the head of the department or authorized person.

Notes	
1	One experiment from the regular practical syllabus will be conducted. (Total 15 Marks).
2	Complete laboratory journal/records (05 Marks).
3	Viva-voce (05 Marks).

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: ThirdYear	Semester -VI
Course: Heat Transfer Lab	Course Code: ME 607P
Practical : 3 Hrs/Week	Max. University Practical Examination: 25 Marks
	Lab Continuous Internal Assessment: 25 Marks
Max. Time for Exam.: 2 Hrs	Credit: 1

Sr. No.	Practical Description
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 Thermal Contact Resistance
5	Determination of heat transfer coefficient in Natural Convection
6	Determination of heat transfer coefficient in Forced Convection
7	Determination of temperature distribution, fin efficiency in Natural /Forced Convection
8	Determination of Emissivity of a Test surface
9	Determination of Stefan Boltzman"s Constant
10	Study of pool boiling phenomenon and determination of critical heat flux

Lab Work:
Lab Work assessment shall be conducted for the Project, Tutorials and Seminar. Lab Work is continuous assessment based on work done, submission of work in the form of report/journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the institute. At the end of the semester, the final grade for a Lab Work shall be assigned based on the performance of the student and is to be submitted to the University.

Notes

Each student should perform at least 10 of the above experiments. The regular attendance of students during the syllabus practical course will be monitored and marks will be given accordingly . Good Laboratory Practices

Practical/Oral/Presentation:
Practical/Oral/Presentation shall be conducted and assessed jointly by internal and external examiners. The performance in the Practical/Oral/Presentation examination shall be assessed by at least a pair of examiners appointed as examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University.

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Third Year	Semester - VI
Course: Technical Seminar	Course Code: ME 608P
Practical : 3 Hrs/Week	PPT presentation: 25 Marks
Max. Time for Exam.: 2 Hrs	Report Submission: 25 Marks
	Credit: 1

Sr. No.	Description
1	Student has to prepare and present one ppt on any technical topic related to the latest technological development around the world. OR A creative solution to the problems of the Indian society preferably relevant to the locality of the student through technology.
2	Prepare and submit a report on the above study

Lab Work:
Lab Work assessment shall be conducted for the Project, Tutorials and Seminar. Lab work is continuous assessment based on work done, submission of work in the form of report/journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the institute. At the end of the semester, the final grade for a Lab Work shall be assigned based on the performance of the student and is to be submitted to the University.

Notes	
1	Each student should choose a separate topic.
2	The topic must be out of the things taught in the regular course structure.
3	Student should look into the problems around his locality and try to give a feasible solution to it. Paper publications and patent of technology by the students are expected.

Practical/Oral/Presentation:
Practical/Oral/Presentation shall be conducted and assessed jointly by internal and external examiners. The performance in the Practical/Oral/Presentation examination shall be assessed by at least a pair of examiners appointed as examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University.

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Fourth Year	Semester -VII
Course: Operation Management	Course Code: ME 701T
Theory: 4 Hours/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 4

Objectives :	
1	Introduce students to the concepts underlying effective operation and control of manufacturing and service businesses.
2	Study approaches to production control, inventory policy, facilities planning, methods improvement and technological assessment.

Unit Number	Details	Hours
1	**Productions and Operations Management :** Introduction, Functions withinbusiness organizations, the operation management function, Classification ofproduction systems, Productivity, factors affecting productivity,contemporary issues and development **Decision-Making:** The decision process, characteristics of operationsdecisions, use of models, decision making environments, graphical linearprogramming, analysis and trade-offs.	10
2	**Forecasting:** Steps in forecasting process, approaches to forecasting, forecasts based on judgment and opinion, analysis of time series data, accuracy and control of forecasts, choosing a forecasting technique, elements of a good forecast **Capacity and Location Planning:** Importance of capacity decisions, defining and measuring capacity, determinants of effective capacity, determining capacity requirement, developing capacity alternatives, evaluating alternatives, Need for location decisions, nature of locations decisions, general procedure for making locations decisions, evaluating	9

	locations decisions, facilities layout – need for layout decisions, types of processing.	
3	**Aggregate Planning and Master Scheduling :** Aggregate planning – Nature and scope of aggregate planning, strategies of aggregate planning, techniques for aggregate planning – graphical and charting techniques, mathematical techniques. The master production schedule, Master scheduling process, Master scheduling methods.	9
4	**Inventory Management :** Types of Inventories, independent and dependent demand, reasons for holding inventory, objectives of inventory control, requirements for effective inventory management – information, cost, priority system. Inventory control and economic-order-quantity models.	10
5	**Material Requirement Planning (MRP) :** Dependent versus independent demand, an overview of MRP – MRP inputs and outputs, MRP processing, An overview of MRP-II and ERP capacity requirement planning, benefits and limitations of MRP. **Purchasing and Supply Chain Management (SCM) :** Introduction, Importance of purchasing and SCM, The procurement process, Concept of tenders, Approaches to SCM, Vendor development, Measures of purchasing and SCM, Make or buy decision, Types of buying, E-procurement.	7
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Evaluate the operations function in manufacturing and service production settings
CO2	Apply forecasting methods as the basis of management's planning and control activity
CO3	Evaluate approaches to problem solving and process improvement in production settings

Resources	
Recommended Books	1. Production and Operations Management by Pannerselvam R
Reference Books	1. Modern Production/Operations Management by Buffa
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Fourth Year	Semester -VII
Course: Automotive Engineering	Course Code: ME 702T
Theory : 3 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5Hrs	Credit: 3

Objectives : The student will be able to learn:	
1	The anatomy of the automobile in general
2	The location and importance of each part
3	The functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels
4	Suspension, frame, springs and other connections
5	Emissions, ignition, controls, electrical systems and ventilation

Unit Number	Details	Hours
1	**Engine Components And Cooling & Lubrication Systems** : Spark Ignition (SI) & Compression Ignition (CI) engines, cylinder – arrangements and their relatives merits, Liners, Piston, connecting rod, crankshaft, valves, valve actuating mechanisms, valve and port timing diagrams, Types of combustion chambers for S.I.Engine and C.I.Engines, Compression ratio, methods of a Swirl generation, choice of materials for different engine components, engine positioning, cooling requirements, methods of cooling, thermostat valves, different lubrication arrangements. **Fuels, Fuel Supply Systems For SI and CI Engines** : Conventional fuels, alternative fuels, normal and abnormal combustion, cetane and octane numbers, Fuel mixture requirements for SI engines, types of carburetors, C.D.& C.C. carburetors, multi point and single point fuel injection systems, fuel transfer pumps, Fuel filters, fuel injection pumps and injectors.	10
	Superchargers And Turbochargers : Naturally aspirated engines, Forced	

2	Induction, Types pf superchargers, Turbocharger construction and operation, Intercooler, Turbocharger lag. **Ignition Systems** : Battery Ignition systems, magneto Ignition system, Transistor assist contacts. Electronic Ignition, Automatic Ignition advance systems.	10
3	**Power Trains :** General arrangement of clutch, Principle of friction clutches, Torque transmitted, Constructional details, Fluid flywheel, Single plate, multi-plate and centrifugal clutches. Gear box: Necessity for gear ratios in transmission, synchromesh gear boxes, 3, 4 and 5 speed gear boxes. Free wheeling mechanism, planetary gears systems, over drives, fluid coupling and torque converters, Epicyclic gear box, principle of automatic transmission, calculation of gear ratios, Numerical calculations for torque transmission by clutches.	8
4	**Drive To Wheels** : Propeller shaft and universal joints, Hotchkiss and torque tube drives, differential, rear axle, different arrangements of fixing the wheels to rear axle, steering geometry, camber, king pin inclination, included angle, castor, toe in & toe out, condition for exact steering, steering gears, power steering, general arrangements of links and stub axle, over steer, under steer and neutral steer, numerical problems, types of chassis frames. **Suspension, Springs And Brakes** : Requirements, Torsion bar suspension systems, leaf spring, coil spring, independent suspension for front wheel and rear wheel. Air suspension system. Types of brakes, mechanical compressed air, vacuum and hydraulic braking systems, construction and working of master and wheel cylinder, brake shoe arrangements, Disk brakes, drum brakes, Antilock –Braking systems, purpose and operation of antilock-braking system, ABS Hydraulic Unit, Rear-wheel antilock & Numerical Problems	10
5	**Automotive Emission Control Systems** : Automotive emission controls, Controlling crankcase emissions, Controlling evaporative emissions, Cleaning the exhaust gas, Controlling the air-fuel mixture, Controlling the combustion process, Exhaust gas recirculation, Treating the exhaust gas, Air-injection system, Air-aspirator system, Catalytic converter, Emission standards- Euro I, II, III and IV norms, Bharat Stage II, III norms.	7
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Identify the different parts of the automobile
CO2	Explain the working of various parts like engine, transmission, clutch, brakes
CO3	Describe how the steering and the suspension systems operate
CO4	Understand the environmental implications of automobile emissions
CO5	Develop a strong base for understanding future developments in the automobile industry

Resources	
Recommended Books	1. Kirpal Singh, Automobile Engineering, Standard Publishers Distributors 2. Kamaraju Ramakrishna, Automobile Engineering, Prentice-Hall India.
Reference Books	1. Jain &Asthana, "Automobile Engineering", Tata McGraw-Hill, New Delhi, 2002. 2. Crouse &Anglin, "Automotive Mechanics", Tata McGrawHill, New Delhi, 10th Edition 2007.
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: FourthYear	Semester - VII
Course: Turbomachinery	Course Code: ME 703T
Theory : 4 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 4

Objectives :	
1	To give an overview of different types of turbomachinery used for energy transformation, such as pumps, fans, compressors, as well as hydraulic, steam and gas-turbines.
2	To focus on applications in power generation, transport and the built environment
3	To classify various types of turbomachines based on different criteria.

Unit Number	Details	Hours
1	**Introduction:** Definition of turbomachine, parts of turbomachines,Comparison with positive displacement machines, Classification, Dimensionless parameters and their significance, Effect of Reynold's number, Unit and specific quantities, model studies. Application of first and second law's of thermodynamics to turbomachines, Efficiencies of turbomachines. Problems. **Thermodynamics of fluid flow :** Static and Stagnation states-Incompressible fluids and perfect gases, Overall isentropic efficiency, stage efficiency (their comparison) and polytropic efficiency for both compression and expansion processes. Reheat factor for expansion process.	10
2	**Energy exchange in Turbomachines** : Euler's turbine equation, Alternate form of Euler's turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor, Problems. **General Analysis of Turbomachines** : Radial flow compressors and pumps – general analysis, Expression for degree of reaction, velocity triangles, Effect of blade discharge angle on energy transfer and degree of reaction,	10

	Effect of blade discharge angle on performance, Theoretical head – capacity relationship, General analysis of axial flow pumps and compressors, degree of reaction, velocity triangles, Problems.	
3	**Steam Turbines** :Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, Multi-stage impulse turbine, expression for maximum utilization factor, Reaction turbine – Parsons's turbine, condition for maximum utilization factor, reaction staging. Problems.	7
4	**Hydraulic Turbines** : Classification, Different efficiencies, Pelton turbine – velocity triangles, design parameters, Maximum efficiency. Francis turbine - velocity triangles, design parameters, runner shapes for different blade speeds. Draft tubes- Types and functions. Kaplan and Propeller turbines - velocity triangles, design parameters. Problems.	8
5	**Centrifugal Pumps** : Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump, Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming, Pumps in series and parallel. Problems. **Centrifugal Compressors Axial flow Compressors** : Centrifugal Compressors: Stage velocity triangles, slip factor, power input factor, Stage work, Pressure developed, stage efficiency and surging and problems. Axial flow Compressors: Expression for pressure ratio developed in a stage, work done factor, efficiencies and stalling. Problems.	10
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Explain the working principles of turbomachines and apply it to various types of machines
CO2	Determine the velocity triangles in turbomachinery stages operating at design and offdesign conditions
CO3	Explain the working principle of various types of hydro turbines and know their application range
CO4	Recognize and discuss today's and tomorrow's use of turbomachines for enabling a sustainable society

Resources	
Recommended Books	1. B.K. Venkanna, Fundamentals of Turbomachinery, Prentice-Hall India. 2. B.U.Pai, Turbomachines, Wiley Publication 3. Onkar Singh, Thermal Turbomachines, Wiley Publication
Reference Books	1. Fluid Mechanics and Thermodynamics of Turbomachinery by S.L. Dixon and C.A. Hall
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Fourth Year	Semester -VII
Course: Hydraulics and Pneumatics	Course Code: ME 704T
Theory : 3 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 3

Objectives :	
1	Application of fluid mechanics and governing laws in hydraulic and pneumatic systems.
2	Study of working principle of various components used in hydraulic and pneumatic systems.
3	Selection of different components used in hydraulic and pneumatic systems.
4	Design of hydraulic and pneumatic circuits.
5	Industrial applications of hydraulic and pneumatic circuits.

Unit Number	Details	Hours
1	**Introduction to Hydraulics and Pneumatics:** Introduction to oil hydraulics and pneumatics, their structure, advantages and limitations. Properties of fluids, Fluids for hydraulic systems, governing laws. Distribution of fluid power, ISO symbols, energy losses in hydraulic systems.	8
2	**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/ design procedure, applications of accumulators. Types of Intensifiers, Pressure switches /sensors, Temperature switches/sensors, Level sensors.	10

3	**Hydraulic Actuators:** (i) Linear and Rotary. (ii) Hydraulic motors - Types- Vane, Gear, Piston types, radial piston. (iii) Methods of control of acceleration, deceleration. (iv) Types of cylinders and mountings. (v) Calculation of piston velocity, thrust under static and dynamic applications, considering friction, inertia loads. (vi) Design considerations for cylinders. Cushioning of cylinders. (Numerical treatment).	9
4	**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.	8
5	**Pneumatics :** Principle of Pneumatics: (i) Laws of compression, types of compressors, selection of compressors. (ii) Comparison of Pneumatics with Hydraulic power transmissions. (iii) Types of filters, regulators, lubricators, mufflers, dryers. (iv) Pressure regulating valves, (v) Direction control valves, two way, three way, four way valves. Solenoid operated valves, push button, lever control valves. (vi) Speed regulating - Methods used in Pneumatics. (vii) Pneumatic actuators-rotary, reciprocating.(viii) Air motors- radial piston, vane, axial piston (ix) Basic pneumatic circuit, selection of components, (x) Application of pneumatics in low cost automation and in industrial automation. Introduction to vacuum and vacuum measurement, Vacuum pumps, types, introduction to vacuum sensors and valves. Industrial application of vacuum. **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 manufacturers catalogues)	10
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Working principle of various components used for hydraulic & pneumatic systems
CO2	Identify various components of hydraulic & pneumatic systems
CO3	Ability to select appropriate components required for hydraulic and pneumatic systems.
CO4	Ability to design hydraulic and pneumatic system for industrial applications
CO5	Ability to understand industrial applications of hydraulic and pneumatic system.

Resources	
Recommended Books	1. Esposito, Fluid Power with application, Prentice Hall 2. Majumdar S.R, Oil Hydraulic system- Principle and maintenance ,Tata McGraw Hill 3. Majumdar S.R ,Pneumatics Systems Principles and Maintenance ,Tata McGraw Hill 4. H.L.Stewart, Hydraulics and Pneumatics , Taraporewala Publication
Reference Books	1. J. J. Pipenger, Industrial Hydraulics, McGraw Hill 2. Pinches, Industrial Fluid Power, Prentice Hall 3. D. A. Pease, Basic Fluid Power, Prentice Hall
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Fourth Year	Semester -VII
Course: Robotics Professional Elective III- A	Course Code: ME 705TE-A
Theory : 4 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 4

Objectives :	
1	Introduce to students the basic concepts of robotics.
2	To make students learn about the kinematics involved in the functioning of a robot
3	To introduce to students the control of movements of robotic joints and their control systems.
4	To make students able to write simple programs to command a robot.
5	

Unit Number	Details	Hours
1	**Introduction:** Automation and Robotics, Robot Anatomy – Links, Joints and Joint Notation scheme, Degrees of Freedom (DOF), Required DOF in a Manipulator, Precision of Movement, The kinematic Modeling of Manipulator, Direct kinematics model mechanical structure & Notations Description of links & Joints, The Inverse kinematics manipulator: workspace, solvability of inverse kinematic model. Solution technique, closed form solutions. Types of end-effector, methods of holding, Mechanical grippers, Mechanisms for grippers	9
2	**Kinematics of Robotics:** Differential kinematics, linear and angular velocity of a Rigid Body, Relationship between Transformation matrix and angular velocity, mapping velocity vectors, velocity propagation along links. Manipulator Jacobian, Jacobian Inverse, Jacobian singularities, Static Analysis. Jacobian, Examples.	9
	Mechanics of Robotics: Lagrangian Mechanics, Lagrange – Euler	

3	formulation - Velocity of a point on the manipulator, The inertia tensor, The kinetic energy, the potential energy. Equations of Motions, the Lagrangian-Euler (LE) Dynamic model algorithm. Examples on Dynamic modeling.	9
4	**Control of Movements:** Control of movements of mechanical joints, control sequence, n-joints manipulator control system, system performance, control system with damping, control strategy, Architecture of control systems.	9
5	**Robot Programming:** Robot Programming issues, optimization position definitions, interpolation language command, data object command, motion commands, gripper command, tool commands, sensors command, other command, Writing programs for different tasks.	9
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Understand the basic concepts of Robotics
CO2	Understand the kinematics behind the functioning and operation of a robotic system.
CO3	Understand the control of movements of the robotic joints and arms
CO4	Write simple programs for the operation of a robot

Resources	
Recommended Books	1. Mittal R. K. &Nagrath I. J., "Robotics and Control", TMH, 2003 (Reprint 2007 or later). 2. Groover, M. P., et al., "Industrial Robotics", MGHISE, 1986
Reference Books	1. Fu, K. S., et al., Robotic: Control, Sensing, Vision & Intelligence, MGHISE, 1987. 2. Robert J., Schilling, Fundamentals of Robotics: Analysis and Control, Prentice Hall, NJ, 2002.
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Fourth Year	Semester -VII
Course: Vehicle Dynamics Professional Elective III- B	Course Code: ME 705TE-B
Theory : 4 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 4

Objectives :	
1	To make students understand the principle and performance of vehicle in various modes such as longitudinal, vertical and lateral directions.
2	To make students learn about the various forces and loads and performance under acceleration, ride and braking.

Unit Number	Details	Hours
1	**Introduction to Vehicle Dynamics**, **Longitudinal Dynamics :** Vehicle Load Distribution – Acceleration and Braking - Brake Force Distribution, Braking Efficiency and Braking Distance - Longitudinal dynamics of a Tractor-Semi Trailer	9
2	**Tire Mechanics – An Introduction :** Mechanical Properties of Rubber - Slip, Grip and Rolling Resistance - Tire Construction and Force Development - Contact Patch and Contact Pressure Distribution	9
3	**A Simple Tire Model:** Lateral Force Generation - Ply Steer and Conicity - Tire Models – Magic Formula - Classification of Tire Models and Combined Slip	9
4	**Lateral Dynamics :** Bicycle Model - Stability and Steering Conditions - Understeer Gradient and State space Approach - Handling Response of a Vehicle - Mimuro Plot for Lateral Transient Response - Parameters affecting	9

	vehicle handling characteristics	
5	**Subjective and Objective Evaluation of Vehicle Handling** **Vertical Dynamics** : Rollover Prevention - Half Car Model - Quarter Car Model Noise, Vibration and Harshness – Random Processes	9
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Understand the dynamics of vehicle ride
CO2	Calculate and refer the loads and forces associated to the vehicles
CO3	Analyse the behavior of the vehicles under acceleration, ride and braking

Resources	
Recommended Books	1.Wong J Y, "Theory of Ground Vehicles", John Wiley & Sons, New York, 1978 2. Heinz Heister, "Vehicle and Engine Technology", SAE Second Edition, 1999.
Reference Books	1.. R.V. Dukkipati, Vehicle dynamics, Narsova Publications. 2. Thomas D Gillespie, "Fundamentals of Vehicle dynamics", SAE USA 1992.
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Fourth Year	Semester -VII
Course: Mechanical Vibrations Professional Elective III- C	Course Code: ME 705TE-C
Theory : 4 Hrs/Week	Max. University Theory Examination: 60 Marks
	Continuous Internal Assessment: 40 Marks
Max. Time for Theory Exam.: 2.5 Hrs	Credit: 4

Objectives :	
1	Fully make students understand and appreciate the importance of vibrations in mechanical design of machine parts that operate in vibratory conditions.
2	Obtain linear vibratory models of dynamic systems with changing complexities.
3	Write the differential equation of motion of vibratory systems.
4	Make free and forced (harmonic, periodic, non-periodic) vibration analysis of single and multi degree of freedom linear systems.

Unit Number	Details	Hours
1	**Introduction:** Types of vibrations, Definitions, Simple Harmonic Motion (S.H.M.), Work done by harmonic force, Principle of super position applied to SHM, Beats, Fourier theorem and problems.	9
2	**Undamped Free Vibrations:** Derivations for spring mass systems, Methods of Analysis, Natural frequencies of simple systems, Springs in series and parallel, Torsional and transverse vibrations, Effect of mass of spring and Problems.	9
3	**Damped Free Vibrations:** Types of damping, Analysis with viscous damping - Derivations for over, critical and under damped systems, Logarithmic decrement and Problems.	9

4	**Forced Vibrations:** Introduction, Analysis of forced vibration with constant harmonic excitation - magnification factor, rotating and reciprocating unbalances, excitation of support (relative and absolute amplitudes), force and motion transmissibility, Energy dissipated due to damping and Problems.	9
5	**Vibration Measuring Instruments and Whirling of Shafts:** Vibrometers, Accelerometer, Frequency measuring instruments and Problems. Whirling of shafts with and without damping, discussion of speeds above and below critical speeds and Problems.	9
	Total (Hrs)	45

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Course Outcome	
Student Should able to :	
CO1	Appreciate the need and importance of vibration analysis in mechanical design of machine parts that operate in vibratory conditions.
CO2	Analyze the mathematical model of a linear vibratory system to determine its response
CO3	Obtain linear mathematical models of real life engineering systems
CO4	Determine vibratory responses of SDOF and MDOF systems to harmonic, periodic and non-periodic excitation

Resources	
Recommended Books	1. Mechanical Vibrations/Groover/Nem Chand and Bros 2. Mechanical Vibrations! SS Rao/ Pearson, 2009Mth Edition
Reference Books	1. Elements of Vibration Analysis I Meirovitch
E-Resources	http://nptel.ac.in/

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: FourthYear	Semester - VII
Course: CIM and Automation Lab	Course Code: ME 706P
Practical : 3 Hrs/Week	Max. University Practical Examination: 25 Marks
	Lab Continuous Internal Assessment: 25 Marks
Max. Time for Exam.: 2 Hrs	Credit: 1

Sr. No.	Description
	Part A
1	CNC part programming using CAM packages. Simulation of Turning, Drilling, Milling operations. 3 typical simulations to be carried out using simulation packages like Master- CAM, or any equivalent software
	Part B (Only for demo/viva voce)
2	FMS (Flexible Manufacturing System): Programming of Automatic storage and Retrieval system (ASRS) and linear shuttle conveyor Interfacing CNC lathe, milling with loading unloading arm and ASRS to be carried out on simple components.
	Part C (Only for demo/viva voce)
3	Pneumatics and Hydraulics, Electro-Pneumatics: 3 typical experiments on Basics of these topics to be conducted.

Lab Work:
Lab Work assessment shall be conducted for the Project, Tutorials and Seminar. Lab Work is continuous assessment based on work done, submission of work in the form of report/journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the institute. At the end of the semester, the final grade for a Lab Work shall be assigned based on the performance of the student and is to be submitted to the University.

Notes	
1	Each student should perform all the above experiments.
2	The regular attendance of students during the syllabus practical course will be

	monitored and marks will be given accordingly .
3	Good Laboratory Practices

Practical/Oral/Presentation:
Practical/Oral/Presentation shall be conducted and assessed jointly by internal and external examiners. The performance in the Practical/Oral/Presentation examination shall be assessed by at least a pair of examiners appointed as examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University, authenticate and seal it. Sealed envelope shall be submitted to the head of the department or authorized person.

Notes	
1	One experiment from the regular practical syllabus will be conducted. (Total 25 Marks).
2	Complete laboratory journal/records (15 Marks).
3	Viva-voce (10 Marks).

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Fourth Year	Semester -VII
Course: Automotive Engineering Lab	Course Code: ME 707P
Practical : 3 Hrs/Week	Max. University Practical Examination: 25 Marks
Max. Time for Exam.: 2 Hrs	Lab Continuous Internal Assessment: 25 Marks
	Credit: 1

Sr. No.	Practical Description
1	Constructional details, working principles and operation of the following **Automotive Engine Systems & Sub Systems.** (a) Multi-cylinder : Diesel and Petrol Engines. (b) Engine cooling & lubricating Systems. (c) Engine starting Systems. (d) Contact Point & Electronic Ignition Systems
2	Constructional details, working principles and operation of the following **Fuels supply systems:** (a) Carburetors (b) Diesel Fuel Injection Systems (c) Gasoline Fuel Injection Systems
3	Constructional details, working principles and operation of the following **Automotive Clutches.** (a) Coil-Spring Clutch (b) Diaphragm – Spring Clutch. (c) Double Disk Clutch.
4	Constructional details, working principles and operation of the following **Automotive Transmission systems.** (a) Synchromesh – Four speed Range. (b) Transaxle with Dual Speed Range. (c) Four Wheel Drive and Transfer Case. (d) Steering Column and Floor – Shift levers
5	Constructional details, working principles and operation of the following **Automotive Drive Lines & Differentials**. (a) Rear Wheel Drive Line. (b) Front Wheel Drive Line.

	(c) Differentials, Drive Axles and Four Wheel Drive Line
6	Constructional details, working principles and operation of the following **Automotive Suspension Systems**. (a) Front Suspension System. (b) Rear Suspension System.
7	Constructional details, working principles and operation of the following **Automotive Steering Systems.** (a) Manual Steering Systems, e.g. Pitman –arm steering, Rack & Pinion steering. (b) Power steering Systems, e.g. Rack and Pinion Power Steering System. (c) Steering Wheels and Columns e.g. Tilt & Telescopic steering Wheels, Collapsible Steering Columns.
8	Constructional details, working principles and operation of the following **Automotive Tyres & wheels.** (a) Various Types of Bias & Radial Tyres. (b) Various Types of wheels
9	Constructional details, working principles and operation of the **Automotive Brake systems.** (a) Hydraulic & Pneumatic Brake systems. (b) Drum Brake System. (c) Disk Brake System. (d) Antilock Brake System. (e) System Packing & Other Brakes.
10	Constructional details, working principles and operation of **Automotive Emission / Pollution control systems.**

Lab Work:
Lab Work assessment shall be conducted for the Project, Tutorials and Seminar. Lab work is continuous assessment based on work done, submission of work in the form of report/journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the institute. At the end of the semester, the final grade for a Lab Work shall be assigned based on the performance of the student and is to be submitted to the University.

Notes	
1	Each student should perform all the above experiments.
2	The regular attendance of students during the syllabus practical course will be monitored and marks will be given accordingly
3	Good Laboratory Practices.

Practical/Oral/Presentation:
Practical/Oral/Presentation shall be conducted and assessed jointly by internal and external examiners. The performance in the Practical/Oral/Presentation examination shall be assessed by at least a pair of examiners appointed as examiners by the University. The examiners will prepare the mark/grade sheet in the format as specified by the University.

Notes	
1	One experiment from the regular practical syllabus will be conducted. (Total 15 Marks).
2	Complete laboratory journal/records (05 Marks)
3	Viva-voce (05 Marks).

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School: Engineering &Technology	Programme: B.Tech (Electrical Engg.)
Year: Fourth Year	Semester -VII
Course: Project Work (Phase- I)	Course Code: ME 708P
Practical : 3 Hrs/Week	Synopsis Submission: 25Marks
	PPT presentation : 25 Marks
Max. Time for Exam.: 2 Hrs	Credit: 1

Practical Objectives :	
1	To develop skills for carrying literature survey and organize the material in proper manner.
2	To provide opportunity of designing and building complete system/subsystem based on their knowledge acquired during graduation.
3	To understand the needs of society and based on it to contribute towards its betterment and to learn to work in a team.

Sr. No.	Practical Description
1	Project shall be assigned to students at the start of VII th semester. There should not usually be more than 3 students in batch. The project should be based on latest technology as far aspossible and it may be hardware or/and software based. The assessment of performance of students should be made at least twice in the semester. Students should be encouraged to present their progress of project using LCD projector.

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Fourth Year	Semester -VIII
Course: Seminar / Technical Report Writing	Course Code: ME 801P
Practical : 3 Hrs/Week	TW: 200 Marks
	Credit: 2

Practical Objectives :	
1	Making students aware of the research work and paper publication in journals. Student must choose one area of interest to carry out further study and paper publication. At least one paper must be published by every student individually with the help of teachers.

Sr. No.	Practical Description
1	Each student should study various journal papers and choose his topic himself based on his area of interest. Topics can be industrial or related to the locality of the student OR it can be about latest developments in any particular technology. At the end of the course he/she must be able to publish one paper in any international/national journal A final seminar is to be conducted where the student will prepare a ppt. On the same topic the student shall be prepared for a viva. This will be his/her criteria for awarding marks.

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School: Engineering &Technology	Programme: B.Tech (Mechanical Engg.)
Year: Fourth Year	Semester -VIII
Course: Project Work (Phase- II)	Course Code: ME 802P
Practical : 18 Hrs/Week	Max. University Practical Examination: 150 Marks
	Lab Continuous Internal Assessment: 100 Marks
Max. Time for Exam.: 2 Hrs	Credit: 14

Practical Objectives :	
1	To explore and to acquire specified skill in areas related to Mechanical Engineering
2	To ensure the completion of given project such as fabrication, conducting experimentation, analysis, validation with optimized cost.
3	Collect the data in report form and represent and communicate findings of the completed work in written and verbal form.

Sr. No.	Practical Description
1	The student shall complete the remaining part of the project which is an extension of the work carried out in 7th Semester. Remaining part of the project consists of design, simulation, fabrication of set up required for the project, analysis and validation of results and conclusions. The student shall prepare duly certified final report of the project work in the standard format.