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COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
							THEORY			PRACTICAL	
			L	T	P	CREDITS	END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
BTME601	DCS	ROTARY MACHINES	3	1	2	5	60	20	20	30	20

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs)

To introduction with (A)Turbo Machinery, (B)Steam Turbines, Water Turbines, (C)Rotary Fans, Blowers and Compressors.

Course Outcomes (COs)

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Students would be able to understand the need of turbo machinery in power plant.
2. Students would be able to understand impulse and reaction machines.
3. Students will be able to understand working of steam turbine.
4. Students would be able to understand phenomenon of impact of jet on turbine blades.
5. Students would be able to understand how the power is transfer in power plant.
6. Students would be able to understand working of Rotary Fans, Blowers and Compressors.

Syllabus

Unit - I

Introduction to Turbo Machinery: Fluid Properties, Moment of momentum equation and Euler turbine equation, principles of impulse and reaction machines, degree of reaction, energy equation for relative velocities, one dimensional analysis only.

Unit – II

Water Turbines and Pumps: Classification, Pelton, Francis and Kaplan turbines, vector diagrams and work-done, draft tubes, governing of water turbines. Centrifugal Pumps: classification, advantage over reciprocating type, definition of mano-metric head, gross head, static head, vector diagram and work done. Performance and characteristics: Application of dimensional analysis and similarity to water turbines and centrifugal pumps, unit and specific quantities, selection of machines, Hydraulic, volumetric, mechanical and overall efficiencies, Main and operating characteristics of the machines, cavitation.

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Unit – III

Rotary Fans, Blowers and Compressors: Classification based on pressure rise, centrifugal and axial flow machines. Centrifugal Blowers Vane shape, velocity triangle, degree of reactions, slip coefficient, size and speed of machine, vane shape and stresses, efficiency, characteristics, fan laws and characteristics. Centrifugal Compressor-Vector diagrams, work done, temp and pressure ratio, slip factor, work input factor, pressure coefficient, Dimensions of inlet eye, impeller and diffuser. Axial flow Compressors- Vector diagrams, work done factor, temp and pressure ratio, degree of reaction, Dimensional Analysis, Characteristics, surging, Polytrophic and isentropic efficiencies.

Unit - IV

Steam Turbines: Impulse staging, velocity and pressure compounding, utilization factor, analysis for optimum U.F Curtis stage, and Rateau stage, include qualitative analysis, effect of blade and nozzle losses on vane efficiency, stage efficiency, analysis for optimum efficiency, mass flow and blade height. Reactions staging: Parson's stages, degree of reaction, nozzle efficiency, velocity coefficient, stator efficiency, carry over efficiency, stage efficiency, vane efficiency, conditions for optimum efficiency, speed ratio, axial thrust, reheat factor in turbines, problem of radial equilibrium, free and forced vortex types of flow, flow with constant reaction, governing and performance characteristics of steam turbines.

Unit-V

Power Transmitting Turbo Machines: Application and general theory, their torque ratio, speed ratio, slip and efficiency, velocity diagrams, fluid coupling and Torque converter, characteristics, Positive displacement machines and turbo machines, their distinction, Hydrostatic systems hydraulic intensifier, accumulator, press and crane.

Reference Books:

1. "Turbo machinery", by Venkanna BK; Publisher: PHI, 2009.
2. "Turbo machinery", by Shepherd DG; 2005.
3. "An introduction to Energy Conversion Vol. III", by Kadambi V Manohar Prasad; Wiley Eastern Delhi, 2005.
4. "Fluid Mechanics & Fluid Machines", by Bansal R. K; Laxmi Publication, 2010.
5. "Steam Turbine: Theory & Practice", by Kearton W. J.; 2005.

List of Experiments

1. To study the characteristics of a centrifugal pump.
2. Verification of Impulse momentum principle.
3. To Study different types of pump.
4. To study different types of compressors.
5. To study of Pelton Turbine.

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6. To study of Francis Turbine.
7. To study of Kaplan turbines.
8. To study Parson's Reaction Turbine.
9. To Study of fluid coupling and Torque converter.
10. To Study Hydrostatic systems hydraulic intensifier, accumulator, press and crane.

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							THEORY			PRACTICAL	
			L	T	P	CREDITS	END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
BTME602(1)	DES	FINITE ELEMENT ANALYSIS	3	0	0	3	60	20	20	0	0

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs)

(A)To familiarize students with the displacement-based finite element method for displacement and stress analysis and to introduce related analytical and computer tools. (B)To provides a bridge between hand calculations based on mechanics of materials and machine design and numerical solutions for more complex geometries and loading states. (C)To study approximate nature of the finite element method and convergence of results are examined.

Course Outcomes (COs)

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Introduction to Engineering Analysis tool FEA its application in Linear static Analysis and 2D problems
2. Study of Finite Element modeling and simulation Techniques
3. Use of FEA in structural vibration and thermal Analysis
4. Study of Finite Element Software - Ansys

Syllabus

Unit - I

Basics of FEM: Basic concept of Finite Element Method, Historical background, FEM Applications, General Description of FEM, Commercial FEM software packages, Spring element-stiffness matrix, boundary conditions, solving equations, Variation formulation approach- Rayleigh-Ritz method, Principle of minimum Potential Energy, Weighted residual methods. Initial value and boundary value problems, weighted residual Galerkin and Raleigh Ritz methods-review of Variation calculus, Integration by parts, Basics of variation formulation.

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Unit - II

Element Types and Characteristics: Discretization of the domain, Basic element shapes, Aspect ratio, Shape functions, Generalized co-ordinates and nodal shape functions; ID bar and beam elements, 2D rectangular and triangular elements; axis-symmetric elements.

Unit – III

Assembly of Elements and Matrices: Concept of element assembly, Global and local coordinate systems, Band width and its effects, Banded and skyline assembly, Boundary conditions, Solution of simultaneous equations, Gaussian elimination and Chloe's decomposition methods, Numerical integration, One and 2D applications

Unit - IV

Higher Order and Iso-parametric Elements: One dimensional quadratic and cubic elements, Use of natural co-ordinate system, Area co-ordinate system continuity and convergence requirements, 2D rectangular and triangular requirement.

Unit-V

Structural Vibration and Dynamic Analysis: Review of basic dynamic equations, Hamilton's principle, element mass matrices, free vibration (normal mode) analysis, Eigen values and Eigen vectors, Introduction to transient response analysis.

Reference Books:

1. *"Finite elements in Engineering", by Chandrupatla & Belagundu Prentice Hall of India Private Ltd., 1997.*
2. *"Finite Element Method in Engineering", by Rao S.S. Pregamon Press, 1989.*
3. *"Finite Element Analysis- Theory and Programming", Krishnamoorthy. C.S., Tata McGraw-Hill Publishing Co., 1987.*
4. *"An introduction to the Finite Element Method", by Reddy, J.N. McGraw Hill Book Company New York; 1984.*
5. *"The Finite Element Method in Engg. Science", by Zienkiewicz. O.C McGraw-Hill, London, 1977.*
6. *"Concepts and Applications of Finite Element Analysis", by Cook, Robert Davis ET all Willy, John & Sons, 1999.*
7. *"The Finite Element Method for Engineers", by Hubner. K.H., Donald. L.D, D.E. Smith, Ted G. Byron John, Willy & Sons, 1982.*

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COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
							THEORY			PRACTICAL	
			L	T	P	CREDITS	END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
BTME602(2)	DES	RESOURCE MANAGEMENT TECHNIQUES	3	0	0	3	60	20	20	0	0

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
Q/A – Quiz/Assignment/Attendance, MST Mid Sem Test.
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

To introduction with (A) the student should be made able to be familiar with resource management techniques. Learn to solve problems in linear programming and Integer programming.(B)The student should be made able to introduce methods of optimization to engineering students, network flow algorithms, CPM and PERT.(C)The student should be made able to understand interior point methods, quadratic programming, nonlinear programming, and heuristic methods.

Course Outcomes (COs):

Upon successful completion of this course, the student will be able to understand:

1. Basic theoretical principles in optimization techniques
2. Formulation of optimization models
3. Solution methods in optimization using simplex method.
4. Apply integer programming and linear programming to solve real-life applications.
5. Methods of sensitivity analysis
6. Applications to a wide range of engineering problems PERT and CPM for problems in project management

Syllabus

Unit-I

Linear programming - Principal components of decision problem, Modeling phases ,LP Formulation and graphic solution, introduction to duality theory, Simplex method, big M method, Definition of dual problem- Primal, Dual relationships- Dual simplex methods, Two-phase method, Sensitivity analysis.

Unit-II

Resource allocation Problem: Transportation & assignment models, Mathematical model for Transportation problem, balanced and unbalanced problem -Assignment problem, Shortest route Problem.

Unit-III

Integer Programming - Cutting plan algorithm - Branch and bound methods, Multistage (Dynamic) programming.

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Unit-IV

Classical Optimization Theory: Unconstrained external problems, Newton Raphson method, Equality constraints - Jacobean methods, Lagrangian method, Kuhn Tucker conditions - Simple problems.

Unit-V

Project Evaluation: Project scheduling, project network, determination of critical path, project duration and slack time calculation, Cost considerations in project scheduling, Time charts and resource leveling -PERT, Critical path method

Text Book:

1. "Operation Research" by H.A. Taha, Prentice Hall of India, 2002.

References Books:

1. *"Problems on operations research", by Gupta and Hira, S.Chand & Company, New Delhi, 1991.*
2. *"Operations Research", by R Panneer selvam, Prentice – Hall of India, New Delhi, 2002.*
3. *"Quantitative Methods for Business"by Anderson '8th Edition, Thomson Learning, 2002.*
4. *"Quantitative Techniques in Management" by Tata Vohra, Mc Graw Hill, 2002.*
5. *"Operation Research" by Anand Sarma, Himalaya Publishing House, 2003.*

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							THEORY			PRACTICAL	
			L	T	P	CREDITS	END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
BTME602(3)	DES	ROBOTICS AND MACHINE VISION SYSTEM	3	0	0	3	60	20	20	0	0

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

(A) Make the students to learn about the mechanical design of robots, various sensors and its application in the area of industrial robotics. (B) Impart knowledge in the area of mechanical design, sensors and programming of industrial robots. (C) Expose students to various applications of vision and challenges involved in each. (D) Impart knowledge on imaging, machine vision and its applications.

Course Outcomes (COs):

After completion of this course the students are expected to be able to

1. Explain the various image processing and image analysis algorithms and the issues involved in applying them to various machine vision applications
2. Apply the basic concepts of optics in imaging.
3. Explain the various hardware components of an imaging system for machine vision applications.

Syllabus

Unit-I

Introduction: Definition, Types of Industrial Robots; classifications based on work envelope – Generations, configurations and control loops; co-ordinate system, need for robot, basic parts and functions, specifications.

Robot motion, Kinematics of Robot motion, Direct and Indirect kinematics; Homogeneous transformations; linkages and joints, mechanism, method for location and orientation of objects; drive systems, end effectors, types, selection, classification and design of grippers, gripper force analysis.

Functions of Sensors, Position and proximity's sensing, tactile sensing, sensing joint forces; vision system, object recognition and image transformation, safety monitoring; sensor systems, image analysis, application of image processing.

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Unit-II

Robot Programming & AI Techniques: Types of Programming; Teach pendant programming; Basic concepts in AI techniques, Concept of knowledge representations, Expert system and its components; Robotic cell layouts, Inter locks, Humanoid robots, Micro-robots; Application of robots in surgery, Manufacturing industries, space and underwater.

Unit-III

Image Acquisition: Human vision, Machine and Computer vision, Benefits, Block diagram and function; System implementation of industrial machine vision system; Light Physics and Interactions, Refraction at a spherical surface, Thin Lens Equation, Scene constraints, Lighting parameters, Lighting sources; Selection Lighting Techniques, Types and Selection; Machine Vision Lenses and Optical Filters, Specifications and Selection; Imaging Sensors, CCD and CMOS; Specifications Interface Architectures, Analog and Digital Cameras, Digital Camera Interfaces, Camera Computer Interfaces; Specifications and Selection – Geometrical Image, formation models – Camera Calibration.

Unit-IV

Image Processing: Machine Vision Software, Fundamentals of Digital Image, Image Acquisition Modes, Image Processing in Spatial and Frequency Domain, Point Operation, Thresholding; Grayscale Stretching, Neighborhood Operations, Image Smoothing and Sharpening; Edge Detection, Binary Morphology, Color image processing

Unit-V

Machine Vision Analysis & Applications: Feature extraction – Region Features, Shape and Size features, Texture Analysis; Template Matching and Classification – 3D Machine Vision Techniques, Decision Making; Machine vision applications in manufacturing, electronics, printing, pharmaceutical, textile etc.; applications in non-visible spectrum, metrology and gauging, OCR and OCV; vision guided robotics – Field and Service Applications, Agricultural, and Bio medical field, augmented reality, surveillance, bio-metrics.

Text Books:

1. *"Automation, Production Systems and Computer Integrated Manufacturing" by Mikell P.Grover, Pearson Education Asia, 2001.*
2. *"Robots and manufacturing Automation" by C. Ray Asfahl, John Wiley and Sons New York, 1992*
3. *"Introduction to Robotics- mechanics and control" by Craig. J. J., Addison- Wesley, 1999.*

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Reference Books:

1. *"Industrial Robotics, technology, programming and application", by Groover.M.P. Mc-Graw Hill book and co. 2012*
2. *"Robotics Control, sensing, vision and intelligence", by Fu.K.S ,Gonzalac R.C ,Lee C.S.G, Mc- Graw Hill book co 2011.*
3. *"Introductory Techniques For 3D Computer Vision", by EmanueleTrucco, Alessandro Verri, FirstEdition, 2009*
4. *"Digital Image Processing Publishers", by Rafael C.Gonzales, Richard.E.Woods, Third Edition, 2007*

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COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
							THEORY			PRACTICAL	
			L	T	P	CREDITS	END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
BTME602(4)	DES	NON-CONVENTIONAL ENERGY SOURCES	3	0	0	3	60	20	20	0	0

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

To introduction with (a) Solar Energy (b) Wind Energy (c) Bio Energy (d) Ocean Energy & Geothermal Energy.

Course Outcomes (COs):

After learning the course the students should be able to:

1. Understand the basic concept of renewable energy engineering.
2. Acknowledge, access and analysis various renewable energy system & technology.
3. Evaluate renewable energy related system for a particular application.
4. Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation.

Syllabus

Unit – I

Introduction: Needs of Renewable Energy, Advantages and Limitations of Renewable Energy, Present energy scenario of conventional and renewable energy sources, Review of energy sources ,Present energy consumption /Utilisation pattern sector wise in India ,Environmental impact of fossil fuels, growth of energy sector and its planning in India.

Unit – II

Solar Energy: Solar radiation at the earth's surface, solar radiation measurements, estimation of average solar radiation, solar thermal flat plate collectors, concentrating collectors, solar thermal applications; heating, cooling, desalination, drying, cooking, etc, principle of photovoltaic conversion of solar energy, photovoltaic applications. Photovoltaic system for power generation, solar cell modules and arrays, solar cell types, material, applications, advantages and disadvantages

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Unit – III

Wind Energy: Power in the wind, Betz limit, site selection, wind energy conversion devices, characteristics, applications, offshore wind energy, Hybrid systems, safety and environmental aspects, wind energy potential and installation in India. basics of wind energy conversion system, effect of density, angle of attack and wind speed, windmill rotors, horizontal and vertical axes rotors, drag, lift, torque and power coefficients, tip speed ratio, solidity of turbine, wind turbine performance curves, wind energy potential and site selection, basics of wind.

Unit - IV

Bio-Energy: Biomass resources and their classification, biomass conversion processes, thermo chemical conversion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, alcohol production from biomass, bio diesel production, urban waste to energy conversion, biomass energy programs in India.

Unit-V

Ocean Energy: OTEC principle, open, closed and hybrid cycle OTEC system, Energy from tides, estimation of tidal power, tidal power plants, single and double basin plants, site requirements, advantages and limitations wave energy, wave energy conversion devices, advantages and disadvantages, ocean thermal energy.

Geothermal energy: Introduction, vapor and liquid dominated systems, binary cycle, hot dry rock resources, magma resources, advantages and disadvantages, applications

MHD Power generation: concept and working principle

Reference Books:

1. *"Solar Energy: Principles of Thermal Collection and Storage", by S. P. Sukhatme and J. K. Nayak, McGraw-Hill Education (1996).*
2. *"Solar Engineering of Thermal Processes", by John A. Duffie, William A. Beckman, John Wiley, New York (2013).*
3. *"Non-conventional energy resources", by Shobh Nath Singh, Pearson India (2015).*
4. *"Solar Energy Engineering", by Soteris Kalogirou, Elsevier/Academic Press (2009).*
5. *"Principles of Solar Energy", by Frank Krieth & John F Kreider, John Wiley, New York (2015).*
6. *"Renewable Energy Engineering and Technology", by Kishore VVN, Teri Press, New Delhi (2010).*

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							THEORY			PRACTICAL	
			L	T	P	CREDITS	END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
BTME603	DCS	MECHANICAL VIBRATION	3	0	2	4	60	20	20	30	20

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs)

This course provides a fundamental understanding of (A) Vibration and noise in automobiles (B) Design modifications to reduce the vibration and noise(C) Improve the life of components.

Course Outcomes (COs)

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Understand free and forced vibrations of single degree freedom systems.
2. Analyze balancing problems in rotating and reciprocating machinery.
3. Understanding causes, source and types of vibrations in machineries.
4. Gaining knowledge in sources and measurement standard of noise.
5. Ability to design and develop vibrations and noise control systems.

Syllabus

Unit - I

Fundamental Aspects of Vibrations: Definition of Vibration, main causes, advantages and disadvantages; engineering applications of vibration and noise; vector method of representing harmonic motion; characteristics of vibration, harmonic analysis and beats phenomenon, work done by harmonic forces on harmonic motion; periodic, non-harmonic functions- Fourier series analysis; evaluation of coefficients of Fourier series; elements of vibratory system; lumped and distributed parameter systems.

Un-damped Free Vibrations: Derivation of differential equation of motion: the energy method, the method based on Newton's second law of motion, and Rayleigh's method. Solution of differential equation of motion: Natural frequency of vibration. Systems involving angular oscillations: compound pendulum.

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Unit - II

Damped Free Vibrations: Viscous damping: coefficient of damping; damping ratio; under damped, over damped and critically damped systems; logarithmic decrement; frequency of damped free vibration; Coulomb or dry friction damping; frequency, decay rate and comparison of viscous and Coulomb damping; solid and structural damping; slip or interfacial damping.

Unit - III

Harmonically excited Vibration: One degree of freedom, forced harmonic vibration vector representation of forces; excitation due to rotating and reciprocating unbalance; vibration Isolation, force and motion transmissibility; absolute and relative motion of mass (Seismic Instruments).

Whirling Motion and Critical Speed: Whirling motion and Critical speed: Definitions and significance. Critical – speed of a vertical, light – flexible shaft with single rotor: with and without damping .Critical speed of a shaft carrying multiple discs (without damping), Secondary critical speed.

Unit – IV

Systems With Two Degrees of Freedom : Un-damped free vibration of 2 d.o.f and Principal modes of vibration; torsion vibrations; Forced, Un-damped vibrations with harmonic excitation ; Coordinate coupling; Dynamic vibration absorber; torsion Vibration Absorber; Pendulum type of dynamic vibration.

Unit-V

Noise Measurement & Control : Noise and its causes, sound pressure / intensity / power level and their inter-relation, Decibel scale, Loudness and equal loudness contours, Effect of machine / process noise on operators, employees and local residents. Standards of noise level and exposure limit, Methods of industrial noise control, Measurement of noise, Sound spectra and octave band analysis. Background noise, weighted networks,

Reference Books:

1. *"Mechanical Vibrations and Noise Engineering", by Ambekar A.G; Publisher: PHI, 2013.*
2. *"Element of Vibration Analysis", by Meirovitch Leonard Publisher: TMH, 2010*
3. *"Text book of Mechanical Vibrations", by Dukikipati RV Srinivas J; Publisher PHI, 2012.*
4. *"Mechanical Vibrations", by Kelly SG and kudari SK; Publisher: Schaum Series; TMH, 2011.*
5. *"Theory of Vibration with Applications", by Thomson, W.T publisher: C.B.S Pub & distributors; 1997.*

List of Experiments

1. To find out effect of load on natural frequency of vibrations of a lever pin supported at one end carrying adjustable load on a vertical screwed bar and spring supported at some

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intermediate point (i) When the dead weight of rods is neglected and (ii) when their dead weight is taken into account

2. To find out frequency of damped free vibration and rate of decay of vibration-amplitude in the system
3. To find out natural frequency and damped free frequency of a torsion pendulum and, hence to find out coefficient of damping of the oil
4. To observe the phenomenon of ' whirl' in a horizontal light shaft and to determine the critical speed of the shaft
5. To observe the mode shapes of a spring-connected, double pendulum and hence to demonstrate the phenomenon of beats.
6. To demonstrate the principle of tuned Un-damped Dynamic Vibration Absorber and to determine the effect of mass-ratio (of main and auxiliary mass) on the spread of the resulting natural frequencies
7. To take measurements of sound Pressure Level (SPL) and to carry out octave band analysis of a machine using Noise Level Meter

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							THEORY			PRACTICAL	
			L	T	P	CREDITS	END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
BTME604	DCS	HEAT AND MASS TRANSFER	3	1	2	5	60	20	20	30	20

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

To introduction with (A) Basic concepts of heat transfer, (B) various modes of heat transfer in detail, (C) Convection heat transfer.(D) Extended Surface

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Students would be able to understand various modes of heat transfer.
2. Students would be able to analyses basics difference of conduction, convection and radiation.
3. Students would be able to understand significant of various dimension less no in convection.
4. Students will be able to understand concept of radiation.
5. Students would be able to explain concept of mass transfer and concentration difference.

Syllabus

Unit-I : Basic Concepts: Modes of heat transfer, Fourier's law, Newton's law, Stefan Boltzmann law; thermal resistance and conductance, analogy between flow of heat and electricity, combined heat transfer process.

Conduction: Fourier heat conduction equation, its form in rectangular, cylindrical and spherical coordinates, thermal diffusivity, linear one dimensional steady state conduction through a slab, tubes, spherical shells and composite structures, electrical analogies, critical-insulation-thickness for pipes, effect of variable thermal conductivity.

Unit –II : Extended surfaces (fins): Heat transfer from a straight and annular fin (plate) for a uniform cross section; error in measurement of temperature in a thermometer well, fin efficiency, fin effectiveness, applications; Unsteady heat conduction: Transient and periodic conduction, heating and cooling of bodies with known temperatures distribution, systems with infinite thermal conductivity, response of thermocouples.

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B. Tech/B.Tech+MBA in Mechanical Engineering

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Unit-III : Convection: Introduction, free and forced convection; principle of dimensional analysis, Buckingham 'pie' theorem, application of dimensional analysis of free and forced convection, empirical correlations for laminar and turbulent flow over flat plate and tubular geometry; calculation of convective heat transfer coefficient using data book.

Unit-IV : Heat exchangers: Types- parallel flow, counter flow; evaporator and condensers, overall heat transfers coefficient, fouling factors, log-mean temperature difference (LMTD), method of heat exchanger analysis, effectiveness of heat exchanger, NTU method; Mass transfer: Fick's law, equi-molar diffusion, diffusion coefficient, analogy with heat transfer, diffusion of vapour in a stationary medium.

Unit-V : Thermal radiation: Nature of radiation, emissive power, absorption, transmission, reflection and emission of radiation, Planck's distribution law, radiation from real surfaces; radiation heat exchange between black and gray surfaces, shape factor, analogical electrical network, radiation shields.

Boiling and condensation: Film wise and drop wise condensation; Nusselt theory for film wise condensation on a vertical plate and its modification for horizontal tubes; boiling heat transfer phenomenon, regimes of boiling, boiling correlations.

References Books:

1. *"Heat and mass transfer" by Sukhatme SP, University Press Hyderabad, 2005.*
2. *"Heat transfer" by Holman JP, TMH, 2011*
3. *"Heat and Mass Transfer" by Nag PK, TMH, 2007.*
4. *"Heat Transfer Principles and App, by Dutta BK, PHI Learning, 2015.*
5. *"Heat transfer" by Mills AF and Ganesan V, Pearson, 2009.*
6. *"Heat and Mass transfer" by Cengel Yunus A, TMH, 2011.*
7. *"Heat and Mass Transfer" by Yadav R, Central India pub-Allahabad,1992*

List of Experiments

1. Conduction through a rod to determine thermal conductivity of material.
2. Forced and free convection over circular cylinder.
3. Free convection from extended surfaces.
4. Parallel flow and counter flow heat exchanger effectiveness and heat transfer rate
5. Calibration of thermocouple.
6. Experimental determination of Stefan Boltzmann constant.
7. Force convection from extended surfaces.
8. Study of various heat exchangers.

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SEMESTER VI

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
							THEORY			PRACTICAL	
			L	T	P	CREDITS	END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
BTME605	DCS	DESIGN AND OPTIMIZATION	3	0	2	4	60	20	20	30	20

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs)

To develop fundamental knowledge for (A) Analysis and design gear systems,(B) Internal Combustion engine components and (C)Engineering Design Optimization.

Course Outcomes (COs)

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Design gears of various types.
2. Engineering Design Optimization.
3. Design of Power Screw and Threaded Joints
4. Design IC engine components and miscellaneous components- flywheels, crane hook, machine frame.

Syllabus

Unit – I

Introduction: Philosophy, Design Procedure, design considerations (strength, manufacturing, maintenance, environment, economics and safety), Engineering Materials- Classification and properties, Material selection in Machine Design, IS coding of steels and Cast Irons, Simple & Compound stresses in machine elements, Theories of failures, factor of Safety.

Unit – II

Design of Power Screw and Threaded Joints: Forms of thread, Single and Multiple threaded screw, Terminology of power screw, Torque requirement of lifting/lowering, Self-locking, Efficiency of threads, coefficient of friction, design of screw and nut. Basic types of screw fastening, Cap and Set screw, Bolt of Uniform strength, locking devices, Terminology of Screw thread, Bolted Joint: Simple and Eccentric loading, Torque requirement for bolt tightening, Design of turnbuckle, Elastic analysis of bolted joints.

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Unit - III

Gear Design: Definition of gears, Classification of gears, Law of gearing, gear terminology, Lewis and Buckingham equations; wear and dynamic load consideration, Design& force analysis of spur, helical, bevel & worm gears.

Unit - IV

IC Engine Components: General design considerations in I C engines; Design of cylinder and Cylinder head, Design of piston, Design of connecting rod, Design of crankshaft and Design of valve-gear mechanism.

Design of Miscellaneous Components: Design of Pressure vessel, flywheels, crane hook, C-clamp, machine frame etc.

Unit-V

Engineering Design Optimization: Introduction to optimization Terminology; Optimization problem statement; Iterative optimization Existence and uniqueness of solutions; Necessary and sufficient conditions. **Functions of a single variable**: Interpolation methods, Elimination methods.

Reference Books:

1. *"Shigley's Mechanical Engineering Design", by R G Budynas, and K J Nisbett; Publisher: McGraw-Hill, 2011.*
2. *"Design of Machine Elements", by V B Bhandari; Publisher: McGraw Hill, 2010.*
3. *"Machine Design: An Integrated Approach", by R L Norton; Publisher: Pearson, 2006.*
4. *"Vehicular Engine Design", by K Hoga, B Dondlinger; Publisher: Springer, 2010.*
5. *"Machine Elements in Mechanical Design", by Robert, L. Mott; Publisher: Macmillan Publishing Co., London, 1992*
6. *"Machine Design: Fundamentals and Applications", by P C Gope; Publisher: PHI, 2012.*
7. *"Handbook of Gear design", by Maitra, G.M; Publisher: Tata McGraw Hill, 1988*

List of Experiments

1. Design of Spur Gear and Helical Gears.
2. Design of Bevel Gear &Worm gear.
3. Design of IC engine components.
4. Design of Power Screw and Threaded Joints.
5. Design of crankshaft, Pressure vessel, flywheels.
6. Design of valve-gear mechanism.
7. Study of Engineering Design Optimization techniques.

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							THEORY			PRACTICAL	
			L	T	P	CREDITS	END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
BTME606	DS	SIMULATION OF MECHANICAL SYSTEM LAB	0	0	4	2	0	0	0	0	50

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
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Course Educational Objectives (CEOs)

(A)Ability to recognize modeling and identification concepts as related to mechanical systems.(B)Make use of modern modeling tools to represent mechanical systems(C) Understand various techniques of simulation (D) Develop the skills of modeling and simulation using various software / programming languages. (E)Apply modeling and simulation techniques to simulate industrial systems using software packages

Course Outcomes (COs)

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Have knowledge of modeling and simulation using various software / programming languages.
2. Ability to get experience on modeling software's such as Creo.
3. Ability to simulate the physical behavior of systems using Ansys, Matlab & Simulink.
4. Ability to analyze results obtained from these simulation tools.

Syllabus

Unit - I

Modeling Basics: Models, modeling purpose, objectives and examples of models

Principles of Physical Modeling: Concept of System and environment, basic relationship; Continuous and discrete systems; Linear and non-linear systems; stochastic activities, Bond Graphs.

Unit - II

Computer Aided Modeling: Solid modeling of component using Creo, finite element modeling using ANSYS; Static and Dynamic models, Estimating Transient Response, Spectra and Frequency Functions; Parameter Estimation in Dynamic Models; System Identification as a Tool for Model Building.

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Unit - III

Basic Simulation Modeling: Role of simulation in model evaluation and studies, advantages of simulation.

System Simulation: Techniques of simulation, Monte Carlo method, Experimental nature of simulation, Numerical computation techniques.

Unit - IV

System Simulation and Its Types: Continuous system model; Analog and Hybrid simulation;, Feedback system; Computers in simulation studies, Simulation software packages.

System Dynamics: Growth and Decay models, Logistic curves, System dynamics diagrams.

Unit-V

Simulation of Mechanical Systems: Building of Simulation models, simulation of translational and rotational mechanical systems, Simulation of electro mechanical, thermo - mechanical, hydraulic & pneumatic elements; Case studies related to industrial problems.

Reference Books:

1. *"Modeling and Simulation with HDL", by George Pelz, John Wiley & Sons Ltd, 2003.*
2. *"Modeling Analysis and Control of Dynamic Systems", by W.J. Palm, John Wiley, 1983.*
3. *"System Simulation"by Gordon, G; Prentice Hall, 2008.*
4. *"Modeling of Dynamic Systems" by Lennart, L. and Torkel, G., Prentice Hall, 2016.*
5. *"Mathematical Modeling for Design of Machine Components", by Bhonsle, S.R., and Weinmann, K.J., Prentice Hall, 1999.*
6. *"Bond Graph in Modeling, Simulation and Fault Identification", by Mukherjee, A., Karmaker, R. and Samantaray, A.K., I & K Internationa, 2009.*
7. *"Systems Modeling & Analysis", by I.J. Nagarath & M. Gopal, Tata McGraw Hill, 1982.*

List of Experiments

1. Introduction to CAD (Creo) and FEM analysis software package(Ansys)
2. Solid modeling of structural components using Creo.
3. Introduction to 2D and 3D Meshing.
4. Finite element analysis of structural component using Ansys.
5. Static structural analysis g of machine component using Ansys.
6. Mode analysis of machine component using Ansys.
7. Nonlinear structural analysis using Ansys.
8. Static thermal analysis using Ansys.
9. Transient thermal analysis using Ansys.

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10. Transient analysis of vibrating system Ansys.
11. Introduction to durability analysis of Mechanical component using Ansys.
12. Introduction to rigid body dynamic analysis using Ansys.
13. Introduction to Topology optimization and Structure/Weight Optimization.
14. Matlab tutorial for simulation of various mechanical systems.

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			L	T	P	CREDITS	END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
BTME608	DCS	TECHNICAL COMMUNICATION AND SOFT SKILLS	0	0	2	1	0	0	0	0	50

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs)

(A)To give students introduction of Information design and development (B)To provide students understanding of Technical writing (C) To introduce students to carrier planning (D) To make student aware of Ethics in Industries.

Course Outcomes (COs)

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Design different technical documents.
2. To set goals for carrier planning.
3. To correlate Ethics with Industrial environment.

Syllabus

Unit - I

Information Design and Development: Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.

Unit - II

Technical Writing, Grammar and Editing: Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style, Introduction to advanced technical communication, Usability, Hunan factors, Managing technical communication projects, time estimation, Single sourcing, Localization.

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Unit - III

Self-Development and Assessment: Self-assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem.

Unit - IV

Communication and Technical Writing: Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.

Unit-V

Ethics: Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity.

Reference Books:

1. "Guide to writing as an Engineer", by David F. Beer and David McCurry, John Willey. New York, 2004
2. "Pocket Style Manual", by Diane Hacker, Bedford Publication, New York, 2003. (ISBN0312406843)
3. "You Can Win", by Shiv Khera, Macmillan Books, New York, 2003.
4. "Technical Communications", by Raman Sharma, Oxford Publication, London, 2004
5. "Business Correspondence and Report Writing, Sharma", by R. and Mohan, K. TMH New Delhi 2002

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